GREAT FACES. GREAT PLACES.

DEPARTMENT of ENVIRONMENT and NATURAL RESOURCES
JOE FOSS BUILDING
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October 26, 1995

David Rathke 8WM-WQ
EPA Region VIII
One Denver Place, Suite 500
999 18th Street
Denver, Colorado 80202-2466

SUBJECT: Final Report (Draft)- Little Minnesota River Watershed Project

Product Submission - Lake Kampeska Watershed Project

Dave:

Enclosed please find one copy each of the documents referenced above.

The Kampeska Long Range Plan is a final copy of the plan listed as a product in the workplan under Objective 4, Task 1. It was used during the preparation of the Upper Big Sioux Watershed Project.

The Little Minnesota River Watershed Report is a draft. Following receipt of any comments and/or suggestions for changes from your office, the final draft will be prepared.

Please contact this office if additional information is required relative to either the Little Minnesota Report or Kampeska Long Range Plan.

Sincerely,

Dennis C. Clarke
Natural Resources Program Scientist

ENC: 2

Big Stone Lake Restoration

Little Minnesota River

Watershed Project

Final Report
C9008631-92-0

Start-Up August 1992

End August 1995

Prepared by: Roberts County

And

SD Department of Environment &

Natural Resources

GRANT #C9008631-92-0

(August 21, 1992 - August 20, 1995)

INTRODUCTION:

Big Stone Lake is a 12,610 acre interstate body of water located along the Minnesota and South Dakota border. Its 740,157 acre watershed includes portions of Roberts, Grant and Marshall Counties in South Dakota, and Big Stone and Traverse Counties in Minnesota. The principal tributaries are the Whetstone and Little Minnesota Rivers. The Whetstone River enters the lake from the southwest near the lake's outlet and the Little Minnesota River lies northwest of the lake and empties into its upper end. (Figure 1a)

Physical Characteristics of the Lake are:

Lake length, miles 25.8

Maximum width, miles..... 1.3

Surface area, acres.....12,610

Volume, acre-feet.....98,880

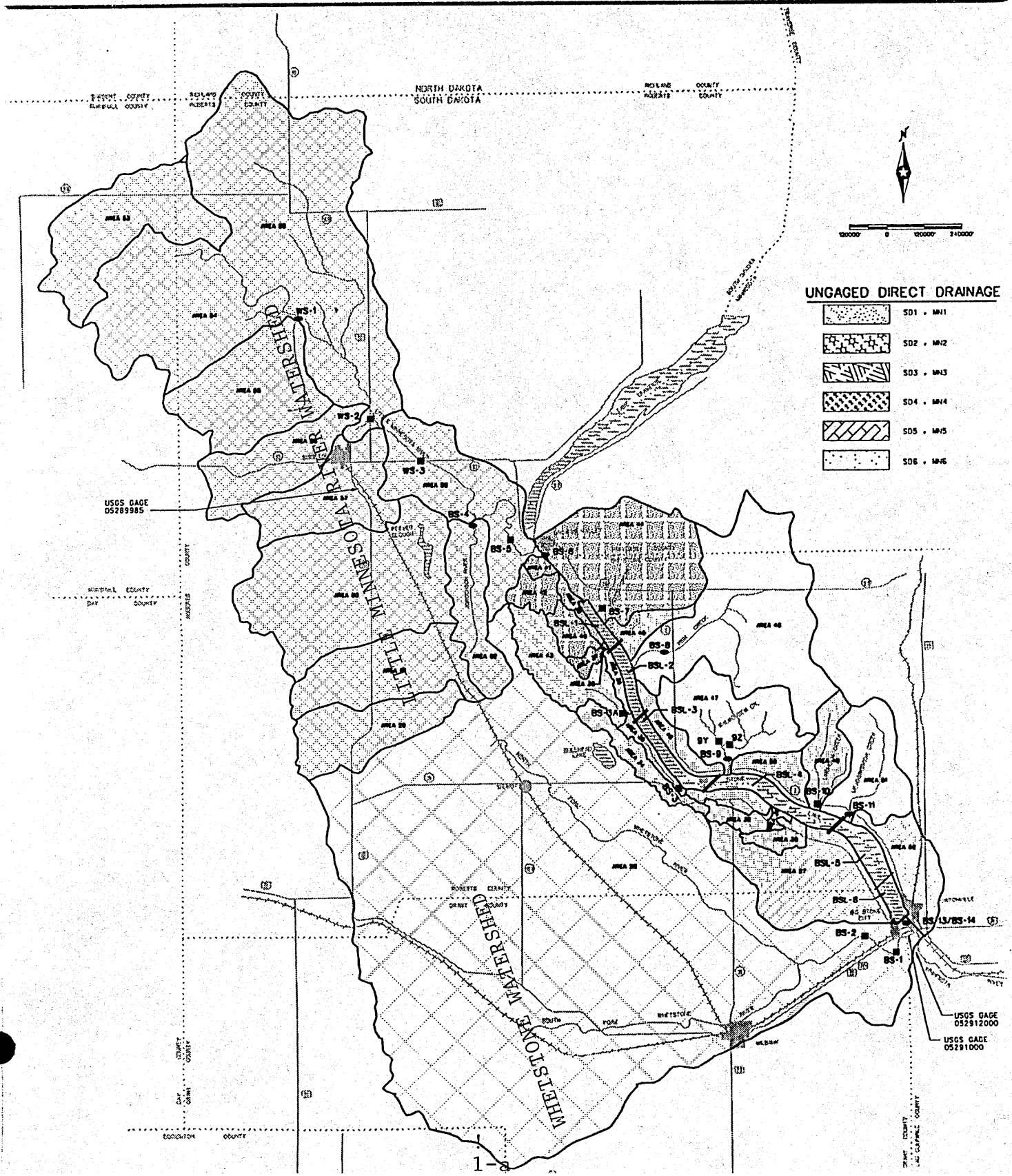
Maximum depth, feet.....16

Mean depth, feet.....8

Shoreline length, miles.....59.9

Watershed area, acres.....740,157

MAP OF BIG STONE LAKE WATERSHED



GEOLOGIC HISTORY AND ORIGIN OF THE LAKE:

Big Stone Lake is located in the valley of a former glacial river which drained Lake Agassiz. Lake Agassiz was a large glacial lake which covered most of eastern North Dakota, northwestern Minnesota and a small part of northeastern South Dakota during the ice-age that ended about "eight thousand," years ago. During an early stage of development, the meltwater from glacial ice was ponded in Lake Agassiz by a ridge of ice and rock materials located along the lower end of the present Lake Traverse. As the ice in the ridge melted, the ponded meltwaters began to drain southward from Lake Agassiz, eroding a channel through the glacial sand and gravel deposits. The drainage waters increased in flow and eventually a large river formed a wide, deep valley which extended from the foot of what is now Lake Traverse through much of south-central Minnesota. Eventually, the direction of flow from Lake Agassiz reversed, and the lake was drained northward along the present Red River. Following the glacial drainage, the Whetstone River carried large amounts of sediments in the valley of the Minnesota River at the present site of Big Stone City, South Dakota and Ortonville, Minnesota. The sediments formed a delta and a natural dam which created Big Stone Lake in a valley above the mouth of the Whetstone River.

RESTORATION GOAL AND OBJECTIVES:

Big Stone Lake is a hypereutrophic lake. The lake is characterized by excessive algal blooms, an over abundance of rooted vegetation and excessive sedimentation. The Big Stone Lake Restoration Project was a multifaceted implementation project designed to control nonpoint sources of pollution to the lake and reduce existing pollution levels in the lake. The overall goal of the restoration effort was to increase the recreation potential and lifespan of Big Stone Lake. Major objectives of the project included: a reduction of both the density and duration of algae blooms, limitation of aquatic macrophytes, and a reduction in sedimentation and phosphorus loadings. Because the restoration effort for Big Stone Lake was extremely large and funds were limited, the project was developed to be implemented in a step-wise manner.

PROJECT HISTORY:

Restoration activities that were implemented before the present 319 Grant period included a Phase I Diagnostic/ Feasibility Study (1983), Phase II. Step I Workplan (1985) and a Phase II Step II 319 Work Plan (1989). Previous Phase I and Phase II activities were funded in part by Section 314 Clean Lakes Grants.

A major component of the Phase I study was water quality

monitoring of the lake and its tributaries. Another major component was the compilation of historical information about lake water quality and use. Based on results of this study, it was concluded that both water quality and lake use were declining. It was also determined that the factor having the most detrimental effect on lake water quality was runoff from agricultural lands in the watershed. This included contributions from livestock feedlots as well as other general agricultural runoff. The following program elements were recommended in the Phase I Diagnostic/ Feasibility Study:

1. *Whetstone River Flow Management*
2. *Lake Level Management*
3. *Feedlot Management*
4. *Watershed Management*
5. *Phase II Monitoring Program*
6. *Public Involvement*

IMPLEMENTATION OF GRANT #C9008631-92-0:

Implementation of Phase II Step II "Big Stone Lake Restoration - Little Minnesota River Watershed" 319 Workplan #C9008631-92-0 was initiated August 21, 1992. A one year extension with budget and milestone modifications was requested May 2,1994. Funds became exhausted August 20, 1995.

Project goals included:

1. Reduce phosphorus loadings to the lake from feedlots by 2278 pounds by building 9 Animal Waste Management Systems.

2. Promote grassland management by cross fencing, water dugouts and construct 20 Water Impoundment Reservoirs.

3. Increase conservation tillage in Big Stone Lake watershed by 40 percent.

4. Promote planting of trees for the purpose of controlling soil erosion.

5. Continue Water Quality Monitoring program to document and quantify reductions in pollutant loadings due to BMP's implementation.

6. Continue Data Management Program.

7. Continue Information and Dissemination Plan.

Progress made toward the restoration goal is discussed in detail in the following sections of this report.

