SD Department of Environment & Natural Resources
Watershed Protection Program
Total Maximum Daily Load

Lower Bad River Watershed and Upper Lake Sharpe, Portions of Jones & Stanley Counties, South Dakota
April, 2000

This TMDL was developed in accordance with Section 303(d) of the federal Clean Water Act and guidance developed by the US Environmental Protection Agency. The 1998 303(d) Waterbody List identified the Bad River as impaired by a measure of accumulated sediment in Lake Sharpe from the mouth of the Bad River past the point where Antelope Creek Flows into Lake Sharpe. The sediment occurring from the flow of the Bad River into Lake Sharpe also includes a measure of impairment with an impact to recreation by limiting boat, fishing use days, and water contact sports and impairs warm water marginal fish life propagation by reducing the fish spawning opportunities and success. A TMDL for sediment reduction has been developed and is supported below.

TMDL Summary Table:

Waterbody Name	**Bad River/Lake Sharpe**
Hydrologic Unit Code (HUC)	10140102
TMDL Pollutant	**Accumulated Sediment**
Water Quality Target	Revegetate 45% of the Type F & G channels (Rosgen's Stream Channel Classification) that are located is the subwatersheds of the Bad River in Jones, Stanley and portions of Haakon counties. Priority will be given to those areas of the subwatersheds with the greatest potential of sediment delivery.
TMDL Goal	Reduce sediment delivered annually by Bad River to Lake Sharpe by 30% by 2010.
303(d) Status	1998 303(d) Waterbody List, Priority 1, Page 19
Impaired Beneficial Uses	Warmwater marginal fish life propagation; limited contact recreation; wildlife propagation and stock watering; irrigation
Reference Documents	Lower Bad River Basin Study, Upper Bad River Basin Study, Phase I and IB of the Bad River Water Quality Project, Bad River Phase II Water Quality Final Report

I. Executive Summary:

- ***Waterbody Description and Impairments***

The Bad River drains 3,173 square miles from the area known as the Badlands between Wall and Kadoka, to the Missouri River/Lake Sharpe between Pierre and Fort Pierre, South Dakota. The Bad River annually delivers about 3.25 million tons of sediment to Lake Sharpe (U.S Army Corps of Engineers' (COE) 1986 data). The sediment load causes decreased fish spawning success, decreased fish growth and fishing use days, as well as, reductions in other water-based recreation in the Pierre-Fort Pierre area.

The sediment accumulation (sediment built up at a given point since Lake Sharpe was created) below the mouth of the Bad River is creating a higher water elevation in the Pierre-Fort Pierre portion of Lake Sharpe. The increased water elevation is causing flooding and high water tables in parts of both towns during high water releases from Oahe Dam. Oahe Dam is located about six miles upstream from the mouth of the Bad River. The flooding and related problems are increasing and occur whenever large discharges of water are released from the dam. These problems have been especially troublesome when ice cover occurs on Lake Sharpe during the winter months. The ice builds up, causing reduced flows downstream and raising the water level in the upper portion of Lake Sharpe. This results in the need for reduced discharge from Oahe Dam to alleviate the flooding and related high water problems. These problems occur during very cold weather which is a peak power requirement time for Oahe Dam. Estimated economic losses from reduced power generation and recreation impairment exceed $13 million annually.

The sediment load delivered (sediment carried by the waters of the Bad River into Lake Sharpe pool area) is primarily due to eroding gullies and streambanks in grazing lands, especially in the lower third of the watershed (Figure 1). This statement is supported by two studies completed by the United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS). The Lower Bad River River Basin Study was completed in March of 1994 and the Upper Bad River River Basin Study was finished in October of 1998. Both studies indicate that sediment occurs from several sources of erosion, which include cropland, gullies, stream banks, rangeland, and the Badlands area. Cropland located in the upper portions of the watershed is the second largest source of sediment. The cropland erosion is severe but most of the eroded soil is trapped and remains in the uplands. Runoff from this cropland increases when the residual cover is low and does have a significant effect on the gully and stream bank erosion in the lower portions of the watershed.

The Badlands area also provides sediment to Lake Sharpe. The Badlands exist in the uppermost part (western end) of the watershed. A study completed in 1989 using 319 funds from South Dakota Department of Environment and Natural Resources (DENR) and sponsored by the North Central Resource Conservation and Development (RC&D) Council, indicated that about 11 percent of the sediment delivered to Lake Sharpe from the upper portion of the watershed originates in the Badlands. The majority of the Badlands erosion is geologic.

The Bad River is an intermittent stream throughout most of the watershed. Water flow has been measured at the Fort Pierre site since 1929. There is only one year when flow was continuous for a year long period. The Bad River provides some limited warm water fishing, stock water and irrigation along the main channel and major tributaries. The sediment in the Bad River runoff negatively effects these uses during periods of high flow. However, this TMDL only addresses the sediment that is being delivered to Lake Sharpe.

- ***Stakeholder Description***

The Stanley County Conservation District in cooperation with the DENR was the sponsor for the Lower Bad River -River Basin Study (LBRRBS). Cooperative river basin studies are made under the authority of Section 6 of Public Law 83-566, as amended, (the Watershed Protection and Flood Prevention Act, and was funded through the USDA Soil Conservation Service (SCS), and Forest Service (FS). Table 1 lists the participants and stakeholders in the LBRRBS.

