SECTION 319 NONPOINT SOURCE POLLUTION CONTROL PROGRAM WATERSHED PROJECT FINAL REPORT

CENTRAL BIG SIOUX RIVER WATERSHED PROJECT – Segment 1

By

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This project was conducted in cooperation with the State of South Dakota and the United States Environmental Protection Agency, Region 8.

Grant Numbers: 9998185-00, 9998185-01, 99981185-02, 9998185-03, 9998185-04, 9998185-05, 9998185-06

EXECUTIVE SUMMARY

PROJECT TITLE: CENTRAL BIG SIOUX RIVER WATERSHED PROJECT – Segment 1

Grant Numbers: 9998185-00, 9998185-01, 99981185-02, 9998185-03, 9998185-04, 9998185-05, 9998185-06

PROJECT START DATE:		August 12, 2005
PROJECT COMPLETION DATE:		September 30, 2010
FUNDING: TOTAL BUDGET		$7,032,725.90
TOTAL EPA GRANT 2005 (ORIGINAL)	825,000.00	
TOTAL EPA GRANT 2000	178,200.23	
TOTAL EPA GRANT 2001	33,365.48	
TOTAL EPA GRANT 2002	185,464.93	
TOTAL EPA GRANT 2003	20,694.48	
TOTAL EPA GRANT 2004	176,848.28	
TOTAL EPA GRANT 2006	296,100.00	
TOTAL 319 EXPENDITURES		$1,715,673.40
EPA 319 Grant	$1,705,751.82	
East Dakota Water Development District	294,473.83	
Land Owner Match	517,340.98	
South Dakota Conservation Districts	5,405.97	
Conservation Commission	142.50	
Sioux Falls State Revolving Funds	3,139,371.91	
Total Match		$3,956,735.19
Other Federal		$54,013.00
TOTAL EXPENDITURES		$5,716,500.01

The goal of the Central Big Sioux Watershed Project was:

Restore and protect the beneficial uses of the portion of the Big Sioux River and its tributaries (in South Dakota) between the communities of Watertown and Brandon by implementing and promoting best management practices (BMPs) in the watershed that reduce sediment loading and prevent bacterial contamination.

The work was completed in several areas to include renovation and improvement of existing high-priority animal feeding operations; reduction of livestock access to water bodies; stabilizing banks along critical reaches of Skunk Creek and the Big Sioux River and the restoration of riparian areas. To assist in the effort there was an information and education components and water monitor activities. In the following table is a summary of project accomplishments.

SUMMARY ACCOMPLICHMENTS*

BMP	Unit	Total Expected	Total Implemented
Ag Waste System	AWMSs engineering designs and plans	14	16
Ag Waste System	Constructed AWMS	12	12
Bank Stabilization	Big Sioux Bank Stabilization - LF	1,500	15,400
Bank Stabilization	Skunk Creek Bank Stabilization-LF	10,000	10,000
Grazing Management	Alternative Water sources-Each	10	4
Grazing Management	Rock Crossings -Each	7	4
Information & Education	Field tours of project activities	9	2
Information & Education	Informational meetings and workshops	14	8
Information & Education	Public service announcements	7	8
Information & Education	Quarterly news releases	14	7
Riparian Restoration	Acres enrolled in CRP	150	230.25
Riparian Restoration	rural riparian easements-acres	500	561.52
Riparian Restoration	urban riparian easements-acres	13.1	0
Water Quality Monitoring	QA/QC Samples -each	90	121
Water Quality Monitoring	Water Quality Samples	798	966

*As shown on the Best Management Practices Tracker system.

Annual load reductions achieved due to the installation of the Best Management Practices.

BMP	Nitrogen Lbs/Yr	Phosphorus Lbs/Yr	TSS Tons/Yr
Ag Waste System	121,337	26,968	224
Bank Stabilization – Skunk Creek	190	73	119
Bank Stabilization – Big Sioux River	40,028	15,411	28,146
Riparian Area Management	23,519	5,782	1,032
Conservation Easement	13,169	3,149	1,799
TOTAL	198,242	51,383	31,320

The watershed project achieved most of its goals for BMPs installed but was unsuccessful in achieving the desired load reduction for the segments of the Big Sioux River.

TABLE OF CONTENTS

PAGE

EXCUTIVE SUMMARY ii

TABLE OF CONTENTS iv

INTRODUCTION 1

DESCRIPTION AND LAND USE OF PROJECT AREA 4

BENEFICIAL USES 6

PROJECT GOALS, OBJECTIVES AND ACTIVITIES 9

Objective 1, Task 1

ANIMAL WASTE MANAGEMENT SYSTEMS 9

Objective 1, Task 2

ROCK CROSSING & ALTERNATE WATER SOURCES 15

Objective 2, Task 3

SKUNK CREEK BMP EFFECTIVENESS EVALUATIONS 18

BIG SIOUX RIVER – BANK STABILIZATION 20

Objective 2,Task 4,

RIPARIAN AREA MANAGEMENT 26

CONSERVATION EASEMENTS 29

Objective 3, Task 5

INFORMATION AND EDUCATION 32

Outreach Program 32

Objective 4, Task 6

WATER QUALITY MONITORING 43

SUMMARY OF PUBLIC PARTICIPATION 54

ASPECTS OF THE PROJECT THAT DID NOT WORK WELL 55

FUTURE ACTIVITY RECOMMENDATIONS 56

LIST OF TABLES:

Table 1: Beneficial Use Impairments Identified for the Central Big Sioux River Watershed 1
Table 2: Beneficial Use Impairments Identified for the North Central Big Sioux River Watershed.....2
Table 3: 2007 Cropland Productions by County 5
Table 4: 2007 Livestock Production Numbers by County 5
Table 5: South Dakota Beneficial Uses.....6
Table 6: South Dakota Beneficial Use of the Big Sioux River Depending on Segment.....6
Table 7: Central Big Sioux River Segments with TMDLs and Reduction Needed to Achieve TMDL at the Beginning of the Implementation Project.....7
Table 8: North Central Big Sioux River Segments with TMDLs and Reduction Needed to Achieve TMDL at the Beginning of the Implementation Project.....7
Table 9: Current Status of North Central and Central Big Sioux River Segments with TMDLs and Reduction Needed to Achieve TMDL.....8
Table 10: Summary of AWMS Participation 10
Table 11: Load Reduction Achieved from Construction of Animal Waste Management Systems 14
Table 12: Division of Resource Conservation & Forestry Grant Budget of the Other Funds.....15
Table 13: Division of Resource Conservation & Forestry Grant Budget Breakdown of Funds 15
Table 14: The Rock Crossing Expenditures 15
Table 15: The Alternate Water Source Expenditures.....16
Table 16: Skunk Creek and Silver Creek Bank Stabilization Project 19
Table 17: Big Sioux River Bank Stabilization Project Phase 1 and Reductions Achieved.....25
Table 18: Big Sioux River Bank Stabilization Project Phase 2 and Reductions Achieved.....25
Table 19: Summary for the RAM Program and Resulting Acres Combined with Enrolled CRP.....27
Table 20: Annual Load Reduction Achieved as a Result of the Enrollment in the RAM Program.....28
Table 21: Shows the Conservation Easement Payment Schedule.....29
Table 22: Annual Load Reduction Achieved from Enrollment in Conservation Easements 31
Table 23: Cropland Acres within the Priority Area.....36
Table 24: Rangeland Acres within the Priority Area.....36
Table 25: Monitoring Sites along the Big Sioux River 45
Table 26: Monitoring Sites along the Tributaries to the Big Sioux River.....45
Table 27: Pathogen and Phosphorus Reduction Target and Achieved for TMDL Segments 49
Table 28: Nitrogen and Total Suspended Solid Reduction Target and Achieved for TMDL Segments: ..50
Table 29: Pollutants for TMDL Segment Big Sioux River Lake Kampeska to Willow Creek.....50
Table 30: Pollutants for TMDL Segment Big Sioux River Lake Kampeska to Stray Horse Creek.....51
Table 31: Pollutants for TMDL Segment Big Sioux River Lake Kampeska to I-29 51
Table 32: Pollutants for TMDL Segment Big Sioux River Lake Kampeska to near Dell Rapids 51
Table 33: Pollutants for TMDL Segment Big Sioux River Lake Kampeska to below Baltic.....51
Table 34: Pollutants for TMDL Segment Big Sioux River Lake Kampeska to above Brandon.....51
Table 35: Initial Budget.....52
Table 36: Expenditures.....53

LIST OF FIGURES:

Figure 1: Central Big Sioux River Watershed Project area boundaries 4
Figure 2: Conventional feeding operation 11
Figure 3: Feedlot sediment basin.....11
Figure 4: Newly constructed vegetative treatment area 12
Figure 5: Clean water diversion adjacent to feedlot in Minnehaha County 13
Figure 6: Feedlot location that was required to be abandoned once the new feedlot was operational. 13
Figure 7: Previous feedlot that can no longer be managed as a feedlot but is allowed to be grazed ...14
Figure 8: Cattle standing in water.....16
Figure 9: Damaged stream due to cattle crossing.....17
Figure 10: Installed cattle rock crossing.....17
Figure 11: Skunk Creek bank stabilization and rock spurs 18
Figure 12: Skunk Creek bank stabilization.....19
Figure 13: Bank stability and Potential Load Reduction study reach and locations 21
Figure 14: Preconstruction of segment 65.....22
Figure 15: Rip rap placed on segment 65 23
Figure 16: Preconstruction picture of a segment13 23
Figure 17: Segment 17 after placement of rip rap during the winter of 2010 24
Figure 18: The preconstruction picture of segment.....24
Figure 19: Conservation Easement closing for property located Southeast of Castlewood, SD.....29
Figure 20: Largest single conservation easement closing 30
Figure 21: Shows a conservation easement southeast of Castlewood South Dakota.....30
Figure 22: Public meeting held in Castlewood, South Dakota. 33
Figure 23: Landowner meeting in Brandon, SD.....33
Figure 24: Riparian Buffer Conservation Tour – Minnehaha and Moody Counties.....35
Figure 25: Priority areas in Brookings County.....37
Figure 26: Priority areas in Codington County.....38
Figure 27: Priority areas in Minnehaha County 39
Figure 28: Priority areas in Moody County.....40
Figure 29: Priority areas in Hamlin County 41
Figure 30; Study area use in the Better Management Practices to Improve Water Quality study 42
Figure 31: Monitoring Site Locations of the North Central Big Sioux River Watershed 43
Figure 32: Monitoring Site Locations of the Central Big Sioux River Watershed Project. 44
Figure 33: Average of Median Specific Conductivity Values.....46
Figure 34: Average of Median Fecal Coliform Values 47
Figure 35: Average of Median Total Suspended Solids Values.....47
Figure 36: Average of Median Turbidity Values 48