WATERSHED PROJECT TEAM:

February 5, 1990, the Roberts County Commissioners entered into an agreement with the South Dakota Department of Environment and Natural Resources (DENR) by which the County became the local sponsor for the Big Stone Lake Restoration Project. The Commissioners assigned responsibility for the project to the Roberts Conservation District. The District's Big Stone Lake Watershed Team consisted of three positions:

1. *South Dakota Director*
2. *Secretary*
3. *NRCS Technician*

The office for the watershed team was located in the Federal Building in Sisseton, South Dakota. All team members carried out their responsibilities as set forth in the 319 Workplan. Total personnel expenses incurred during the 319 Grant period, including salary and benefits, were $122,270. A breakdown of personnel and administrative expenses are located in Appendix A-1.

PROJECT ACCOMPLISHMENTS:

Whetstone River Flow Management:

During 1937, the Federal Government through the Works Progress Administration diverted the Whetstone River into Big Stone Lake. This was done in an attempt to raise the water level of the lake. An unintended result of the diversion was sediment and nutrient loading of Big Stone Lake.

The objective of Whetstone River Flow Management was to reduce sediment and nutrient loads entering Big Stone Lake and to reestablish the normal flow from the Whetstone River. The 279,678 acre Whetstone River watershed enters Big Stone at the lower South end of the lake. Data from the Phase I

Study (DENR, 1983) indicated that water quality in the Whetstone River was the poorest of all the tributaries in the Big Stone Lake watershed. Both sediment and nutrient loads carried by the river were excessive. Based on the US Army Corps of Engineers Study (1975), the Whetstone River data showed a mean value of 37.3 tons per day for dissolved solids and 18.05 tons per day for suspended solids.

During the first four years of the project (1985-1988), a new control structure was constructed at the south end of the lake where the Whetstone River enters Big Stone Lake. One of the purposes of the control structure was to divert 85 percent of the flow of the Whetstone River away from the lake and directly into the Minnesota River. In addition to the new control structure, the silt barrier located where the Whetstone River enters the lake was raised by one foot. A debris barrier was also constructed upstream from the new control structure. The completion of these projects allowed for improved control of Whetstone River flows and reduced nutrient and sediment loading of Big Stone Lake. A decrease of 40 percent in total phosphorus levels has been noted at the station.

The Whetstone River flow management was an ongoing activity during the 319 Workplan. The responsibility for actual

operation of the control structure was delegated to the Upper Minnesota River Watershed District. The South Dakota watershed team provided technical assistance as needed by monitoring the Whetstone River watershed.

Lake Farley Project:

The Lake Farley Project was a supporting project of the Whetstone River Flow Management Project. Lake Farley is a small man made lake located near Milbank, South Dakota on the South Fork of the Whetstone River. It receives runoff from a 75 square mile watershed and serves as a sediment basin for the Whetstone River and ultimately Big Stone Lake. Since originally constructed during 1886, the lake had filled in with silt and become ineffective as a sediment basin. Because of unsafe conditions, Lake Farley's dam was breached during the spring of 1985. Local and state efforts to reestablish Lake Farley included the removal of 100,000 cubic yards of sediment from the lake basin using land-based equipment and strengthening of the dam. During 1993 the spillway was replaced at a cost of $375,000. The Lake Farley project is completed. Based on historical data, Lake Farley removes annually 1,000 cubic yards of sediment from the Whetstone River flows. The watershed team provided technical assistance for the project as requested. No further efforts were undertaken in the Whetstone watershed.

LAKE LEVEL MANAGEMENT:

The objectives of lake level management were to decrease bank erosion and increase the export of in-lake nutrients to improve water quality within Big Stone Lake. The level of Big Stone Lake has been set by the Minnesota and South Dakota legislatures at 964.6 ft. mean sea level. This level is regulated by the Minnesota/South Dakota Boundary Waters Commission, which granted the Minnesota Department of Natural Resources (DNR) the authority to issue operational instructions for the control structure. The Minnesota Department of Natural Resources delegated the actual operation of the control structure to the Upper Minnesota River Watershed District. Lake level management continues to be an ongoing activity. The South Dakota watershed team provided technical assistance in monitoring the Big Stone Lake watershed and all major tributaries flowing into the lake. This information was shared with the Upper Minnesota River Watershed District for the purpose of lake level management.

FEEDLOT MANAGEMENT:

To identify and prioritize potential problem feedlots, a "Feedlot Rating Model" developed by Young, Otterby and Roos (1982) was used. The AGNPS model is a computer simulation developed to predict the water quality of runoff from

agricultural watersheds. The model predicts runoff volume, peak discharge rate, eroded and delivered sediment, nitrogen, phosphorous and chemical oxygen demand of the runoff. Based on the Phase I Diagnostic/Feasibility Study (1983), the project's objective was to address all feedlots having a rating number greater than 50.

Whetstone Watershed:

Because of the diversion of 85 percent of peak flows of the Whetstone River by the new control structure, the focus of the project was shifted to the Little Minnesota River watershed. During this work plan, no projects were constructed in the Whetstone Watershed with 319 Grant funds.

Prior to this time, 14 Animal Waste Management Systems (AWMS's) were constructed in the Whetstone Watershed. Additional related information about the 14 completed AWMS's is presented in Appendix B1.

Little Minnesota Watershed:

The Little Minnesota River drains the largest subwatershed of any tributary to Big Stone Lake (286,414 acres). Because the new control structure diverted 85 percent of the Whetstone River flows away from the lake, the Little Minnesota River became the largest pollution source to Big

Stone Lake. Water quality monitoring data from the Phase I Study (DENR, 1983) and an HDR Engineering Inc. report (1992) indicated that during normal years, the Little Minnesota River contributes 48.9 percent of Big Stone Lake's phosphorus budget. The nutrients and sediment from the Little Minnesota River watershed have maximum detrimental effects since they are the largest in quantity and also have the potential to flow through the total length of the lake.

The Phase I study determined that 88% of the phosphorus having the most detrimental effect on lake water quality entered the lake from agricultural lands in the watershed. Total phosphorus load includes contributions from livestock feedlots as well as general agricultural runoff. The study further determined that 20 percent of the phosphorus load was derived from feedlots. To identify and prioritize potential problem feedlots, the "Feedlot Rating Model" developed by Young, Otterby and Roos (1982) was used. Project staff identified 135 feedlots in the Little Minnesota & Adjacent Lake Shore sub-watersheds and rated them using the model. Sixty-three feedlots in the Little Minnesota watershed had index values greater than 50.

During the "Workplan," eight Animal Waste Management Systems (AWMS's) were constructed at a cost of $325,860. The eight

systems are designed to contain the nutrient and sediment runoff associated with 1694 animal units. Based on the AGNPS model, an estimated 2,588 pounds of phosphorus is being contained annually and thus prevented from entering the Little Minnesota River and ultimately Big Stone Lake. The contained phosphorus is being applied to cropland in accordance with Waste Utilization Plans developed coopartively by NRCS and the AWMS operator. Additional information about the eight completed AWMS's is located in Appendix B2 & B3.

Best Management Practices:

The implementation of cropland Best Management Practices (BMP's) was encouraged and promoted by the project's watershed team. Cost-share funding for BMP implementation was provided mainly through the Agricultural Conservation Program (ACP) and the special Water Quality Incentive Program (WQIP). Section 319 Project Grant funds were not used for the installation of Best Management Practices.

The watershed team provided technical and educational assistance to promote and install the following BMPs:

1. *Conservation Reserve Program*
2. *No-till farming practices*

3. *Conservation tillage*
4. *Crop residue management*
5. *Grass waterways*
6. *Multi-Purpose Dams*
7. *Complimentary Projects*

Conservation Reserve Program:

The most popular and widely accepted best management practice (BMP) in the Big Stone Lake watershed was the Conservation Reserve Program (CRP). A total of 21,722 acres was enrolled in the watershed. Of this total, 15,853 acres were located in the Little Minnesota River sub-watershed. Many of the CRP acres are located adjacent to tributaries or drainage areas of the Big Stone Lake. They reduce soil erosion and filter runoff from surrounding watershed acres. The Conservation Reserve Program was an ongoing project. Because of changes in the focus of the Conservation Reserve Program, only 118 acres were accepted during this work plan.

No-Till Farming Practices:

According to the Corps of Engineers 1975 Big Stone Lake Feasibility Report an estimated 55% of the phosphorus entering the Big Stone Lake is derived from land runoff. In an effort to address this problem, a "Cost-Share Project" to promote the adoption of No-Till and Minimum Till farming was

conducted from 1982 through 1987. During that time, 63 operators No-Tilled 4,578 acres in the Big Stone Lake watershed. This project was funded by Special ACP funds and discontinued when the funds became exhausted.

During the fall of 1992, a No-Till project was again conducted in the Big Stone Lake watershed. In an effort to ensure greater success and to promote acceptance of reduced tillage, a "Residue Tillage Demonstration Plot" was used as an education and information activity during 1993 and 1994. This plot compared conventional, minimum and no-till practices. Cost analysis and yield information was made available to interested local operators.

Roberts Conservation District, in support of the Residue Management Practice, entered into an agreement with John Deere & Company to sublease two No-Till drills to area operators. Ninety operators no-tilled over 5,000 acres in Roberts County during the 1993, 1994 and 1995 crop years. Of the 5,000 acres No-Tilled, 2,728 acres were located in the Little Minnesota watershed. During 1993, 1994 and 1995, extremely wet climatic conditions hampered further success of the No-Till project.

Due to the continued interest in Residue Management, Roberts

Conservation District and Ducks Unlimited jointly purchased a No-Till drill during 1995 for the purpose of continuing the program.

Grass Waterways:

Five grass waterways (7,300 linear feet) were constructed. These waterways serve to reduce the amount of sediment and nutrients reaching tributaries of the Little Minnesota River and thus Big Stone Lake. Cost-share funding was provided through the CFSA/ACP and LTA programs.

Multi-Purpose Dams:

The multipurpose dam project is an inter-agency cooperative partnership involving the of US Fish & Wildlife, Ducks Unlimited, Robert Conservation District, CFSA, NRCS, Citizens for Big Stone Lake (CBSL) and the Big Stone Lake Restoration Project. The multipurpose dams are located in selected areas to decrease the amount of sediment and nutrients entering tributaries to Big Stone Lake, improve range land management by better water distribution and provide better habitat for wildlife. During this work-plan, twenty-five multipurpose dams were completed in the Big Stone Lake watershed at a cost of $76,080 (Appendix C-1). Based on NRCS estimates, the multi-purpose dams will contain annually 1,392 cubic yards of sediment. The projects have

an estimated lifespan of 10 years.