Table 1.
Lower Bad River Basin Study Stakeholders

USDA Soil Conservation Service	SD Dept. of Agriculture
USDA Forest Service	SD Dept. of Game, Fish, and Parks
SD Dept. of Environment and Nat. Resources	SD State University
Stanley Co. Conservation District	North Central RC&D Council
Jones Co. Conservation District	City of Pierre
Jackson Co. Conservation District	City of Fort Pierre
Haakon Co. Conservation District	Pierre Chamber of Commerce
American Creek Conservation District	SD Great Lakes Association
SCS Offices in Jones, Jackson, Haakon,	USDA Ag. Stab. and Conservation Service
Stanley & Lyman Counties	USDA Cooperative Extension Service
U.S. Army Corps of Engineers	U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency	U.S. Geological Service

The Upper Bad River-River Basin Study (UBRRBS) was sponsored by the Badlands Resource Conservation and Development (BRC&D) Area Council, Inc. and the conservation districts in East Pennington, Haakon, Jackson, Jones, Lyman, and

Stanley Counties. This cooperative river basin study used the same authority and funding as the LBRRBS however, the Soil Conservation Service was now renamed the Natural Resource Conservation Service. Table 2 lists the sponsors and participants in the UBRRBS.

Table 2.
Upper Bad River Basin Study Stakeholders

USDA Natural Resource Cons. Service USDA Forest Service SD Dept. of Env. and Nat. Resources SD Dept. of Agriculture, Division of Nat. Resources and Forestry Badlands RC&D North Central RC&D Cities of Fort Pierre, Kadoka, Midland, Murdo, Philip, Pierre, and Wall American Creek, East Pennington,	Haakon, Jackson, Jones, and Stanley Counties Conservation Districts SD Dept. of Game, Fish, and Parks SD Great Lakes Association South Dakota State University USDA Cooperative Extension Service USDA Farm Service Agency US Army Corps of Engineers US Environmental Protection Agency US Fish and Wildlife Service US Geological Service

- ***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 sediment accumulation total maximum daily load (TMDL) for the Lower Bad River \Lake Sharpe as provided in this summary and attached document. This TMDL has been established at a level necessary to protect assigned beneficial uses of Lake Sharpe with consideration of seasonal variation and a margin of safety. Beneficial uses that may benefit by the general improvement in water quality are: cold and warm water fishery, immersion recreation, wildlife propagation and stock watering, irrigation, commerce and industry.

II. Problem Characterization:

- ***Waterbody description/Maps***

The Bad River is the smallest of five major river basins in western South Dakota that drain into the Missouri River. It originates in the Badlands near Wall South Dakota and flows to the east approximately 100 miles where it then discharges into Lake Sharpe of the Missouri River System near the communities of Pierre and Fort Pierre. The Bad River watershed encompasses 3,173 square miles in Haakon, Jackson, Jones, Lyman, Pennington and Stanley Counties. The U.S. Army Corps of Engineers' gauge data from 1948 to 1986 estimates that the Bad River discharges an average annual sediment load of 3,250,000 tons of sediment delivered into Lake Sharpe.

Figure 1.

Waters Covered by TMDL

Lake Sharpe is the main benefactor of this TMDL. The principal sediment source for this problem area of Lake Sharpe is the Bad River Watershed drainage located in Jones and Stanley Counties. Antelope Creek and several other small watersheds between the Bad River and Antelope Creek also contribute sediment to the problem area in Lake Sharpe. Data has not been collected to establish the amount of sediment entering Lake Sharpe from Antelope Creek or the other small unnamed watersheds, but COE information indicates that this area is having a minor impact on sediment build up below the mouth of the Bad River. Existing projects have also targeted reduction of sediment inputs from these areas.

- ***Rationale for Geographic Coverage***

The Lower Bad River-River Basin Study was requested by the Stanley County Conservation District as the result of public concern about the adverse effects sediment deposition from the Bad River has on water quality, recreation, and fish and wildlife habitat in Lake Sharpe. The Bad River was on the priority list for Section 319 Nonpoint Source Pollution Control projects. DENR had provided funds to implement Phase I and IB of the Bad River Water Quality Project. This North Central RC&D Project, completed in 1989, monitored sediment along different reaches of the Bad River with the objective of identifying major sediment sources. Phase I and IB indicated that the lower portion of the Bad River was responsible for the majority of the sediment. One of the principal efforts of the LBRRBS was to identify and quantify areas needing treatment for sediment reduction. The LBRRBS found that approximately two thirds of the sediment that the Bad River delivered to Lake Sharpe originated in the lower one third of the watershed.

The Upper Bad River-River Basin Study (UBRRBS) was sponsored by the Badlands Resource Conservation and Development (BRC&D) Area Council, Inc. and the conservation districts in East Pennington, Haakon, Jackson, Jones, Lyman, and Stanley Counties. The Upper Bad River Basin Study further broke down the various subwatersheds into the different types of channels based on Rosgen's Stream Classification Method. This study accounted for the remaining tons of sediment that originate in the upper portion of the Bad River Watershed. The Upper Bad River Watershed contributed one third of the sediment to Lake Sharpe annually (34%). The study further estimated that about 63 percent of this sediment originates from geologic erosion.

- ***Pollutant(s) of Concern***

Sediments originating in the Bad River, Antelope Creek and several small tributaries lying between these two watersheds that is delivered to Lake Sharpe.

- ***Use Impairments or Threats***

Sediment has a negative effect on fishing and recreation use of Lake Sharpe. When the Bad River is running and discharging large sediment loads during the summer months, immersion recreation is severely impaired and use of the Lake from the mouth of the Bad River past Antelope Creek is almost non existent.

Fishing is even more impaired during high sediment discharges resulting from intense summer storms or early spring snowmelt. South Dakota Game, Fish, and Parks has conducted angler surveys each years since 1991 and estimate that the sport fishing value from the Bad River to DeGrey is somewhere between $1,087,000 to $2,556,000 annually. From these surveys they have determined that the average fishing pressure has been about 49,000 hours. If the sediment discharge were not a factor, the pressure for this reach of the Lake would be about 125,000 hours which more than double the sport fishing value of the area.