APPENDICES

Found at: http://denr.sd.gov/dfta/wp/wqinfo.aspx#Project Under Big Sioux

Appendix A: Animal Waste Management System
Appendix B: Conservation Easements Forms and Evaluation Sheets
Appendix C: Riparian Area Management (RAM) Forms and Evaluation Sheets
Appendix D: East Dakota Water Development District web page
Appendix E: News releases
Appendix F: Central Big Sioux Implementation Grant Final Report Number 2006-CSW-022
Appendix G: Analysis of Bank Stability and Potential Load Reductions
Appendix H: Better Management Practices to Improve Water Quality on Big Sioux
Appendix I: Monitoring Data 2005 thru 2009

INTRODUCTION

The Central Big Sioux River Watershed Project is a 10-year Total Maximum Daily Load, (TMDL) implementation strategy that was to be completed in multiple segments and parts. The project was to restore and/or maintain the water quality of the Big Sioux River and its tributaries to meet the designated beneficial uses. The Central Big Sioux River Watershed Assessment identified various segments of the Big Sioux River and certain tributaries between Watertown and Brandon as failing to meet designated uses due to impairments from total suspended solids (TSS), dissolved oxygen (DO) and/or fecal coliform bacteria (FCB). Twenty-four separate TMDLs were developed for these segments (See Table 1 and Table 2). Activities to improve and/or maintain current sediment and bacterial loadings targeted sub-watersheds within the project area. An information and education campaign was conducted to keep the public informed of project activities and to provide information on BMPs and water quality issues. Water quality samplings were used to monitor and project impacts on impaired water bodies. They were assessed to determine if progress on the TMDLs reductions were achieved.

Table 1: Beneficial Use Impairments Identified for the Central Big Sioux River Watershed.

Segment	Beneficial Use	Impairment
Big Sioux River		
Brookings to I-29	WWFLP[1] LCR[5]	TSS[2]
I-29 to Above Dell Rapids	WWFLP[1]IR[3] LCR[5]	TSS[2]
Above Dell Rapids to Below Baltic	WWFLP[1] IR[3] LCR[5]	FCB[4]
Below Baltic to Skunk Creek	WWFLP[1] IR[3] LCR[5]	TSS[2], FCB[4]
Skunk Creek to Diversion	WWFLP[1] IR[3] LCR[5]	TSS[2], FCB[4]
Diversion to SF WWTF	WWFLP[1] IR[3] LCR[5]	TSS[2], FCB[4]
SF WWTF to Brandon	WWFLP[1] IR[3] LCR[5]	TSS[2], FCB[4]
Tributaries		
Bachelor Creek	WWFLP[1]LCR[5]	FCB[4]
Beaver Creek	WWFLP[1] LCR[5]	TSS[2], FCB[4]
Flandreau Creek	WWFLP[1] LCR[5]	FCB[4]
Jack Moore Creek	WWFLP[1] LCR[5]	FCB[4]
North Deer Creek	WWFLP[1] LCR[5]	FCB[4]
Pipestone Creek	WWFLP[1] IR[3] LCR[5]	FCB[4]
Silver Creek	WWFLP[1]	DO[6]
Six Mile Creel	WWFLP[1] LCR[5]	FCB[4]
Skunk Creek	WWFLP[1] LCR[5]	TSS[2], FCB[4]
Split Rock Creek	WWFLP IR[3] LCR[5]	TSS[2], FCB[4]
Spring Creek	WWFLP[1] LCR[5]	FCB[4]

[1] - Warm water fish life propagation (WWFLP) - applicable standard varies with water body;
[2] - Total suspended solids; (TSS)
[3] - Immersion recreation standard (IR) - 400 colonies per 100 milliliters of water;
[4] - Fecal coliform bacteria; (FCB)
[5] - Limited contact recreation standard (LCR) - 2,000 colonies per 100 milliliters of water; and
[6] - Dissolved oxygen (DO)

Table 2: Beneficial Use Impairments Identified for the North Central Big Sioux River Watershed.

Segment	Beneficial Use	Impairment
BSR Lake Kampeska to Willow Creek	WWFLP[1] LCR[5]	FCB[4]
BSR Willow Creek to Stray Horse Creek	WWSFP[1], LCR[5]	FCB[4]
Willow Creek	WWFLP[1] LCR[5]	FCB[4]
Hidewood Creek	WWMFP[1] LCR[5]	FCB[4]
BSR Stray Horse Creek to near Volga	WWSFP[1] LCR[5]	FCB[4]
Stray Horse Creek	WWMFP[1] LCR[5]	FCB[4]
Peg Munky Run	WWMFP[1] LCR[5]	FCB[4]
East Oakwood Lake	WWSFP[1] IR[3] LCR[5]	TSS[2], Total Phosphorus
West Oakwood	WWSFP[1] IR[3] LCR[5]	TSS[2], Total Phosphorus

[1] - Warm water fish life propagation (WWFLP) - applicable standard varies with water body;
[2] - Total suspended solids; (TSS)
[3] - Immersion recreation standard (IR) - 400 colonies per 100 milliliters of water;
[4] - Fecal coliform bacteria; (FCB)
[5] - Limited contact recreation standard (LCR) - 2,000 colonies per 100 milliliters of water; and

The two watershed assessments that developed the need for the implementation project are described in the next few paragraphs.