COMPLIMENTARY PROJECTS:

Tree Planting Project:

In support of the project, Roberts Conservation District planted an estimated 80 acres of trees to control soil erosion in the Little Minnesota River watershed. Total cost of the plantings was $34,978. Cost-share funds were provided through the CFSA/ACP Program. Project cooperators were required to contribute 30 percent of the cost.

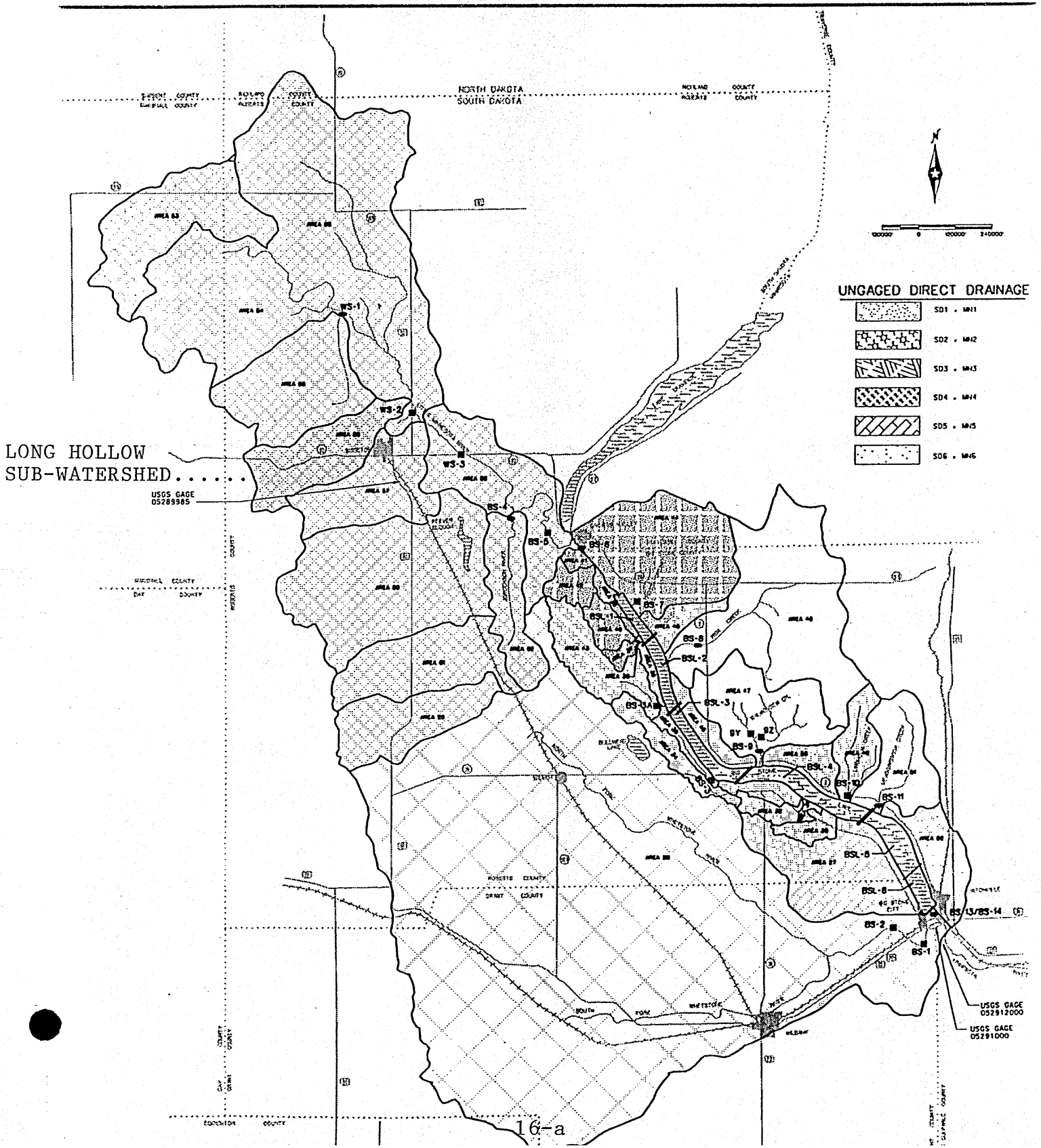
WQIP Project:

A three-year, $118,000 Water Quality Incentive Project (WQIP) was implemented in the Long Hollow sub-watershed during 1994.

The Long Hollow sub-watershed (figure 16a) is an 48,416 acre sub-watershed of the Little Minnesota River watershed. The WQIP project focused on sediment reduction. The following BMPs were promoted:

	Acres
1. *Conservation Tillage*	*815*
2. *Crop Residue Use*	*2,470*

MAP OF LONG HOLLOW SUB-WATERSHED



3. *Conservation Cropping Sequence ..1,616*
4. *Critical Area Planting 51*
5. *Hayland Planting & Management ...1,066*
6. *Livestock Exclusion 110*

The Big Stone Lake Restoration Project team provided direction for project planning, assisted in promotion of the project and provided technical assistance to further implement project practices.

Point Sources of Pollution:

Historic water quality data indicated that municipal wastewater facilities contributed an estimated 10-20 percent of the total phosphorus budget of the Little Minnesota River. Browns Valley, Minnesota and Sisseton, South Dakota municipal wastewater treatment facilities were completed during previous grant periods. Veblen and Peever Wastewater Facilities were completed during this grant period. These new wastewater treatment facilities are located on the Little Minnesota River and Jorgenson River, a tributary of the Little Minnesota River. The projects were designed for zero discharge. Section 319 Grant funds were not used directly in these projects; technical assistance was provided as needed. The construction of the four municipal wastewater treatment facilities has reduced phosphorus

loading of the Little Minnesota River and thus Big Stone Lake by an estimated 6,700 pounds annually.

Additional point sources of pollution have not been identified in the Little Minnesota River watershed.

GIS PROJECT:

A Geographic Information System (land inventory) Project was completed in the Lake Traverse and Little Minnesota River watersheds. The total project area was 369,000 acres with 247,000 acres being located in the Little Minnesota River watershed.

The GIS information generated was used to prioritize selected areas for future project implementation. It will also be used to evaluate present BMP projects implemented by the Big Stone Lake Restoration Project.

Project staff collected the necessary data needed for assembling the GIS data base. Funding for the $13,250 project was from a combination of sources including: 604b Grant Funds, Citizens for Big Stone Lake, Lake Traverse Improvement Association and Roberts Conservation District.

PUBLIC INVOLVEMENT:

In order to keep various agencies and the general public informed about "project" progress, an Information and Education program was conducted. One of its functions was to educate farm and ranch operators in the watershed concerning the BMP's needed and available cost-share funds to implement the BMP's. To accomplish this, the following activities were completed by the Watershed Team:

Six Quarterly and Annual reports were distributed to local governments and private groups involved with the project. These reports assessed progress of the many different project activities and summarized the project's monitoring data. At the end of the year, a summary of the years activities was distributed as an annual report to all interested individuals. A mailing list of those who received the reports is located in Appendix E-1.

The Watershed Team, in cooperation with the Citizens for Big Stone Lake Association, produced three issues of newsletters for distribution to landowners and other individuals interested in the Big Stone Lake Restoration Project. The newsletters generally summarized the quarterly reports and included other information which was pertinent to the lake's watershed.

The Watershed Team participated in one radio talk show at KDIO radio station. This show was used to inform project residents of watershed regulations, cost-share fund availability and project progress.

Articles about the Big Stone Lake and its watershed have been published in area newspapers and magazines (Appendix E). The project also piggybacked on a weekly NRCS newsletter which is published in four local newspapers. This was done to inform the general public about the project.

Each year a Farm Show was held in the Big Stone Lake's watershed. Project staff were present at this event for public exposure, to answer pertinent watershed questions, distribute maps of Big Stone Lake and provide other related information. Two hundred plus contacts were made during each of the years, 1993, 1994, and 1995.

The staff was also involved with providing technical assistance and support to other agencies for BMP promotion and implementation. Because Natural Resource Conservation Service (NRCS) BMP watershed goals and Big Stone Lake Restoration Project BMP goals for the improvement of the lake and watershed are similar, a working relationship developed. The staff also worked with the Dept. of

Consolidated Farm Service Agency (CFSA). CFSA provided supplemental cost-share funds for many of the BMP practices implemented.

In an effort to disseminate information between the many agencies and individuals involved with the project, an "inter-agency meeting" was held during November 1992 and 1993 to review past project progress, establish future project goals and foster good working relationships. These meetings were attended by both South Dakota and Minnesota departments, agencies and individuals.

The staff attended the Minnesota Lake Management Conference (October 1992), Environment and Bottom Line (1993), EPA Region VIII Clean Lakes Conference (1993 & 1994) and Watershed Management Workshop (1995) to exchange information.

These public information activities were conducted on a continuing basis with participation by all members of the Watershed Team. This resulted in an improved awareness of the project and its goals during the Phase II Step II Workplan.

PHASE II MONITORING PROGRAM:

The objective of the water quality monitoring program was to document and quantify reductions in nutrient and sediment loading and water quality improvements that resulted from implementation of BMPs in the Lake Watershed. The monitoring program for the Phase II Big Stone Lake 319 Workplan was patterned after the existing plan for Phase II of the project.

During 1992, the Ortho-Phosphorus chemical analysis was replaced by Total Dissolved Phosphorus chemical analysis. This was necessitated because South Dakota's State Health Laboratory and project staff were unable to meet the recommended EPA holding times for "Ortho-Phosphorus."

June 1, 1994, the monitoring program was amended. After evaluating the accumulated data on the Big Stone Lake and the Little Minnesota River watershed, the Project Staff and South Dakota's Dept. of Environment & Natural Resources proposed reductions in the monitoring program. The monitoring program was further amended January 12, 1994. A request to suspend monitoring was approved. In-lake and tributary monitoring was terminated following the 1994 season. The cost of the monitoring program was $8,399 (Appendix A-2).