Sediment also affects the access to Lake Sharpe in the Pierre - Ft. Pierre area. Dredging has to be performed about every four years below Farm Island and LaFramboise Island to provide access for boats to the main channel of Lake Sharpe. Sediment reduction through this TMDL would provide beneficial results - more immersion recreation use days, more fishing days and a decrease in the required dredging for boat access - when the target is reached.

There are three factors that must be understood about the implementation of this TMDL:

1. ***There is no way to totally eliminate the production of sediment from the Bad River and the other tributaries that drain into Lake Sharpe. There will always be a sediment load delivered. Lake Sharpe has a finite amount of storage. At some point in time this reservoir will be filled with sediment. Implementation of this TMDL will increase the time it takes to fill Lake Sharpe and extend the duration of the reservoirs benefits.***

2. ***The impacts from the Bad River on beneficial uses will only be lessened when this TMDL is implemented. There will always be times during high discharge from the Bad River when the assigned beneficial uses of Lake Sharpe will not be met.***

3. ***The planned treatment to improve the vegetation in the riparian zones and adjacent upland is a part of a natural process based on improvement by vegetative and livestock management over time. This is not a quick fix. The 30 percent reduction in sediment delivery by 2010 is a goal. Weather, climate and other variables will influence achievement of this goal. There will be years when sediment delivery will still be high. Existing projects have already improved the vegetation is some of the eroding riparian zones Total average tons of sediment delivered to Lake Sharpe already appear to be lower, even though we have been through several years of higher than normal runoff.***

- *Probable Sources*

The river basin studies conducted by NRCS indicate that the River Breaks landform is the principal contributor of sediment from the Bad River Watershed with gully and channel erosion the major problem. The Upper Bad River Basin Study further indicates that the Rosgen classification can be used to estimate sediment delivery from the various types of stream channels. Type F & G channels appear to provide significant sediment throughout the watershed. Type B & C channels also can provide considerable sediment and should be considered especially when the health of the riparian area is functioning at risk or degraded to a non-functioning condition.

Gully and streambank erosion should be the principal focus of correction in an effort to reduce sediment delivery to Lake Sharpe. Those areas with the greatest potential to deliver sediment to the main Bad River channel will be considered as areas of priority for treatment. The Breaks landform contains the major amount of gully and streambank erosion areas. The most serious condition to deliver sediment to the Bad River occurs where the riparian zone has degraded starting at the Bad River channel and remains unvegetated or in a nonfunctioning condition up through the subwatershed. In some cases the gullies may continue into the Upland landform. Revegetation of these areas must be accomplished to significantly reduce the sediment delivery. The area of effort will be in those watersheds that enter the Bad River in Jones and Stanley Counties.

Revegetation of the degraded riparian zones will require a variety of applied conservation practices. Resource management systems must be implemented that address all the factors that are causing the degradation of the riparian zones. Some of the common practices that will be implemented to achieve the resource management systems will include; grazing management systems, fencing, livestock water, wind breaks, pipelines, tanks, livestock crossings, tree planting, grass seeding, grade stabilization structures and furrowing.

III. TMDL Endpoint:

- ***Description***

The TMDL endpoint will be based on the annual tons of sediment delivered at the Ft. Pierre gauging station. The goal is a 30% reduction of the 3.25 million tons of sediment delivered annually, based on Corps of Engineers data, by 2010. Although treatment will be applied in the Antelope Creek Watershed, there will not be any effort to gauge the sediment load of this area. Progress in this area will be documented through photo points over time. Trend for sediment delivered at the mouth of the Bad River will be computed on a 10 year running average in order to eliminate the possible problems created by a spike in yield per acre foot because of an abnormal year.

- ***Endpoint Link to Surface Water Quality Standards***

A measurable improvement in fishing and recreation use days may not be achievable for many years. When large runoff events occur from the Bad River Watershed, the clarity and turbidity of the Bad River entering Lake Sharpe will still cause a loss of fishing and recreation use. The biggest benefit will be to runoff from lesser storm events. Bad River clarity is influenced by colloidal matter and any flow tends to cause discoloration in Lake Sharpe. This plume is usually held to the south and west shore of the Lake and doesn't significantly affect use until the flow becomes large enough to encompass the entire Lake surface in the Pierre - Ft. Pierre section.

With a 30 percent reduction in sediment, the times that the access lanes to the main channel of Lake Sharpe have to be dredged will decrease. This will be a great improvement from both the user attitude (dredging stops access) and economic factors (costs to remove the sediment).

There is a possibility that a significant decrease in sediment delivery could lower the amount of sediment to an equilibrium state where the discharges from Lake Oahe would transport the Bad River sediment far enough down into Lake Sharpe that the deposition would not be a problem. The Corps is conducting a study to determine what amount of sediment can be transported annually in this method but has not developed any firm figures to date.

IV. TMDL Analysis and Development:

- ***Data Sources***

DENR Ambient Water Quality Monitoring Data.
United States Geological Survey runoff and sediment data from the Fr. Pierre gauging station.
United States Corps of Engineers sediment data.
North Central Resource Conservation and Development Phase I & II Bad River Sediment Monitoring Study.
USDA NRCS Lower Bad River River Basin Study.
USDA NRCS Upper Bad River River Basin Study.
Stanley County Conservation District Phase II (Plum Creek) Demonstration Project.
Stanley County Conservation District Lower Bad River Implementation Project Phase III.
SDGF&P Creel and Angler Surveys 1991 to 1996.
SDDENR Bad River National Monitoring Study.