The Central Big Sioux River Watershed Assessment Project began in April of 1999 and lasted through December of 2003 when data analysis and compilation into a final report was completed. The title of the report was: “Phase 1, Watershed Assessment Final Report and TMDL” for the central Big Sioux River in Brookings, Lake, Moody and Minnehaha Counties of South Dakota, dated March, 2004. The assessments were conducted as a result of several segments being placed on the 1998 303(d) list for fecal coliform bacteria (FCB), and total suspended solids (TSS) problems.

An EPA section 319 grant provided the majority of the funding for this project. The Department of Environment and Natural Resources and East Dakota Water Development District provided matching funds for the project.

The North-Central Big Sioux River watershed assessment project began in April of 2001 and continued through December of 2005 when data analysis was completed and published in a final report. The title of the report is: “Phase 1, Watershed Assessment Final Report and TMDLs” for the North-Central Big Sioux River in Brookings, Hamlin, Deuel and Codington Counties of South Dakota, dated December, 2005. The assessment was conducted as a result of this area of the Big Sioux River watershed being placed on the 1998 303(d) list for total suspended solids (TSS) problems.

The long term goal for the assessment projects was to locate and document sources of non-point source pollution in the North-Central Big Sioux River (BSR) watershed and Central Big Sioux River (CBS) watershed and provide feasible restoration alternatives to improve water quality. Through identification of sources of impairment in these goals were accomplished. Water quality monitoring and watershed modeling resulted in the identification of several sources of impairment. These sources were to be addressed through best management practices (BMPs) and the construction of several waste management systems at animal feeding operations.

PROJECT LOCATION: Latitude North 44o 00' 00" Longitude West 096o 45' 00"
HYDROLOGIC CODE: 10170202 -North Central Big Sioux River
10170203 -Central Big Sioux River North and West of Brandon, SD

The south boundary was located in Minnehaha County along county road 38 southeast of Sioux Falls, SD. The North boundary was located in Codington County at the outlet for Lake Kampeska.

The Central Big Sioux River Watershed Project boundaries are within the above seven county area of eastern South Dakota shown in Figure 1. Watertown is located to the north and Sioux Falls and Brandon are located on the south portion.

This did not include the following areas that have been included in other watershed projects: Lake Pelican Watershed, Clear Lake, Lake Poinsett, Lake Campbell, Lakes Herman, Madison and Brant Lake watershed, Bachelor Creek and Wall Lake.