Tributary Monitoring:

The purpose of tributary monitoring was to determine nutrient and sediment budgets for the Big Stone Lake hydrologic system. Nine tributary sites were monitored during 1992 and 1993 (Refer to figure 1a for location map). After June 1,1994, monitoring was terminated at stations BS-04, WS-01 and WS-02. These stations monitored sub-tributaries of the Little Minnesota River. The watershed team determined that a sufficient data base existed for these stations. Monitoring of tributary BS-06, located on the Little Minnesota River at the inlet of the lake, continued as in the past.

The chemical parameters analyzed by the South Dakota State Health Laboratory during 1992 and 1993 include:

Total Phosphorus	*Ortho Phosphorus*	*Nitrate + Nitrite*
Ammonia	*Kjeldahl Nitrogen*	*Total Solids*
Suspended Solids	*Total Alkalinity*	*Fecal Coliform*
Dis. Phosphorus		

The modified 1994 parameters measured by the SD Health Laboratory in accordance with their approved Quality Assurance Plan were:

Total Phosphorus *Nitrate+Nitrite* *Suspended Solids* *Fecal Coliform*

Field parameters analyzed by the Water Quality Analyst were:

Air Temperature	*Water Temperature*	*Field PH*
Visual Observation	*Water Velocity*	*Date and Time*

In Lake Monitoring:

The purpose of in-lake monitoring was to determine water quality trends in Big Stone Lake, estimate productivity and changes in the tropic state of the lake and develop in-lake hydrologic and nutrient budgets. The in-lake sampling sites remained the same during 1992 and 1993 as in the original Phase II Workplan (Refer to figure 1a for location map). The following parameters were measured on each of the composite samples collected for in-lake samples:

Total Phosphorus	*Ortho Phosphorus*	*Nitrate+Nitrite*
Ammonia	*Kjeldahl Nitrogen*	*PH*
Total Solids	*Suspended Solids*	*Total Alkalinity*
Specific Conductivity	*Fecal Coliform*	*Dissolved Oxygen*
Water Temperature	*Secchi Disc*	*Dis. Phosphorus*

An amendment to the Monitoring Plan was approved May 2, 1994. The approved amended monitoring plan reduced the number of in-lake sampling sites from six to three and from monthly to the months of June and August. Sampling continued to be conducted at BSL-1, BSL-3 and BSL-6. These

three in-lake sites allowed the lake to be monitored at the inlet, outlet as well as the midpoint of the lake.

The 1994 modified parameters measured by the SD Health Laboratory and project staff were:

Total Phosphorus	*Nitrate+Nitrite*	*Suspended Solids*
Fecal Coliform	*Chlorophyll A*	*Secchi Disc*
PH	*Specific Conductivity*	*Dissolved Oxygen*

In lake monitoring was terminated following the 1994 field season. Water sample collection, preservation and field analysis were conducted in accordance with the Quality Assurance Program of the Division of Water Resource Management. Chemical analyses of samples were conducted by the South Dakota State Health Laboratory in accordance with their approved Quality Assurance Project Plan. Care was taken to ensure that the data was compatible with existing historical data. A comprehensive report of all water quality and hydrologic data was collected and reported in the project's "Annual Reports." Monitoring cost incurred during the grant period was $8,316.

Monitoring Data Conclusions:

Monitoring of the lake and its tributaries was carried out

in a manner which allowed for compatibility with previous historical data. To evaluate trends of phosphorus in the Big Stone Lake (1989-1994), "Total Phosphorus" chemical analyses were used (Appendix D). Water quality changes were analyzed using "Analytical Graphing/Linear Regression." Two sampling stations were considered: BSL-1 located at the North end of the lake and BSL-6 located at the South end of the lake.

BSL-1:

Since 1989, BSL-1, located at the North end of Big Stone Lake, showed a 24.5 percent decrease in the concentration of "Total Phosphorus" (Appendix D1). Secchi disc readings have shown a 9.5 percent improvement (Appendix D2). This measurement of transparency is an estimate of the density of phytoplankton algae populations, which indicates the nutrient richness or trophic state of the lake.

BSL-6:

Station BSL-6 is located at the South end of Big Stone Lake. This station was affected not only by nutrient and sediment flow from the North end but also the Whetstone River which enters the lake at the South end. Since the completion of the control structure which diverts 85 percent of the Whetstone River flows and other Best Management Practices in

the Whetstone Watershed, a decrease of 40 percent in total phosphorus levels has been noted at the station (Appendix D3). Secchi Disc readings have improved by 4.8 percent (Appendix D4).

Big Stone Lake has shown short term improvement. The Watershed Team feels that based on the current data, further improvements will be noted as restoration efforts continue in the lake's watershed. Because of the size and distance of the completed projects in relation to the lake and the average hydraulic residence time of 1.2 years in the Big Stone Lake, the full effects of the completed projects will not be known for sometime.

Project Summary:

The overall goal of the restoration effort was to increase the recreation potential and lifespan of Big Stone Lake. Major objectives included a reduction of both the density and duration of algae blooms, limitation of aquatic macrophytes and a reduction of sediment and phosphorus loadings.

Big Stone Lake contains excessive amounts of nutrients which produce nuisance algal blooms. Nutrients are present in both the aqueous and sediment phases. Phosphorus and

nitrogen are the two substances generally limiting plant growth in the lake. In reality, it is difficult to control the amount of nitrogen entering a lake. For this reason, the Big Stone Lake management strategy is to concentrate on controlling the amount of phosphorus entering the lake.

Projects which were recommended for the purpose of achieving the project's objectives were:

1. Reduce phosphorus loadings to the lake from feedlots by 2278 pounds by building 9 Animal Waste Management Systems.
2. Promote grassland management by cross fencing, water dugouts and construct 20 Water Impoundment Reservoirs.
3. Increase conservation tillage in Big Stone Lake watershed by 40 percent.
4. Promote planting of trees for the purpose of controlling soil erosion.
5. Continue Water Quality Monitoring Program to document and quantify reductions in pollutant loadings due to BMP's implementation.
6. Continue Data Management Program.
7. Continue Information and Dissemination Plan

The following success has been noted in each of these areas:

1. The initial Project Implementation Plan included the goal of 11 Animal Waste Management Systems. This goal was amended May 2, 1994, to 9 projects. Two of the proposed AWMSs were completed during 1992 before the project's

initiation date. This was done in an effort to better utilize available ACP/LTA cost-share funds and manpower.

During 1993 and 1994 extreme wet climatic conditions were encountered. Due to unforseen cost increases while constructing the projects, 319 cost-share funds were exhausted with the completion of eight projects (Appendix B2). Eight Animal Waste Management Systems were constructed during the grant period which contain 2,588 pounds of phosphorus annually.

Four additional AWMS projects are presently designed and will be constructed as cost-share funds become available.

2. Twenty-five Water Impoundment Reservoirs and 7,300 linear feet of grass-waterways were constructed (see pg 13).
3. No-Tilled 2728 acres in the Little Minnesota River watershed (see pg 12).
4. Trees and shelter belts planted on 80 acres (see pg 14).
5. Monitoring program carried out as planned (see pg 20).
6. Data Management Program carried out as planned (see pg 20).
7. Information and Dissemination Plan implemented (see pg 17).

These and past project success's have resulted in the perception that the lake has improved.

Public Perception:

The public, in general, perceives "lake water quality" in terms of algae's bloom density and duration. The public perceives an improvement in the quality of the lake water since restoration efforts were implemented. This perception is reflected in lake usage data which was collected at Hartford Beach State Park, (refer to Appendix D-5). The Hartford Beach State Park is centrally located on the Big Stone Lake and is representative of lake usage. During the period of 1989-1994, lake visitations showed an increase of 10 percent, campground use 89 percent and collected receipts 112 percent. Climate factors, extremely wet weather, reduced park usage during 1993 and 1994. Also, Hartford Beach State Park was under renovation during the 1994 season. These factors had a negative impact on park usage.

With the improved water appearance, the cities of Graceville Minnesota, Big Stone City and Milbank South Dakota are now promoting the lake through fishing tournaments, sport magazines and boat shows. This effort has resulted in an increase of individuals returning to enjoy the lake.

PROJECT CHALLENGES:

Project cost increases and delays have been experienced due

to abnormally high rain-fall experienced during 1993 and 1994. This has resulted in the need for Milestone modifications. Forty-three feedlots identified as potential Nonpoint Sources of pollution in the Little Minnesota and adjacent watershed remain to be treated. These feedlots will be addressed as other cost-share funds become available.

As the project progressed, several challenges were encountered. The degree of design difficulty of the feedlot projects has increased. Project engineers are finding it increasingly more difficult to create designs which not only contain the problem sediment and nutrients but are also acceptable and economically feasible for the feedlot operators. The increased difficulty of these projects has increased the design time and the cost of construction. Even with the present cost-share incentives, area operators are finding it increasingly more difficult to finance their share of the project.

Not being able to design an acceptable alternative for some feedlot operations, may necessitate the lots having to be relocated in the future. At this time, operators do not find this as an acceptable alternative.

FUTURE INTENTION OF PROJECT SPONSORS:

The intention of Roberts County, the project's sponsor, are to continue the restoration effort. Due to the size of Big Stone Lake's watershed and the number of remaining problems which still need to be addressed in the Little Minnesota River watershed, a long term source of cost-share funding is being pursued. At the present time, Roberts County, is pursuing a PL566 Grant. This application has been approved. However, funding has not been appropriated. If this effort is successful, many of the remaining nutrient and sediment problems in the Little Minnesota watershed will be addressed.

Due to the popularity and acceptance of the "Multi-Purpose Dam Project," the Roberts Conservation District has made application for additional cost-share funds to promote the project. This project has been and will continue to be located in selected areas for the purpose of decreasing the amount of sediment and nutrients entering tributaries which enter the Big Stone Lake. When the funds are allocated, 33 dams will be constructed which will contain 18,368 cubic yards of sediment (Based on NRCS estimates).

Efforts are being pursued to implement a Bootstraps Program. This program will address grassland problems now being

encountered in the watershed due to grassland mismanagement.

A demonstration Riparian Project is being implemented. The 3 proposed demonstration projects will target 1800 feet on the Little Minnesota River. These projects when completed will reduce bank erosion 1,999 cubic yards per year(Based on NRCS estimate).