- ***Analysis Techniques or Models***

The Lower and Upper Bad River Basin Studies used the Universal Soil Loss Equation (USLE), Pacific Southwest Interagency Committee (PSIAC) sediment yield method, Ephemeral Gully Erosion Model (EGEM), the Direct Volume Method and direct measurements to determine the sediment yield to Lake Sharpe from the study areas.

The Upper Bad River Basin Study divided the Bad River Watershed into six representative subwatershed areas based on similar landform features, soil associations, land use, and management history. Then in each representative area a smaller subwatershed was selected in which to inventory field data and classify channels. The classified channels incorporated the Rosgen Stream Classification System of stream typing and Schumm's Channel Evolution Model to evaluate each of these methods as a tool for watershed planning and evaluation of watershed health. These two methods have different base criteria so it is impossible to compare the data determined. The Rosgen system appears to provide the better material for determining sediment yield. Both methods provide good data to evaluate the health of the riparian zones.

Erosion rates were assigned to the types of channels in the inventoried watersheds and extrapolated to the whole Bad River Watershed. Gross erosion rates from the different sources within the study area were multiplied by an estimated sediment delivery ratio to calculate sediment loading.

- ***Seasonality***

Runoff data measured at FT. Pierre by USGS indicates that the major sediment yields may be delivered anytime of the year with the period from late February through the middle of July the most likely period of high sediment discharges. This gauging station has been in existence since 1929 and present conditions indicate it will continue to operate well into the future. Runoff and sediment yield will continue to be monitored on a daily basis with annual sediment delivered being a significant factor.

- ***Margin of Safety***

The Forest Service has been in the process of changing the management for grazing of the Fort Pierre and the Buffalo Gap National Grasslands the last three or four years. The new plans are more effective because an effort has been completed to join together the grazing unit for each permitee by implementing land trades and changing the location of their permits. All the new plans implemented a grazing management system on each individual unit. This is a significant improvement as these units were managed for season long grazing in prior years. The Forest Service personnel indicate that they are already seeing improved health and vigor in the vegetative cover and an increase in the woody and herbaceous vegetation in the riparian zones of the public lands. This will provide a decrease in overall water yield from this portion of the watershed.

Treatment will continue to be planned and applied in the Antelope Creek area. This effort will result in additional sediment reduction to Lake Sharpe.

The National Park Service has developed a plan for the Badlands National Monument which address the resources in the Park area. This effort will have positive effects on reducing runoff for the vegetated areas of the Park and will provide positive benefits to sediment reduction to that portion of the Bad River Watershed that receives runoff from the Monument area.

Western South Dakota has shown a continued interest in developing grazing systems. This is true in the Bad River Watershed and it is anticipated that the interest will continue. Grazing systems result in better vegetative cover that improves infiltration and reduces runoff which has a positive effect on reducing erosion and sediment delivery. These additional practices have not been considered as a part of the TMDL.

V. Allocation of TMDL Loads or Responsibilities:

- ***Wasteload Allocation***

There are no significant point sources of sediment in this watershed, therefore the "wasteload allocation" component of the TMDL is considered a zero value. The TMDL is considered wholly included in the "load allocation" component of the TMDL.

- ***Load Allocation***

The TMDL target is a 30% reduction in tons of sediment delivered annually to Lake Sharpe based on sediment measured at the USGS Bad River gage above Fort Pierre. Improving the water quality in the Bad River watershed involves implementing Best Management Practices (BMP's) to revegetate Type F & G channels in the watersheds of the Bad River, Antelope Creek and small drainages that lie between to reduce sediment delivered to Lake Sharpe. These BMP's will reestablish woody and herbaceous vegetation in the non-functioning riparian areas, maintain the health and vigor of functioning riparian areas, increase the health and vigor of herbaceous vegetation in the breaks landform and encourage revegetation of gullied areas, improve vegetative cover of the native rangeland and encourage reduced tillage with improved residue management of cropland residue in the upland landform. The BMP's in the breaks landform will reduce erosion and improve water infiltration into the soil profile while the BMP's in the upland will be mainly an effort to improve water infiltration and reduce total runoff yield per storm event. The BMP's will be implemented using whole unit planning as much as possible.

- ***Allocation of Responsibility***

The Lower Bad River Basin Study used the Pacific Southwest Interagency Committee (PSIAC) sediment yield method to determine the sediment yield to Lake Sharpe from the Lower Bad River Area. The Study broke the watershed into three separate landforms which were:

Bad River Flats - the Bad River and adjacent floodplain.
River Breaks - a steep to excessively steep rangeland area positioned below the Tablelands and above the Bad River valley floor.
Tablelands - the upper portions of the lower watershed generally above elevation 1950 feet with level to sloping (0 to 15 percent) land area.

The area of the study was 792,000 acres, (flats 22,000 acres, breaks 200,000 acres, and tablelands 570,000 acres). The study used COE sediment data which was estimated at 3.25 million ton delivered annually to Lake Sharpe. The PSIAC sediment yield model computed sediment yield delivered to Lake Sharpe from the flats 28,600 tons, breaks 1,800,000 tons, and tablelands 239,400 tons. A sediment yield from the Bad River channel was also figured at 62,000 tons. So the lower one third of the Bad River Watershed generated 2,130, 000 tons of sediment to Lake Sharpe annually (66 percent). The breaks delivered 85% of the sediment from the lower area.