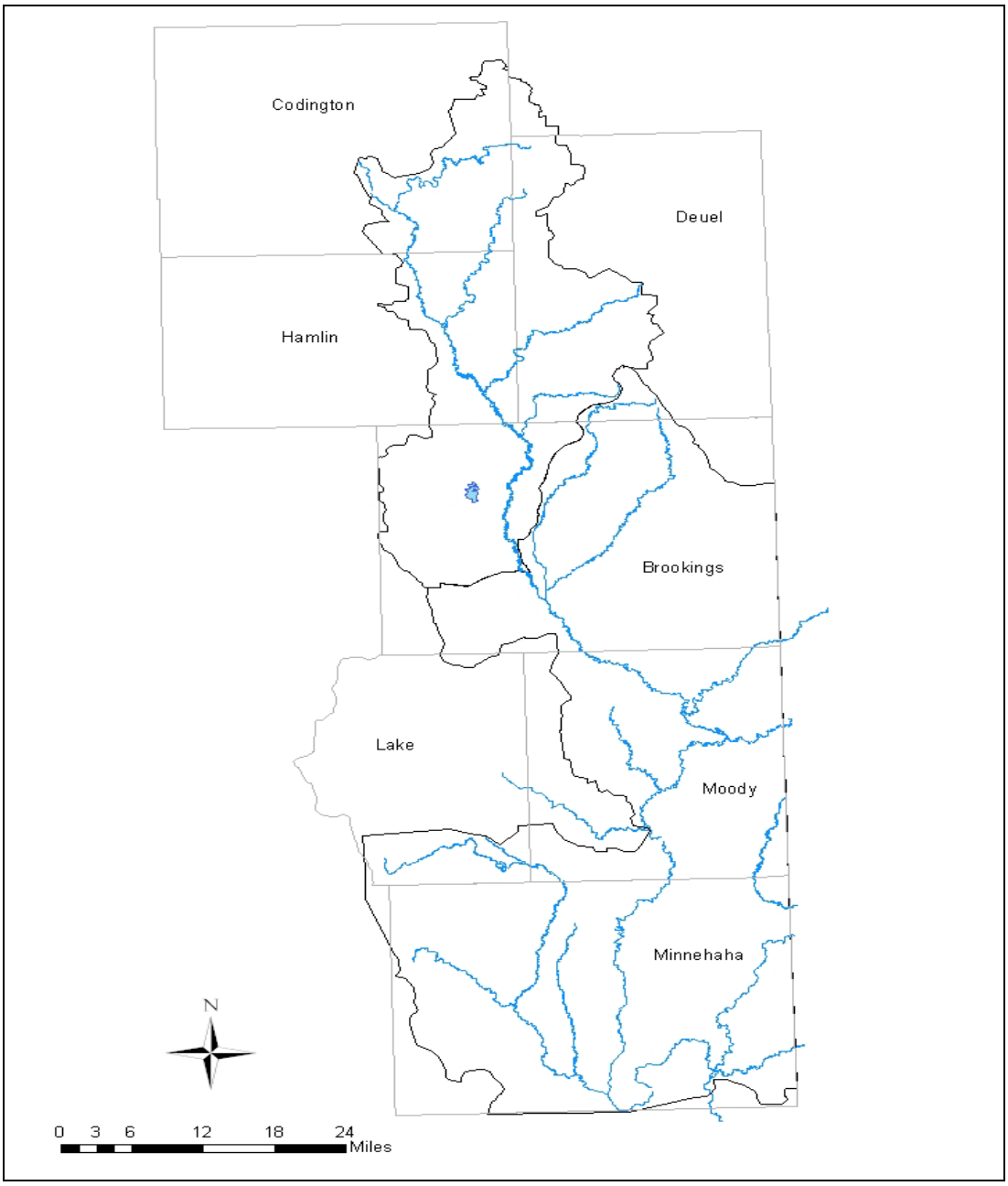


Figure 1: Central Big Sioux River Watershed Project area boundaries.

DESCRIPTION AND LAND USE OF PROJECT AREA:

The surficial character of the watershed can be divided into two parts, relating to the relative age of the landscape. Along the BSR valley, and the eastern tributaries, drainage is well developed and non-drained depressions are rare. To the west of the river, where drainage is poor, there are numerous potholes, sloughs, and lakes. The relief in the area is moderate. Land elevation ranges from nearly 2,000 feet above mean sea level in the northeastern part of the watershed to about 1,265 feet in the southern edge of the project area. Soils within the watershed area are derived from a range of parent materials. Uplands soils are relatively fine-grained and developed over glacial till or thin eolian (loess) deposits. Coarse-grained soils, derived from glacial outwash or alluvial sediments, are found along present or former water courses. In central and eastern

Minnehaha County, in the southern part of the project area, the loess deposits are thick, often in excess of 20 to 30 feet, and the resulting soils are highly erodible. When combined with the relatively high relief, these areas are susceptible to erosion, regardless of land-use practices.

The average annual precipitation in the central BSR watershed is 23.2 inches, of which 76% typically falls April through September. Tornadoes and severe thunderstorms strike occasionally. These storms are often of only local extent and duration, and occasionally produce heavy rainfall events. The average seasonal snowfall is 36.5 inches per year.

The watershed project was confined within the counties of Brookings, Codington, Deuel, Hamlin, Lake, Minnehaha and Moody. Total population in the project area is roughly 280,000.

Land use within this area averaged 73.9 % cropland and the other 26.1% is classed as non-cropland. There is 13.1% of cropland that is not harvested because it is used for pasture, conservation programs, or for other reasons. The non-cropland acres include woodlands, all non-cropland pastures and rangelands, farmsteads, buildings, livestock facilities, ponds, roads, wasteland etc. Corn was the number one crop with an average of 31.5% of the cropland planted to it. Codington County had the lowest percentage of corn with 20% and Moody County was highest with 46.5%. Table 3 provides the crop production figures in 2007 for the major crops.

Table 3: 2007 Cropland Productions by County.

COUNTY	CORN %	WHEAT %	SOYBEANS%	FORAGE %
BROOKINGS	31.6	3.1	22.1	7.1
CODINGTON	20.0	11.0	16.4	8.7
DEUEL	21.6	5.0	14.3	8.2
HAMLIN	31.8	6.9	26.2	4.9
MINNEHAHA	38.2	0	27.3	7.0
MOODY	46.5	04	21.1	5.4
AVERAGE	**31.5**	**4.3**	**21.5**	**7.0**

Cattle production was the primary animal raised with the watershed when comparing AUM's but second by animal numbers. Pigs and hogs are the highest by actual animal numbers. The actual breakdown by animal numbers can be found in Table 4.

Table 4: 2007 Livestock Production Numbers by County.

COUNTY	CATTLE FOR INVENTORY	CATTLE for SALE	PIGS & HOGS	SHEEP
BROOKINGS	73,314	63,292	102,875	7,565
CODINGTON	58,265	38,983	48,707	15,256
DEUEL	50,353	39,012	R*	3,938
HAMLIN	41,650	29,003	61,923	1,203
MINNEHAHA	74,307	52,108	290,027	5,583
MOODY	42,391	39,354	117,517	2,874
AVERAGE	**56,713**	**43,625**	**124,209**	**6,070**

*R indicated that data was not released to the public.

BENEFICIAL USES:

The State of South Dakota has identified 11 beneficial uses that cover all of the bodies of water within the state. The complete list of these uses are listed in the tables below.

Table 5: South Dakota Beneficial Uses.

NUMBER	USE CODE	BENEFICIAL USE
1	DW	Domestic Water Supply
2	CWPFP	Cold Water Permanent Fish Life Propagation
3	CWMFP	Cold Water Marginal Fish Life Propagation
4	WWPFP	Warm Water Permanent Fish Life Propagation
5	WWSFP	Warm Water Semi-permanent Fish Life Propagation
6	WWMFP	Warm Water Marginal Fish Life Propagation
7	IR^3	Immersion Recreation
8	LCR	Limited Contact Recreation
9	FWP/R/SW	Fish & Wildlife Propagation, Recreation & Stock Watering
10	IRR	Irrigation
11	CIW	Commerce and Industry Waters

Within the watershed the state had assigned the following beneficial uses by segment of the Big Sioux River and its tributaries.

Table 6: South Dakota Beneficial Use of the Big Sioux River Depending on Segment.