Support for the Big Stone Lake Restoration effort continues. This has resulted in an increased involvement by many individuals, agencies and organizations. Public perception and monitoring data continue to show water quality improvements. Ten year plans for the future Big Stone Lake Restoration have been completed.

END

319 GRANT #C9008631-92-0
ADMINISTRATION EXPENSES

YEAR	EXPENSE	EPA	LOCAL	TOTAL
	Wages & Benefits Director			
1992		$2,921	$1,382	$4,303
1993		$17,776	$11,850	$29,626
1994		$18,014	$12,009	$30,237
1995		$12,335	$8,224	$20,559
	Secretary & Support Staff			
1992				
1993		$3,721	$2,480	$6,201
1994		$3,290	$2,194	$5,484
1995		$1,967	$1,311	$3,278
	NRCS Technician			
1992				
1993		$7,800	$5,200	$13,000
1994		$4,284	$2,856	$7,140
1995		$3,516	$2,344	$5,860
Sub Total		$75,624	$49,850	$125,688
	Telephone			
1992				
1993		$843	$562	$1,405
1994		$784	$522	$1,306
1995		$376	$251	$627
Sub Total		$2,003	$1,335	$3,338
	Office Expense			
1992				
1993		$958	$639	$1,597
1994		$663	$442	$1,105
1995		$520	$347	$867
Sub Total		$2,141	$1,428	$3,569
	Audit			
1992				
1993			$1,000	$1,000
1994			$1,250	$1,250
1995			$1,600	$1,600
Sub Total		$0	$3,850	$3,850
TOTAL EXPENSES		$79,768	$56,463	$136,445

319 GRANT #C9008631-92-0
MONITORING EXPENSES

	EXPENSE	EPA	LOCAL	TOTAL
	MONITORING & EQUIPMENT			
1992	***	*****	*****	*****
1993	***	$3,247	$2,165	$5,412
1994	***	$1,792	$1,195	$2,987
1995	***	*****	*****	*****
TOTAL EXPENSE		$5,039	$3,360	$8,399

Note: 1992 Monitoring expenses were paid by Grant C9008522-89
No monitoring was carried out in 1995

ANIMAL WASTE MANAGEMENT SYSTEMS
BIG STONE LAKE RESTORATION PROJECT

Grant County:

Year	Name	Location	Type	Animal No.	AU	Rating No. *	Lbs. P*		Costs
1985	**Chuck Liebe**	**WW**	Beef	111	89	54	57		$9,121
1986	**O'Farrell Inc. ****	**WW**	Beef	900	720	81	459		$13,743
1987	**Dahle Dairy**	**WW**	Dairy	135	112	66	124		$11,660
	Orgene McCrea	**WW**	Beef	225	180	50	115		$9,859
	Marlin Schmidt	**WW**	Beef	300	240	62	153		$12,568
1988	**Gerald Thaden**	**WW**	Beef	85	68	37	43		$6,867
	Melvin McCulloch	**WW**	Dairy	55	66	48	51		$17,073

Roberts County:

1986	Maynard Anderson	LMR	Dairy	115	129	76	69		$8,002
	Harry Ziemer	LMR	Beef	120	108	74	61		$10,950
1988	**Donn Bassett**	**WW**	Dairy	100	130	64	92		$12,384
	Lowell Schwenn	**WW**	Dairy	100	98	39	55		$9,131
	Francis VanSambee	**WW**	Beef	200	115	49	200		$9,451
	Wes Green	**WW**	Beef	150	105	46	210		$10,956
	Dale Nigg	LMR	Beef	500	288	71	500		$8,150
	Schiltz's Inc.	LMR	Geese	3,500	98	83	491		$9,100
	Eugene Bucklin	LMR	Dairy	100	98	52	74		$17,759
1989	Darrell Ceroll	LMR	Dairy	105	125		209		$28,146
1990	**Delvin Hanson**	**WW**	Hogs	980	392	68	289		$48,392
	Paul DeBoer	**WW**	Dairy	530	448	84	419		$46,416
	Dennis Fisher	LMR	Beef	175	148	62	159		$36,814
	Brad Ziemer	LMR	Hogs	130	52	83	599		$18,137
1991	Schiltz's Inc.	LMR	Geese	40,000	1260	83	859		$102,478
1992	Scott Nelson	LMR	Beef	250	163	70	283		$13,942
	Lloyd Hanssen	LMR	Dairy	150	160	69	161		$23,681
	Paul Hanson (Grant I)	LMR						$6,403	
	Paul Hanson (Grant II)		Dairy	141	177	70	159	$26,238	$32,641
1993	Ed Lamers	LMR	Dairy & Hogs	135 690	221	76	547		$40,393
1994	John Oetken	LMR	Beef	800	480	83	633		$74,151
	Alan Rowland	LMR	Beef	250	163	79	515		$20,367
	Keith Nielsen	LMR	Dairy	80	88	66	106		$50,580
	Joe Serocki	LMR	Dairy	130	126	66	111		$32,311
	Gary Hanson	LMR	Beef	245	199	69	249		$40,906
1995	Dean Bendickson	LMR	Beef	200	240	70	268		$40,914

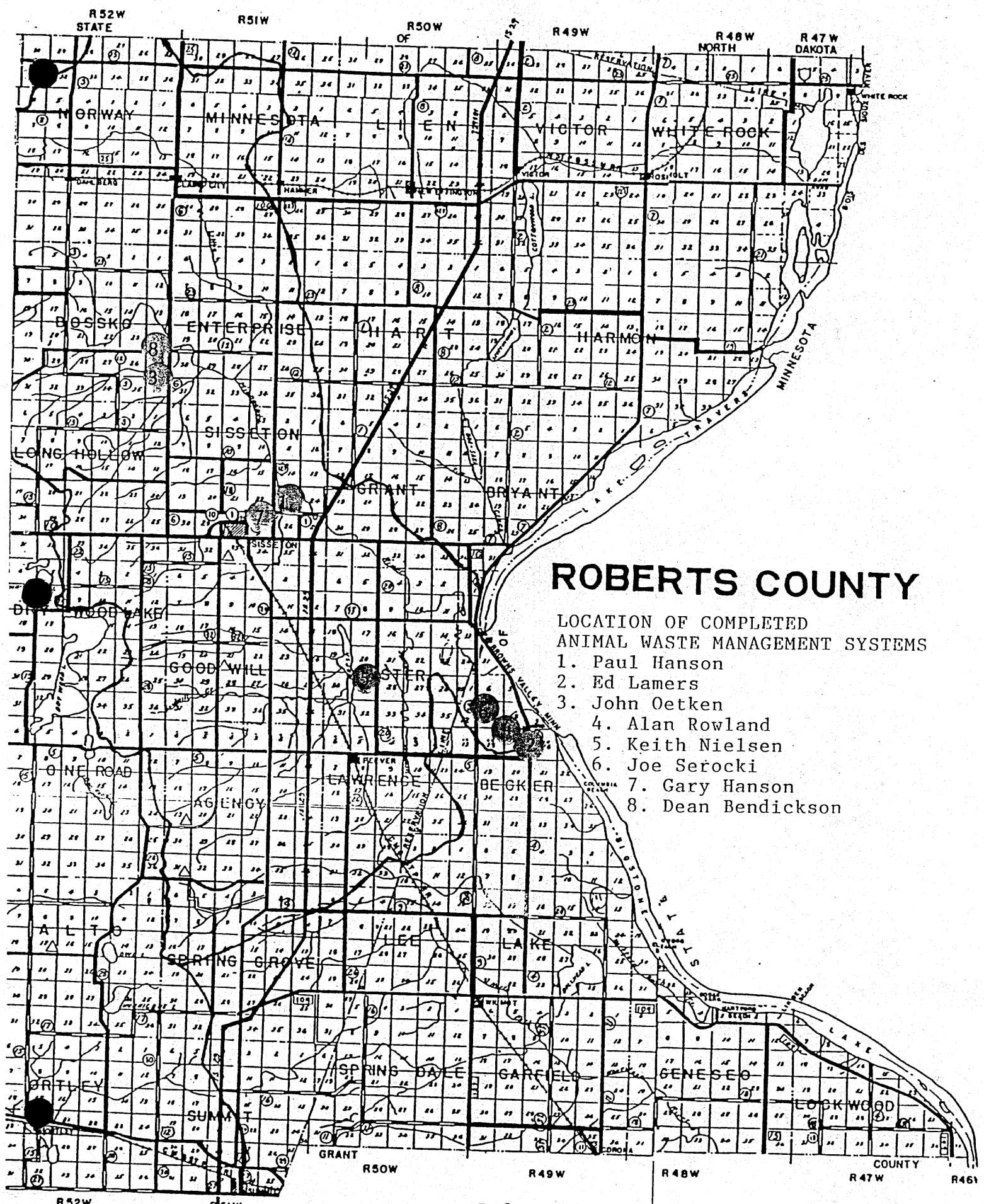
TOTAL DOLLARS SPENT $827,043
TOTAL 319 DOLLARS $650,269

** Two AWMS's Constructed
*Load Reduction estimates & Rating Numbers based on AGNPS
AU Animal Units
WW Whetstone Watershed
LMR Little Minn. Watershed

ANIMAL WASTE MANAGEMENT SYSTEMS
BIG STONE LAKE RESTORATION PROJECT

Year	Name	Type	Animal No.	AU	Rating No. *	Lbs. P*		Costs
1992	Paul Hanson (Grant I)						$6,403	
	Paul Hanson (Grant II)	Dairy	141	177	70	159	$26,238	$32,641
1993	Ed Lamers	Dairy & Hogs	135 690	221	76	547		$40,393
1994	John Oetken	Beef	800	480	83	633		$74,151
	Alan Rowland	Beef	250	163	79	515		$20,367
	Keith Nielsen	Dairy	80	88	66	106		$50,580
	Joe Serocki	Dairy	130	126	66	111		$32,311
	Gary Hanson	Beef	245	199	69	249		$40,906
1995	Dean Bendickson	Beef	200	240	70	268		$40,914
					TOTAL DOLLARS SPENT DURING GRANT II PERIOD			$325,860