The Upper Bad River River Basin Study further broke down the various subwatersheds into the different types of channels based on Rosgen's Stream Classification Method. This study accounted for the remaining tons of sediment that originate in the upper portion of the Bad River Watershed. Again the Study broke the area into four separate landforms which were:

> Valley - the Bad River and adjacent floodplain.
> River Breaks - a steep to excessively steep rangeland area positioned below the Tablelands and above the Bad River valley floor.
> Uplands - the upper portions of the watershed generally above elevation 2000 feet with level to sloping (0 to 15 percent) land area.
> Badlands - located at the upper end of the watershed in gently rolling to vertical slopes. The vertical slopes are usually not vegetated.

The area of study was 1,236,720 acres (valley 60,200 acres, breaks 399,374 acres, uplands 657,146 acres, and badlands 122,000 acres). The PSIAC models computed annual sediment yield delivered to Lake Sharpe from the valley 2,408 tons, breaks 328,592 tons, uplands 492,730 tons and badlands 134,731 tons. Sediment yield from the upper bad River Channel was computed at 69,00 tons. So the upper Bad River Watershed contributed 1,182,060 tons of sediment to Lake Sharpe annually (34%). The Study further estimated that about 63 percent of this sediment originates from geologic erosion.

The study then expanded the data to determine the numbers of each type of channel in the upper and lower portions of the Bad River Watershed. Table 3 displays the findings from this study.

Table 3.
Channel Sediment Yield

The major amount of sediment comes from the Type F & G classified channels in the Breaks landform and the Type F & G classified channels in the Upland landform of the Lower Bad River Watershed. These channel types account for 55 percent of the sediment originating from all the channel types in the entire watershed. Economics indicates that this would be the area that should receive the major effort to reduce the sediment delivery.

VI. Schedule of Implementation:

DENR has been working with two groups of sponsors on different projects in the Bad River watershed. Stanley County Conservation District has been involved with implementation of sediment reducing projects in the lower portion of the Bad River since 1989. Projects include:

1. ***Phase I and IA Bad River Water Quality Project which mainly tried to determine the sources of sediment in the Bad River watershed. Completed in 1990.***
2. ***Bad River Phase II Water Quality Project which was an effort to see if the landowners would participate in a water quality project and if so what practices and management systems would they accept. This project proved that we could achieve a significant reduction in sediment delivery. The project was a learning process for all involved and led to the determination by project end that the emphasis needed to be applied to revegetation of non functioning riparian zones to get the most reduction in sediment delivery. Completed in 1996.***
3. ***Bad River Phase III Water Quality Project which targeted that portion of the Bad River watershed below War Creek and the Antelope Creek area with increased emphasis on riparian management. This project was expanded to include the entire lower Bad River area in Stanley County. Project still in progress.***

The Upper Bad River Demonstration Project with sponsors from Lyman, Jones, Jackson, Haakon, and East Pennington Conservation Districts has been in existence since 1995. This project also included portions of the White River and Cheyenne River watersheds that were contained in these conservation districts. The project was set up to implement grazing and cropland residue management practices as demonstrations of resource management systems that could be installed to reduce downstream sediment delivery. The Demonstration project is scheduled for completion in February of 2000.

Both groups are awaiting the completion of the TMDL target and goal to determine what implementation actions should be developed. Cooperation of landowners within the Bad River Watershed has been good. The implementation plan will be developed as soon as the TMDL is approved. The data in Table 10 and the Land Treatment Alternatives Table from the Upper Bad RiverBasin Study will be used to plan and guide implementation efforts.

VII. Post-Implementation Monitoring:

The Bad River National Monitoring Plan is already in operation and monitoring of the paired watersheds will provide a lot of data to measure effectiveness of installed resource management systems - BMP's. Photo points will also be established to determine effectiveness of efforts to improve riparian health and upland vegetation cover.

VIII. Public Participation:

- ***Summary of Public Review***

Four stakeholder meetings were held to discuss available data on the Bad River and TMDL requirements. Meetings were held in Pierre, Murdo and Midland. People attending included state and federal agency representatives, city, county and conservation district people.

- ***Project Information and Education Efforts***

Public Meetings/ Personal Contact	***Articles/ Fact Sheets***	***Document Distribution***
Electronic media	***Mailings***	***Public Comments Received***

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

SP/TT/DT/Lonnie/Joan

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
999 18TH STREET - SUITE 300
DENVER, CO 80202-2466
http://www.epa.gov/region08

February 7, 2001

Ref: 8EPR-EP

Steven M. Pirner, Secretary
Department of Environment & Natural Resources
Joe Foss Building
523 East Capitol
Pierre, SD 57501-3181

Re: TMDL Approvals
Blue Dog Lake
Clear Lake
Freeman Lake
Punished Woman Lake
Upper Lake Sharpe

Dear Mr. Pirner:

We have completed our review of the total maximum daily loads (TMDLs) as submitted by your office for the waterbodies listed in the enclosure to this letter. In accordance with the Clean Water Act (33 U.S.C. 1251 *et. seq.*), we approve all aspects of the TMDLs as developed for the water quality limited waterbodies as described in Section 303(d)(1).

Based on our review, we feel the separate TMDL elements listed in the enclosed review table adequately address the pollutants of concern, taking into consideration seasonal variation and a margin of safety. Please find enclosed a detailed review of these TMDLs.

For years, the State has sponsored an extensive clean lakes program. Through the lakes assessment and monitoring efforts associated with this program, priority waterbodies have been identified for cleanup. It is reasonable that these same priority waters have been a focus of the Section 319 nonpoint source projects as well as one of the priorities under the State's Section 303(d) TMDL efforts.