SEGMENT NUMBER	USE CODE	BENEFICIAL USE
1	DW	Domestic Water Supply
5	WWSFP	Warm Water Semi-permanent Fish Life Propagation
OR		
6	WWMFP	Warm Water Marginal Fish Life Propagation
7 – Not in all areas	IR^3	Immersion Recreation
8	LCR	Limited Contact Recreation
9	FWP/R/SW	Fish & Wildlife Propagation, Recreation & Stock Watering
10	IRR	Irrigation

In Tables 7 and 8 the term in brackets in column three refers to the water level (high, medium or low) in the Big Sioux River (BSR) and the creeks or the bank condition (moist or dry).

Table 7: Central Big Sioux River segments with TMDLs and Reduction Needed to Achieve TMDL at the Beginning of the Implementation Project.

Segment	Impairment	Reduction Needed (%)*
Beaver Creek	TSS	79 (high)
Split Rock Creek	TSS	67 (high)
Brookings to I-29	TSS	19 (high)
I-29 to Near Dell Rapids	TSS	14 (high)
BSR SF WWTF to above Brandon	TSS	**
Spring	FCB	45 (overall)
Skunk	FCB	95 (high)
Bachelor	FCB	84 (high/moist)
Beaver	FCB	86 (high/moist)
Flandreau	FCB	91 (high/moist)
Jack Moore Creek	FCB	82 (high/moist)
BSR near Dell Rapids to below Baltic	FCB	29 (high)
North Deer Creek	FCB	34 (high/midrange)
Pipestone Creek	FCB	89 (high/moist), 87 (dry/low)
BSR SF WWTF to above Brandon	FCB	**
Six Mile Creel	FCB	12 (high/moist)
Split Rock Creek	FCB	96 (overall)

* Description of what hydrologic conditions the reduction applies to.

**Impairments were determined but additional study is currently underway and the new values have not been released.

Table 8: North Central Big Sioux River Segments with TMDLs and Reduction Needed to Achieve TMDL at the Beginning of the Implementation Project.

Segment	Impairment	Reduction Needed (%)
BSR Lake Kampeska to Willow Creek	FCB	33 (high)
BSR Willow Creek to Stray Horse Creek	FCB	10 (high)
Willow Creek	FCB	78 (high/moist), 5 (dry)
Hidewood Creek	FCB	59(high)
Stray Horse Creek	FCB	99 (high), 14 (mid range/dry)
Peg Munky Run	FCB	38 (overall)

Since the beginning of the implementation project there have been a number of changes to the TMDL's within the state. Table 9 lists these changes.

Table 9: Current Statuses of North Central and Central Big Sioux River Segments with TMDLs and Reduction Needed to Achieve TMDL.

Segment	Initial Impairment	Action and Date
Split Rock Creek	TSS	TMDL approved May 2008
Brookings to I-29	TSS	Delisted April 2008
Brookings to I-29	FCB	Delisted April 2004
I-29 to Near Dell Rapids	TSS	TMDL Approved May 2008
I-29 to Near Dell Rapids	FCB	Delisted April 2004
SF WWTF to above Brandon	FCB	Assessment Initiated
SF WWTF to above Brandon	TSS	Delisted May 2006
Spring	FCB	TMDL approved May 2008
Skunk	FCB	TMDL approved May 2008
Flandreau	FCB	TMDL approved May 2008
BSR near Dell Rapids to below Baltic	FCB	TMDL Approved May 2008
BSR near Dell Rapids to below Baltic	TSS	Delisted April 2004
North Deer Creek	FCB	TMDL approved May 2008
Pipestone Creek	FCB	TMDL approved May 2008
BSR SF WWTF to above Brandon	FCB	Assessment Initiated
BSR SF WWTF to above Brandon	TSS	Delisted May 2006
Six Mile Creel	FCB	Not Initiated April 2008
Split Rock Creek	FCB	TMDL approved May 2008
BSR Lake Kampeska to Willow Creek	Nitrate/FCB	Not Initiated 2008
BSR Willow Creek to Stray Horse Creek	FCB	TMDL approved June 2008
Willow Creek	FCB	TMDL approved June 2008
Hidewood Creek	FCB	TMDL approved June 2008
BSR Stray Horse Creek to near Volga	FCB	Not Initiated April 2008
Stray Horse Creek	FCB	TMDL approved June 2008
Peg Munky Run	FCB	Not Initiated April 2008
East Oakwood Lake	TSI	TMDL approved June 2008
West Oakwood	TSI	TMDL approved June 2008

*Report is available at this web site: http://denr.sd.gov/dfta/wp/tmdlpage.aspx

PROJEST GOALS, OBJECTIVES AND ACTIVITIES:
The restoration and protection of the beneficial uses of the portion of the Big Sioux River and the South Dakota portion of the tributaries between the communities of Watertown and Brandon by implementing and promoting best management practices (BMPs) in the watershed that would reduce sediment loading and prevent bacterial contamination. Attaining the sediment goal would require reducing total suspended solids (TSS) in the river and selected tributaries by between 20% and 70%. Fecal coliform levels found throughout the study area commonly exceed the water quality standard, particularly in regards to immersion recreation. Attainment of fecal coliform TMDLs would in certain areas require reducing bacterial loads by over 95%. Such targets are beyond the scope of this project segment. The interim targets were measurable and sustainable reductions of TSS (20%) and fecal coliform bacteria (15%) levels, to be met at the completion of the first multi-part segment of the restoration project. Restoration of the beneficial uses of the Big Sioux River and its tributaries, through implementation of BMPs described below and those supported through subsequent projects should lead to attainment of TMDL targets.