*Load Reduction estimates & Rating Numbers based on AGNPS
AU Animal Units



ROBERTS COUNTY

LOCATION OF COMPLETED
ANIMAL WASTE MANAGEMENT SYSTEMS

1. Paul Hanson
2. Ed Lamers
3. John Oetken
4. Alan Rowland
5. Keith Nielsen
6. Joe Serocki
7. Gary Hanson
8. Dean Bendickson

MULTI-PURPOSE DAMS
BUILT IN THE
BIG STONE LAKE WATERSHED

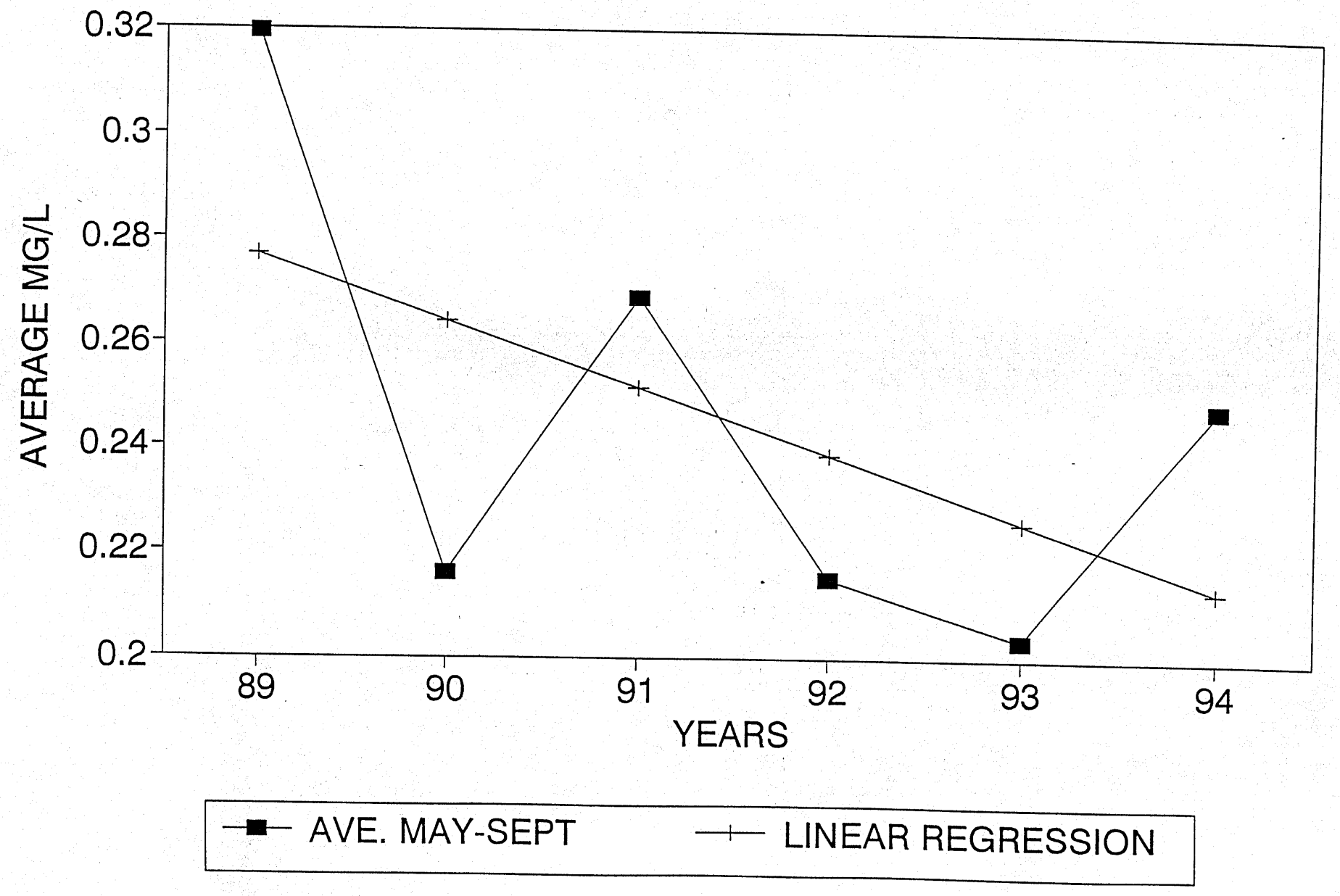
COMPLETED DURING THE BIG STONE LAKE 319 GRANT PERIOD

NAME	DATE	WATERSHED	TOTAL COST
Bruce Prins	9-91	Little Mn.	$2,948 @
Duane Schneider	10-91	Little Mn.	1,300
Duane Stegge	11-91	Little Mn.	4,488 @
Don Hagen	4-92	Little Mn.	1,635
Don Hagen	4-92	Little Mn.	2,565
Allyn Ammann	11-92	Whetstone	1,354
Glen Evenson	9-92	Little Mn.	9,080 @
Glen Evenson	9-92	Little Mn.	3,411
Gene Frerichs	11-92	Whetstone	1,567 @
Henry German	10-92	Little Mn.	2,000 +
Henry German	10-92	Little Mn.	3,960 @
Don Johnson	12-92	Adjacent Lake	5,600 @
Robert Julius	9-92	Little Mn.	2,248 @
Robert Julius	9-92	Little Mn.	2,770 @
Byron Overby	11-92	Adjacent Lake	3,780
Clayton Palmquist	10-92	Whetstone	1,655 @
Betty Peterson	9-92	Little Mn.	2,772 @
Stanley Plant	11-92	Adjacent Lake	1,485 @
Harry Ziemer	11-92	Adjacent Lake	2,970
Wesly Hanson	9-92	Little Mn.	2,413
Truman Nelson	5-93	Little Mn.	3,566
Cal Finnesand	5-93	Little Mn.	5,238 @
Betty Peterson	10-93	Little Mn.	1,643
Fred Oetken	10-93	Little Mn.	1,010
Dakota Nation	9-93	Little Mn.	3,100
Harry Moshier	10-93	Little Mn.	1,163
Melvin Schuchard	11-93	Adjacent Lake	1,738
James Monson	9-94	Little Mn.	7,801@
Michael Myrum	8-94	Little Mn.	629
Michael Myrum	8-94	Little Mn.	3,127
		TOTAL COSTS	$89,016