In the course of developing TMDLs for impaired waters, EPA has recognized that not all impairments are linked to water chemistry alone. Rather, EPA recognizes that *"Section 303(d) requires the States to identify all impaired waters regardless of whether the impairment is due to toxic pollutants, other chemical, heat, habitat, or other problems."* (see 57 Fed. Reg. 33040 for July 24, 1992). Further, EPA states that "*...in some situations water quality standards – particulary designated uses and biocriteria – can only be attained if nonchemical factors such as* *hydrology, channel morphology, and habitat are also addressed. EPA recognizes that it is appropriate to use the TMDL process to establish control measures for quantifiable non-chemical parameters that are preventing the attainment of water quality standards.*" (see Guidance for Water Quality-based Decisions: The TMDL Process; USEPA; EPA 440/4-91-001, April 1991; pg. 4). We feel the State has developed TMDLs that are consistent with this guidance, taking a comprehensive view of the sources and causes of water quality impairment within each of the watersheds. For example, in several of the TMDLs, the State considered nonchemical factors such as lake depth and its relationship to the impaired uses. Further, we feel it is reasonable to use factors such as lake depth as surrogates to express the final endpoint of the TMDL.

Thank you for your submittal. If you have any questions concerning this approval, feel free to contact Vernon Berry of my staff at 303/312-6234.

Sincerely,

Jerry Anderson for

Max H. Dodson
Assistant Regional Administrator
Office of Ecosystems Protection and
Remediation

Enclosure

APPROVED TMDLS

Waterbody Name*	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	Section 303(d)1 or 303(d)3 TMDL	Supporting Documentation (not an exhaustive list of supporting documents)
Blue Dog Lake*	phosphorus	TSI ≤ 65	30% reduction in phosphorus loads	Section 303(d)(1)	■ Phase I Watershed Assessment Final Report, Blue Dog Lake, Day County, South Dakota (SD DENR, Sept. 1999) ■ Report on the Activities and Expenditures of the Blue Dog / Enemy Swim Lake Watershed Assessment Study (Day Conservation District, January 1999)
Clear Lake*	phosphorus	TSI ≤ 61	20% reduction in average annual tributary phosphorus loads	Section 303(d)(1)	■ Phase I Watershed Assessment Final Report, Clear Lake, Deuel County, South Dakota (SD DENR, June 1999)
	sediment	Increase average lake depth by 4 feet over 116 surface area acres	Remove 750,000 cubic yards of lake sediment	Section 303(d)(1)	
Freeman Lake*	nitrate	nitrate - 50 mg/L as a 30 day average nitrate - 88 mg/L as a daily maximum	reduce nitrate delivery to the lake by 33,000 Kg/year	Section 303(d)(1)	■ Water Quality Sample Results (SD DENR, 1979-1999) ■ Freeman Lake Watershed AGNPS Study Results ■ Saline-Seep Diagnosis, Control and Reclamation (USDA, Conservation Research Report No. 30, May, 1983)
	selenium	selenium - 5 μg/L as a 30 day average selenium - 20 μg/L as a daily maximum	reduce selenium delivery to the lake by 152.6 Kg/year	Section 303(d)(1)	

Waterbody Name*	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	Section 303(d)1 or 303(d)3 TMDL	Supporting Documentation (not an exhaustive list of supporting documents)
Punished Woman Lake*	sediment	Increase average lake depth in mid-lake area to 12 - 15 feet	■ 50% reduction of in-lake sediment ■ Remove 421,000 cubic yards of lake sediment	Section 303(d)(1)	■ 1993 South Dakota Lakes Assessment Final Report (SD DENR, March 1994) ■ Punished Woman's Lake Diagnostic / Reasibility Study Report (SD DWNR, April 1991) ■ South Dakota Lakes Classification and Inventory Final Report (SD DWNR, 1981) ■ Classification, Preservation, Resoration of lakes in Northeastern South Dakota (State Lakes Preservation Committee, 1977)
	nutrients	50% reduction of pondweed, cattail, and bulrush 15% reduction of in-lake sediment	Remove 421,000 cubic yards of lake sediment	Section 303(d)(1)	
Upper Lake Sharpe*	sediment	re-vegetate 45% of stream channel types F and G (Rosgen's Stream Channel Classification)	30% reduction of annual sediment delivery to Lake Sharpe by the year 2010	Section 303(d)(1)	■ Lower Bad River Basin Study Final Report (USDA, NRCS, revised June 1994) ■ Upper Bad River Basin Study (USDA, NRCS, October 1998) ■ Bad River Phase II Water Quality Project Final Report (Stanley County Conservation District, 1996) ■ Report on Factors Affecting Sediment Yield in the Pacific Southwest Area and Selection and Evaluation of Measures for Reduction of Erosion and Sediment Yield (Pacific Southwest Inter-Agency Committee, October 1968)

* An asterisk indicates the waterbody has been included on the State's Section 303(d) list of waterbodies in need of TMDLs.

■ TMDL Checklist ■

EPA Region VIII

State/Tribe: South Dakota
Waterbody Name: Blue Dog Lake, Day County
Point Source-control TMDL: Nonpoint Source-control TMDL: X (check one or both)
Date Received: December 12, 2000 Date Review completed: January 10, 2001 VEB