Objective 1: Reduce fecal coliform and sediment loadings to the Big Sioux River and its tributaries through the renovation and improvement of existing, high-priority animal feeding operations and limiting the access of livestock to impaired water bodies.

Task 1: Animal Waste Management Systems. Assist livestock producers to install animal waste management systems (AWMS) at critical locations within priority watersheds within the project area to reduce fecal bacteria and sediment loading.

One of the potential sources of fecal coliform bacteria is domestic raised animals. The project focused on a corridor that was two miles wide on either side of the Big Sioux River or the major tributaries within the project boundaries. Project funds could be used to assist animal feeding operations (AFO) or feedlots that house less than one thousand animal units. Operations larger than one thousand animal units are considered to be CAFO's or concentrated animal feeding operations and are subject to other regulations.

The process we follow includes a serious of steps that are followed in the development of an animal waste management system. These include meetings with interested landowners and operators to determine if the operation meets the established criteria and address the questions from the interested party. These include: what design changes that need to be made, how much was it going to cost, how much assistance would be available for the design, construction and permitting of the facility. If this meeting was successful then we would schedule the next meeting to include the engineer that would be tasked with doing a feasibility study for the site to determine if the current location was acceptable or if there was a better site that maybe more suitable for the project. There will be many meeting between that date and a time when there was a completed design and we were ready to start looking for a contractor or go out for bids to build or add improvements to the feedlot. Not all feasibilities study's end with construction. There can be a number of factors that would cause the process to stop. The process often takes two or more years before one had a finished product. Table 10 shows the producers that had project assistance for some phase of the development animal waste management system.

As seen in Table 10, there are a number of projects that are initiated that were never completed. This can be due to a number of factors. This can include a site not being suitable for remodeling, space requirements, owner not having a suitable site to move to, overall cost, and the cost/benefit ratio. Environmentally the new feedlot would make a significant improvement for the watershed but the owner would not make a commitment to alter their operation. One of the major considerations for the landowner was that this was a voluntary program and he was not required to make the changes. The farm economics have also motivated a few operators to discontinue their feeding or dairy operations.

Table 10: Summary of AWMS Participation.

Land Owner Code	Feasibility / Preliminary Design	Finalize Design	Construction
AW-01	X		
AW-04	X		
AW-05	X		
AW-06	X		
AW-07	X		
AW-08	X	X	
AW-09	X		
AW-10	X		
AW-11	X		
AW-C01	X	X	X
AW-C02	X	X	
AW-D01	X	X	X
AW-H01	X		
AW-H02	X	X	X
AW-H03	X		
AW-H04	X	X	X
AW-H05	X	X	X
AW-H06	X	X	X
AW-H07	X	X	
AW-H08	X		
AW-H09	X	X	
AW-H10			X
AW-H11	X	X	
AW-H12	X	X	X
AW-M01	X	X	X
AW-M02	X	X	X
AW-M03	X	X	
AW-M04	X	X	X
AW-M05	X	X	X
TOTAL	27	18	12

A conventional feeding operation with the feedlot on the left, a sediment basin in the middle and the holding pond in the right can be seen in Figure 2.

Figure 2: Conventional feeding operation.

Figure 3 displays a sediment basin which would be located between the feedlot and the holding pond or vegetative treatment area. The basin traps the solid material and allows the liquid to flow into the receiving area.

Figures 3: Feedlot Sediment Basin.

Not all locations are suited to build a conventional feedlot. There are a number of operations that are choosing vegetative treatment areas (VTA) because it does not require building a deep pond. VTAs produce grass that can be used to feed livestock the operator raises. In Figure 4 is a newly constructed VTA that will be planted to grass. Liquid leaving the sediment basin would flow over the grass and provide water and nutrients. VTA's replace the holding pond found in a conventional system.

Figure 4: Newly constructed vegetative treatment area.

Throughout the project, it had been found that many of the producers were more interested in lower cost options. Producers want to significantly reduce the contamination problems and yet did not want to develop a conventional feedlot waste handling system.

The vegetative treatment areas (VTA) have increased in popularity because of the concerns with space needed for holding ponds, the failure rate of the deep holding ponds and the taking of productive land out of production.

Another method that used was to prevent the contamination of the ground water was to divert water away from the feedlot. Figure 5 shows a diversion dike that was built to prevent the water from entering the lot on the right. The dike doubles as a roadway for this operator. In the past water would flow though the feedlot picking up animal waste and depositing it into the Big Sioux River. This less expense option was the logical choice for the some owners.

Figure 5: Clean water diversion adjacent to feedlot in Minnehaha County.

If the current location was not suitable or there were other factors that cause an operator to choice relocation, the old area was required to be abandoned, reclaimed and could not be used as a feedlot in the future. Sites that were abandoned can be seen in Figures 6 and 7.

Figure 6: Feedlot location that was required to be abandoned once the new feedlot was operational.

Figure 7: Previous feedlot that can no longer be managed as a feedlot but is allowed to be grazed.

The Spreadsheet Tool for Estimating Pollutant Load, (StepL) calculated load reductions achieved though the construction of the twelve animal waste management systems are shown in Table 11.

Table 11: Load Reduction Achieved from Construction of Animal Waste Management Systems.