+ Operator built on his own
@ ACP cost-share included

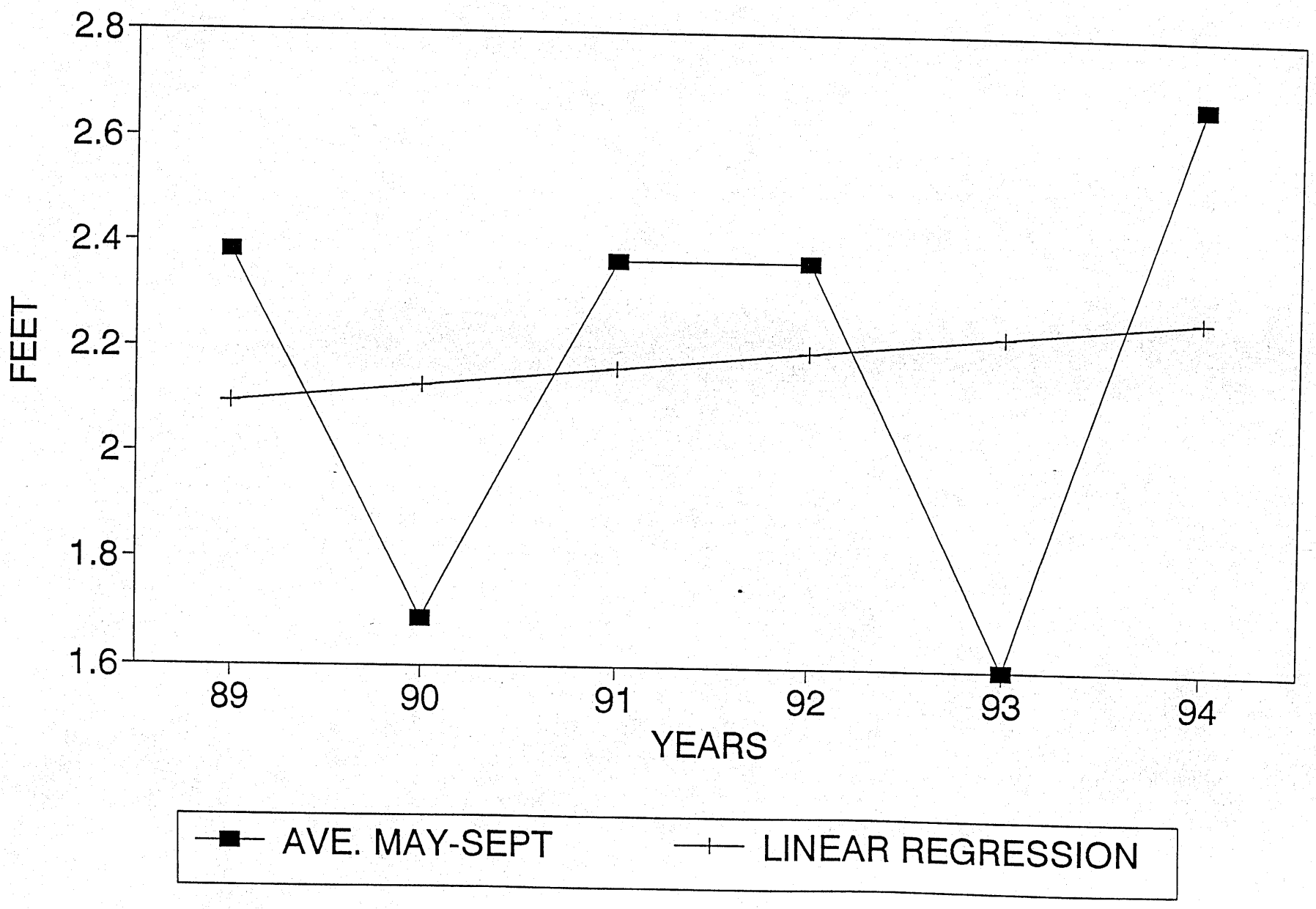
BIG STONE LAKE BSL 1

TOTAL PHOSPHORUS 1989-1994



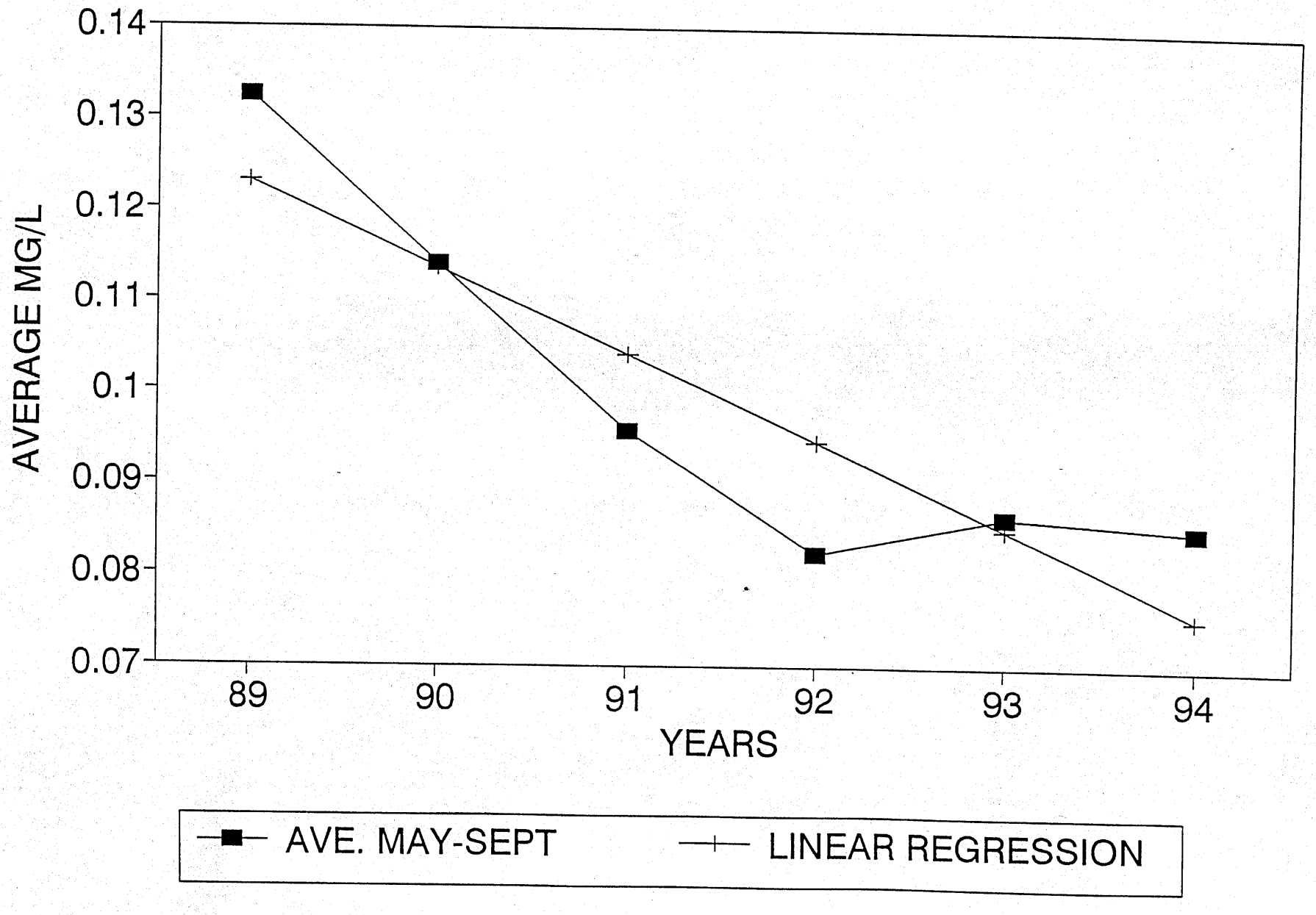
BIG STONE LAKE SECCHI READINGS

BSL-1 1989-1994



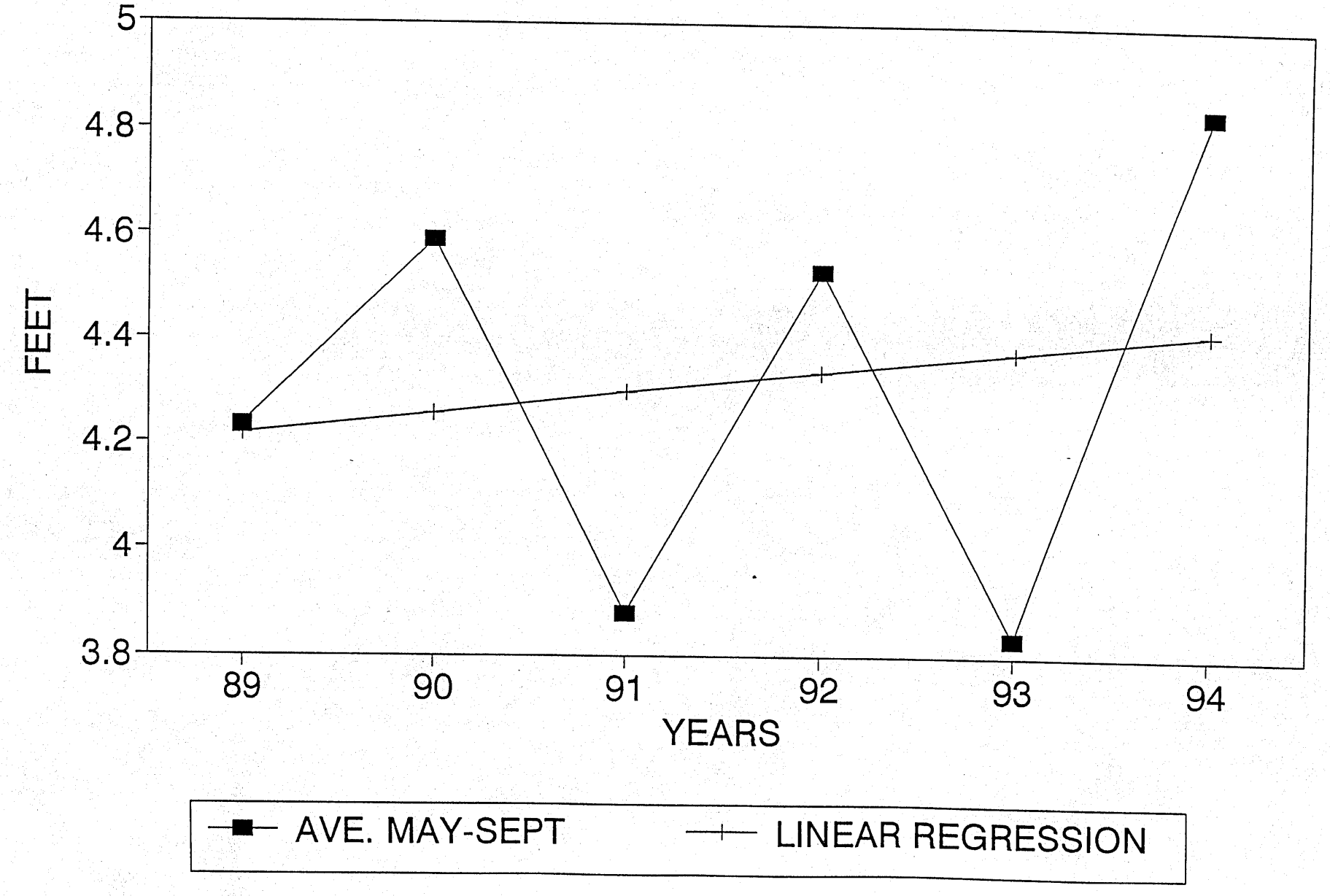
BIG STONE LAKE BSL 6

TOTAL PHOSPHORUS 1989-1994



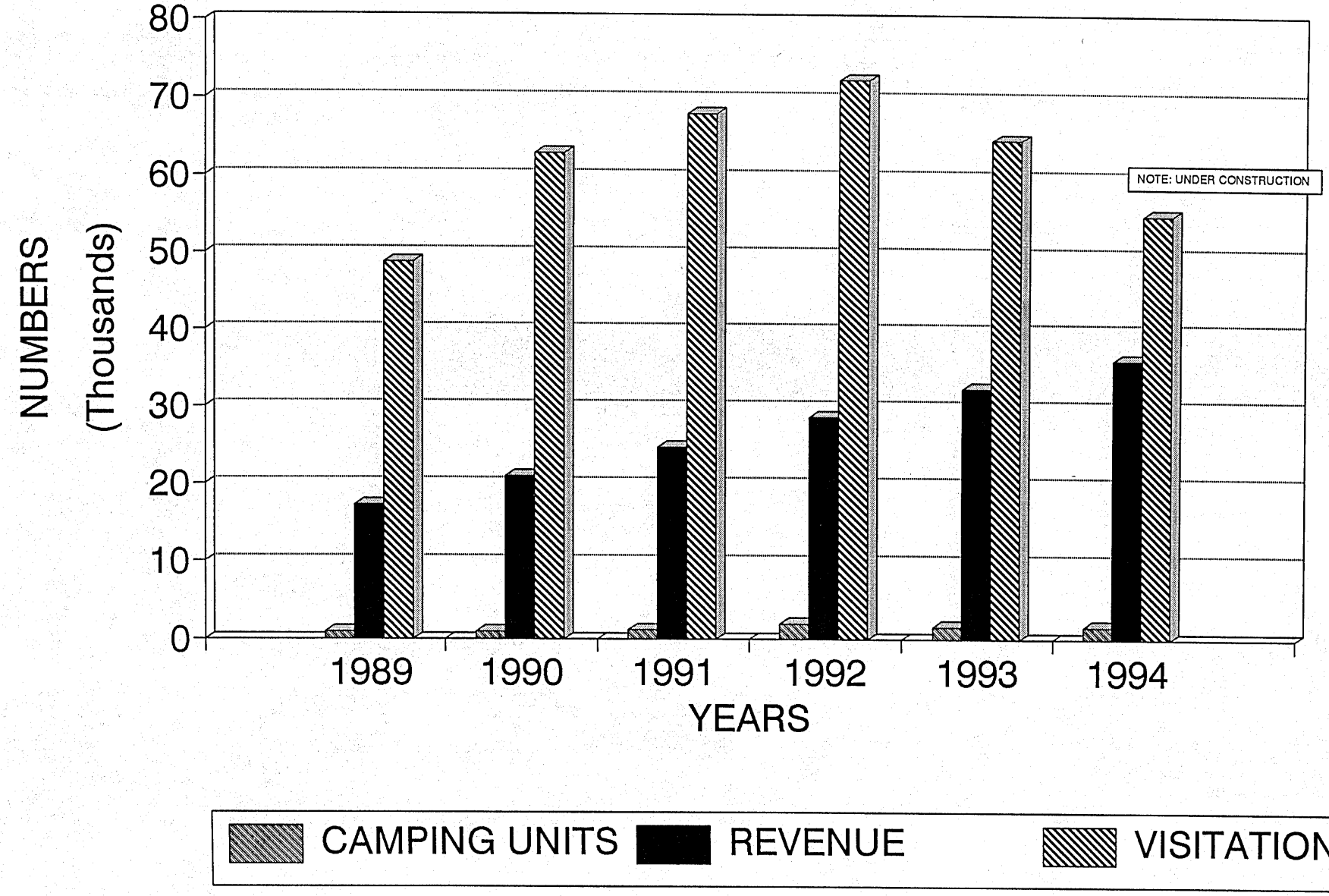
BIG STONE LAKE SECCHI READINGS

BSL-6 1989-1994



HARTFORD STATE PARK

DATA



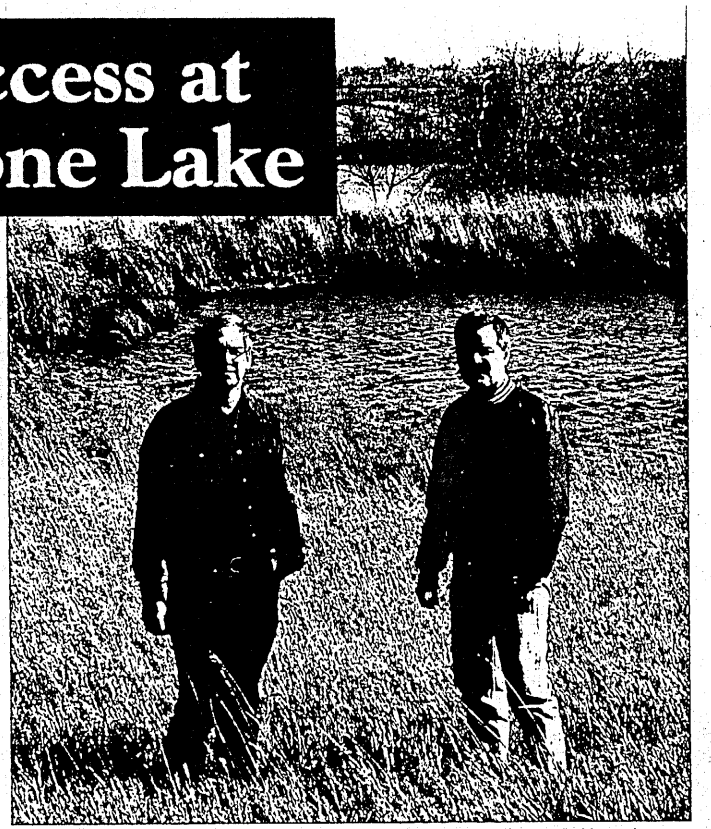
MAILING LIST

Name	Representing	Address
Mike Kuck	NRCS	State Office NRCS Federal BLD 200 4th ST. SW Huron, SD 57350-2475
Leroy Holtsclaw	NRCS	" "
Roy Boschee	NRCS	NRCS 530 3rd Av. P.O. Box 626 Brookings, SD 57006
Gary Coplan	NRCS	" "
Sandy Gregg	Extension	411 2nd Ave Sisseton SD 57262
Roberts County Commissioners		" "
Curt Sylte	ASCS	205 E Oak Federal Building Sisseton SD 57262
Kent Duerre	NRCS	" "
Tom Martin	NRCS	Box 8 Britton SD 57430
Tim Bjork	DENR	Env. & Nat Resources Joe Foss Building 523 E. Capitol Pierre SD 57501-3181
Dennis Clarke	DENR	" "
Bill Stewart	DENR	" "
Citizens for Big Stone Lake		342 NW 2nd St. Ortonville Mn 56278

Big success at Big Stone Lake

Work in the Big Stone Lake Watershed may be proof that we can clean up our water — if we work together

BY LON TONNESON



Curt Hanssen, Big Stone Lake Restoration Project co-coordinator (left), and Kent Duerre, Roberts County district conservationist, stand in front of two ponds built in the watershed.

Big Stone Lake used to be so dirty that area residents said it didn't take a miracle to walk on its water.

You could just walk on the algae.

But now, Big Stone Lake may be making a comeback, thanks to 10 years of effort and more than $5 million spent to reduce city and farm waste runoff in the 740,000-acre watershed.

"This lake is cleaner now than it has been in 20 years," says Wil Hansen, president of Citzens For Big Stone Lake, a clean-up advocacy group.

An annual algae bloom used to plague Big Stone, a 25-mile long, shallow prairie lake that forms the border between Minnesota and northeast South Dakota. The bloom creates a thick, green, foul-smelling mat of algae on the water surface. Biologists say the bloom is caused by excesssive phosphorus in the water — phosphorus that comes largely from human and animal waste.

But today, parts of Big Stone are swimmable most of the summer, says Hansen, who lives on the lake. Some types of fishing also have improved dramatically. Big Stone Lake has hosted a national walleye fishing tournament the past three years. Lakeside property values are up substantially, too. The increased value is attributed largely to water quality improvements. And visits to Hartford Beach topped more than 72,000 in 1992, a record for the state park.

"It's a big turnaround," Hansen says.

This good news is a result of hard work and cooperation among farmers; townspeople; and federal, state and local governments, says Curt Hanssen, a Sisseton, S.D., farmer and the South Dakota coordinator of the Big Stone Lake Restoration Project.

Sisseton and Veblen, S.D., recently built new sewage systems that either dramatically reduce or eliminate discharge into the watershed's creeks and rivers.

Since 1985, more than 30 farmers in the Big Stone Lake Watershed have built animal waste handling systems through federal cost-sharing programs. Other landowners have built dams and dikes on their property to hold runoff on the Coteau Hills, which form the western edge of the watershed. Others have seeded alfalfa along river and creek borders to filter cropland runoff. Some have idled land through the Conservation Reserve Program and other preservation projects.

Harry Ziemer, Browns Valley, Minn., was one of the first farmers in the watershed to build an animal waste system on his farm. His farmstead is located on the banks of Big Stone Lake. With government cost-sharing and technical assistance, Ziemer built a dike at the bottom of the feedlot to divert runoff into evaporation and sediment settling ponds.