Review Criteria (All criteria must be met for approval)	Approved (check if yes)	Comments
■ **TMDLs result in maintaining and attaining water quality standards**	X	The waterbody classification uses which are addressed by this TMDL are warmwater marginal fish life propagation, immersion recreation, and limited contact recreation.
■ **Water Quality Standards Target**	X	Water quality targets were established based on trophic status. This is a reasonable approach because the trophic status of the waterbody relates to the uses of concern.
■ **TMDL**	X	The TMDL is expressed in terms of annual phosphorus load reduction. This is a reasonable way to express the TMDL for this lake because it provides an effective surrogate that reflects both aquatic life and recreational needs, and reflects the long response time of lakes of this type to pollutant controls within the watershed.
■ **Significant Sources Identified**	X	Significant sources were adequately identified in a categorical and/or individual source-by-source basis. All sources that need to be addressed through controls were identified.
■ **Technical Analysis**	X	Monitoring, empirical relationships, AGNPS modeling, and best professional judgement were used in identifying pollutant sources, and in identifying acceptable levels of pollutant control. This level of technical analysis is reasonable and appropriate because of the character of the pollutants, the type of land use practices, and the waterbody type.
■ **Margin of Safety and Seasonality**	X	An appropriate margin of safety is included by performing ongoing monitoring to assure water quality goals are achieved and by application of additional nonpoint source BMPs for croplands within the watershed. Seasonality was adequately considered by evaluating the cumulative impacts of the various seasons on water quality and by tailoring the BMPs to seasonal needs.
■ **Allocation**	X	The allocation for the TMDL was a "load allocation" attributed to nonpoint sources. Allocation was attributed to such sources as animal feeding areas and croplands.
■ **Public Review**	X	Public review and participation was conducted through meetings, electronic media, and mailings. The extent of public review is acceptable. Further, the review process sponsored by the State was adequate for purposes of developing a TMDL that will be implemented because of public acceptance.
■ **EPA approved Water Quality Standards**	X	Standards upon which this TMDL was based have been formally approved by the EPA. No tribal waters were involved in this TMDL.

■ TMDL Checklist ■

EPA Region VIII

State/Tribe: South Dakota
Waterbody Name: Clear Lake, Deuel County
Point Source-control TMDL: Nonpoint Source-control TMDL: X (check one or both)
Date Received: December 12, 2000 Date Review completed: January 10, 2001 VEB

Review Criteria (All criteria must be met for approval)	Approved (check if yes)	Comments
■ **TMDLs result in maintaining and attaining water quality standards**	X	The waterbody classification uses which are addressed by this TMDL are warmwater marginal fish life propagation, immersion recreation, and limited contact recreation.
■ **Water Quality Standards Target**	X	Water quality targets were established based on trophic status and lake depth. This is a reasonable approach since it relates to the trophic status of the waterbody as well as the physical nature of the lake, which in turn, relate to the uses of concern.
■ **TMDL**	X	The TMDL is expressed in terms of annual phosphorus load reduction and removal of lake sediment. This is a reasonable way to express the TMDL for this lake because it provides an effective surrogate that reflects both aquatic life and recreational needs.
■ **Significant Sources Identified**	X	Significant sources were adequately identified in a categorical and/or individual source-by-source basis. All sources that need to be addressed through controls were identified (including the removal of lake bottom sediments, if needed).
■ **Technical Analysis**	X	Monitoring, empirical relationships, AGNPS modeling, and best professional judgement were used in identifying pollutant sources, and in identifying acceptable levels of pollutant control. This level of technical analysis is reasonable and appropriate because of the character of the pollutants, the type of land use practices, and the waterbody type.
■ **Margin of Safety and Seasonality**	X	An appropriate margin of safety is included by augmenting the watershed land use controls with in-lake dredging, and urban BMPs for lawn fertilization. The in-lake dredging will further reduce the amount of available nutrients into the lake because of increased depth and provide further aquatic life habitat. Seasonality was adequately considered by evaluating the cumulative impacts of the various seasons on water quality and by tailoring the BMPs to seasonal needs.
■ **Allocation**	X	The allocation for the TMDL was a "load allocation" attributed to nonpoint sources. Allocation was attributed to such sources as animal feeding areas and croplands.
■ **Public Review**	X	Public review and participation was conducted through meetings, electronic media, and mailings. The extent of public review is acceptable. Further, the review process sponsored by the State was adequate for purposes of developing a TMDL that will be implemented because of public acceptance.
■ **EPA approved Water Quality Standards**	X	Standards upon which this TMDL was based have been formally approved by the EPA. No tribal waters were involved in this TMDL.

■ TMDL Checklist ■
EPA Region VIII

State/Tribe: South Dakota
Waterbody Name: Freeman Lake, Jackson County
Point Source-control TMDL: Nonpoint Source-control TMDL: X (check one or both)
Date Received: January 16, 2001 Date Review completed: January 30, 2001 VEB

Review Criteria (All criteria must be met for approval)	Approved (check if yes)	Comments
■ **TMDLs result in maintaining and attaining water quality standards**	X	The waterbody classification uses which are addressed by this TMDL are warmwater permanent fish life propagation, immersion recreation, limited contact recreation, and criteria for fish and wildlife propagation, recreation and stock watering.
■ **Water Quality Standards Target**	X	The 30-day average and daily maximum numeric standards for nitrate and selenium were used as quantified endpoints.
■ **TMDL**	X	The TMDLs are expressed in terms of annual nitrate load reduction, and annual selenium load reduction. These are reasonable ways to express the TMDLs for this lake because they provide effective surrogates that reflect both aquatic life and recreational needs, and reflect the long response time of lakes of this type to pollutant controls within the watershed.
■ **Significant Sources Identified**	X	Significant sources were adequately identified in a categorical and/or individual source-by-source basis. All sources that need to be addressed through controls were identified.
■ **Technical Analysis**	X	Monitoring, empirical relationships, AGNPS modeling, and best professional judgement were used in identifying pollutant sources, and in identifying acceptable levels of pollutant control. This level of technical analysis is reasonable and appropriate because of the character of the pollutants, the type of land use practices, and the waterbody type.
■ **Margin of Safety and Seasonality**	X	An appropriate margin of safety is included by performing ongoing monitoring to assure water quality goals are achieved and possibly by application of additional nonpoint source BMPs. Seasonality was adequately considered by evaluating the cumulative impacts of the various seasons on water quality and by tailoring the BMPs to seasonal needs.
■ **Allocation**	X	The allocation for the TMDL was a "load allocation" attributed to nonpoint sources. Allocation was attributed to saline seeps which are compounded by factors such as fallow croplands and poor surface drainage.
■ **Public Review**	X	Public review and participation was conducted through meetings, electronic media, and mailings. The extent of public review is acceptable. Further, the review process sponsored by the State was adequate for purposes of developing a TMDL that will be implemented because of public acceptance.
■ **EPA approved Water Quality Standards**	X	Standards upon which this TMDL was based have been formally approved by the EPA. No tribal waters were involved in this TMDL.

■ TMDL Checklist ■

EPA Region VIII

State/Tribe: South Dakota
Waterbody Name: Punished Woman Lake, Codington County
Point Source-control TMDL: Nonpoint Source-control TMDL: X (check one or both)
Date Received: December 12, 2000 Date Review completed: January 10, 2001 VEB

Review Criteria (All criteria must be met for approval)	**Approved** (check if yes)	**Comments**
■ **TMDLs result in maintaining and attaining water quality standards**	X	The waterbody classification uses which are addressed by this TMDL are warmwater semi-permanent fish life propagation, immersion recreation, and limited contact recreation.
■ **Water Quality Standards Target**	X	Water quality targets were established based on lake depth and reduction of in-lake aquatic vegetation and sediment. These are reasonable targets because they relate to the impaired uses of concern.
■ **TMDL**	X	The TMDL is expressed in terms sediment load reduction and removal of lake sediment. Lake depth is a particularly important factor related to both the recreational use and fisheries use of the lake.
■ **Significant Sources Identified**	X	Significant sources were adequately identified in a categorical and/or individual source-by-source basis. All sources that need to be addressed through controls were identified.
■ **Technical Analysis**	X	Monitoring, empirical relationships, AGNPS modeling, and best professional judgement were used in identifying pollutant sources, and in identifying acceptable levels of pollutant control. This level of technical analysis is reasonable and appropriate because of the character of the pollutants, the type of land use practices, and the waterbody type.
■ **Margin of Safety and Seasonality**	X	An appropriate margin of safety is included by performing ongoing monitoring to assure water quality goals are achieved and possibly by application of additional nonpoint source BMPs. Seasonality was adequately considered by evaluating the cumulative impacts of the various seasons on water quality and by tailoring the BMPs to seasonal needs.
■ **Allocation**	X	The allocation for the TMDL was a "load allocation" attributed to nonpoint sources. Allocation was attributed to such sources as shoreline erosion and bank sloughing.
■ **Public Review**	X	Public review and participation was conducted through meetings, electronic media, and mailings. The extent of public review is acceptable. Further, the review process sponsored by the State was adequate for purposes of developing a TMDL that will be implemented because of public acceptance.
■ **EPA approved Water Quality Standards**	X	Standards upon which this TMDL was based have been formally approved by the EPA. No tribal waters were involved in this TMDL.

■ TMDL Checklist ■

EPA Region VIII

State/Tribe: South Dakota
Waterbody Name: Upper Lake Sharpe, Jones & Stanley Counties
Point Source-control TMDL: Nonpoint Source-control TMDL: X (check one or both)
Date Received: December 12, 2000 Date Review completed: January 10, 2001 VEB

Review Criteria (All criteria must be met for approval)	Approved (check if yes)	Comments
■ **TMDLs result in maintaining and attaining water quality standards**	X	The waterbody classification uses which are addressed by this TMDL are coldwater permanent fish life propagation, immersion recreation, and limited contact recreation.
■ **Water Quality Standards Target**	X	Water quality targets were established based on re-vegetation of Bad River channels (i.e., F & G types according to Rosgen's Stream Channel Classification) flowing into the lake. This is a reasonable approach because the majority of sediment delivered to the lake originates in the Bad River watershed. This target relates to the uses of concern in the lake.
■ **TMDL**	X	The TMDL is expressed in terms of annual sediment load reduction. This is a reasonable way to express the TMDL for this lake because the measure reflects both aquatic life and recreational needs and reflects the long response time of lakes of this type to pollutant controls within the watershed.
■ **Significant Sources Identified**	X	Significant sources were adequately identified in a categorical and/or individual source-by-source basis. All sources that need to be addressed through controls were identified.
■ **Technical Analysis**	X	Monitoring, empirical relationships, modeling (e.g., PSIAC, USLE, EGEM), and best professional judgement were used in identifying pollutant sources, and in identifying acceptable levels of pollutant control. This level of technical analysis is reasonable and appropriate because of the character of the pollutants, the type of land use practices, and the waterbody type.
■ **Margin of Safety and Seasonality**	X	An appropriate margin of safety is included by performing ongoing monitoring to assure water quality goals are achieved and by application of additional nonpoint source BMPs (e.g., improved grazing management) within the Bad River and Antelope Creek watersheds. Seasonality was adequately considered by evaluating the cumulative impacts of the various seasons on water quality and by tailoring the BMPs to seasonal needs.
■ **Allocation**	X	The allocation for the TMDL was a "load allocation" attributed to nonpoint sources. Allocation was attributed to such sources as gully and channel erosion from poor landuse management practices (e.g., grazing).
■ **Public Review**	X	Public review and participation was conducted through meetings, electronic media, and mailings. The extent of public review is acceptable. Further, the review process sponsored by the State was adequate for purposes of developing a TMDL that will be implemented because of public acceptance.
■ **EPA approved Water Quality Standards**	X	Standards upon which this TMDL was based have been formally approved by the EPA. No tribal waters were involved in this TMDL.