The system works as promised, and it hasn't complicated his manure handling chores. "It improved the feedlot and reduced runoff into the lake," Ziemer says.

Paul Hanson, a Sisseton dairy producer, built an ag waste handling system, too, even though his farm is 20 miles from Big Stone Lake. But the farm lies on a tributary of the Little Minnesota River, which eventually empties into the lake.

like Hanson's is a priority, because the Little Minnesota River flows through a heavy livestock producing area of the watershed and is the major contributor to Big Stone Lake pollution, says Kent Duerre, district conservationist in Roberts County for USDA's Natural Resources Conservation Service. "Once phosphorus in animal waste mixes with water somewhere in the watershed, it eventually ends up in Big Stone," he says.

In 1992, Hanson took advantage of a 75 percent government cost-sharing program and built a dike around the feedlot and installed an evaporation pond. Feedlot runoff is pumped into the pond where it eventually evaporates. "I'm happy with the system," he says. "It hasn't changed how I handle manure. Maintenance is minimal and it keeps my feedlot and barn runoff out of the river. Like most farmers around here, I hunt and fish. I want the water as clean as possible, too."

John Oetken, another Sisseton area farmer, had an eye on the future and the environment when he built a waste handling system for his beef cattle feedlot in 1994. The system drains feedlot runoff into an evaporation pond, preventing it from entering Cow Creek. The creek flows past the feedlot and eventually into the Little Minnesota River.

Not only will the waste system improve water quality now, but Oetken figures it will help him comply with future feedlot regulations. Strict environmental rules will eventually be the law of the land, even in farmer-friendly states like North and South Dakota. "I talked to a lot of people in the cattle industry and they all said the same thing — build a system now, while you can still get financial and technical help," he says.

Grain growers are also helping to clean up Big Stone Lake. Gordon and Dana Stapleton, near Sisseton, signed up to try no-till on land enrolled in the restoration program. [illegible] prevents soil from blowing into the ditches and creeks, thereby reducing the sediment load in watershed waterways, Duerre says.

The Stapletons enrolled land in the restoration project for several reasons. They support the watershed clean-up efforts and practice minimum tillage on much of their land. But they also are interested in potential no-till financial savings and yield benefits, especially in dry years. "The cost-sharing program will help us learn how no-till works," Gordon says.

Though much has been accomplished in the Big Stone Lake Restoration Project — one of the longest running projects in South Dakota — much more work remains, says Curt Hanssen, the co-coordinator. Officials recently applied for a $2-million federal grant to continue restoration efforts for 10 more years. Along with state and county funds, the money will be used to build more animal waste systems, expand no-till and minimum-till acres and implement other soil and water erosion management methods.

The goal is to cut the phosphorus load going into Big Stone Lake by another 40 percent. "Big Stone may never be pristine. Maybe it never was," Curt Hanssen says. "But we can make it a lot better."

(Above left) Gordon Stapleton is trying no-till to reduce fertilizer and soil runoff into streams that feed Big Stone Lake.

(Above right) Harry and Marlys Ziemer are pleased with an ag waste system built for their beef and hog feedlots.

(Right) John Oetken says the ag waste system he built for his beef cattle operation will reduce runoff now and help him comply with future feedlot regulations.