Land Owner Code	Nitrogen Reductions in pounds*	Phosphorus Reductions in pounds*	Sediment Reductions in tons**	Fecal Bacteria Annual Reduction**
AW-C01	3,040.1	684.0	8.35	1.12E+11
AW-D01	15,119.6	3,401.9	22.9	9.43E+10
AW-H02	7,628.5	1,727.0	33.8	8.98E+10
AW-H04	4,540.4	1,021.6	6.5	8.98E+10
AW-H05	6,053.9	1,362.1	8.7	8.98E+10
AW-H06	7,567.4	1,702.7	10.9	8.98E+10
AW-H10	4,540.4	1,021.6	21.8	1.12E+11
AW-H12	22,435.7	2,506.3	21.8	1.12E+11
AW-M01	22,533.8	5,070.1	30.5	8.98E+10
AW-M02	4,979.6	3,430.4	12.0	8.98E+10
AW-M04	6,817.9	1,422.2	24.8	1.12E+11
AW-M05	16,079.5	3,617.9	21.8	8.98E+10
TOTAL	121,336.8	26,967.8	223.9	1.17E+12

*StepL load reductions

**Feedlot and Grazing Reductions Model (FLGR 3) was used to calculate the fecal load reductions

Tasks 2: Reduce livestock access to water bodies. Provide resources to livestock owners to limit or prevent access to impaired water bodies and provide alternative water sources to replace the impaired water bodies.

The approach that was chosen was to offer assistance to operators for the construction of rock crossings or to provide another source of water away from the creek or river. This would limit the livestock contact with the river or creek and yet provide good fresh water to the animals.

During 2006 Moody County Conservation District applied for a Coordinated Soil and Water Conservation Grant from the South Dakota Department of Agriculture. The purpose of this grant was to provide supplemental funds for technical assistance and cost share dollars to establish alternate water sources and rock crossings in the riparian areas of the project. The grant number 2006CSW-022 for $56,800 was to be available from July 1st, 2006 thru June 31st, 2008. The next two tables reflect the budget that was set up for that part of the overall watershed project.

Table 12: Division of Resource Conservation & Forestry Grant Budget.

Activity	Grant Funds	Local Funds	Other Funds	TOTAL
Salary	$18,800		$56,400	$75,200
Alternative Water Sources	$20,000	$20,000		$40,000
Rock Crossings	$16,000	$24,000		$40,000
Fencing			$10,000	$10,000
TOTAL	$54,800	$44,000	$66,400	$165,200

Table 13: Division of Resource Conservation & Forestry Grant Budget Breakdown of Funds.

	CSWC	LANDOWNER	EDWDD	319 EPA	USF&W
Alternate Water Source	$20,000	$10,000	$10,000		
Rock Crossing	$16,000	$16,000	$8,000		
Technical Assistance	$18,800			$56,400	
Fencing					$10,000
TOTAL	$54,800	$26,000	$18,000	$56,400	$10,000

Even though fence was listed as a component to this activity it was handled by the US Fish and Wildlife service and was not tracked within this project. The two components that were tracked were rock crossings and alternate water sources. These two activities were not in great demand during the project. The next two tables reflect the level of participation.

Table 14: The Rock Crossing Expenditures.

	Cost	**319 EPA**	**Landowner**
RC 1	$4,557.75	$3418.31	$1139.44
RC 2	$4,557.75	$3418.32	$1139.43
RC 3	$5,923.65	$4442.74	$1480.91
RC 4	$2,867.42	$2150.57	$716.85
RC 5	$4,700.00	$3,525.00	$1,175.00
TOTAL	$22,606.57	$16,954.94	$5,651.63

Table 15: The Alternate Water Source Expenditures.

	Cost	RC&F	USF&W	EDWDD	Landowner
ALW 1	$7,246.27	$1,619.96	$641.21	$1,387.46	$3,597.64
ALW 2	$655.99	$328.00		$164.00	$163.99
ALW 3	$6,150.31	$2,000.00		$1,000.00	$3,150.31
ALW 4	$2,607.53	$1,000.00		$651.88	$955.65
TOTAL	$16,660.10	$4,947.96	$641.21	$3,203.34	$7,867.59

Livestock in the water, similar to Figures 8-9, destroy shoreline vegetation, increase sediment loading, raises water temperature, and increase nutrient levels in the water. Figure 9 shows signs of livestock using this site to cross the creek. This was destroying natural vegetation, increasing turbidity, and degrading the water quality. A rock crossing (Figure 10) was put in place to allow livestock to cross without doing damage as observed in Figure 9. Once built, cows quickly found this crossing, and would use this as the preferred location to cross the creek.

Figure 8: Cattle standing in the water.

Figure 9: Damaged stream due to cattle crossing.

Figure 10: Installed cattle rock crossing.

Objective 2: Reduce sediment loadings to the Big Sioux River and its tributaries through bank stabilization of critical river and tributary segments and by restoration of riparian buffer zones.

Task 3: Stabilize banks along critical reaches of Skunk Creek and the Big Sioux River. The assessment study identified portions of lower Skunk Creek and the Big Sioux River in the Sioux Falls area as contributors of significant sediment loads. Urban reaches of these water bodies generated disproportionate loads of sediment, contributing to the overall TSS impairments. Segments of these water bodies will be targeted for bank stabilization, including both hard (rip-rap) and soft (vegetative) practices.

One of the areas identified as in need of bank stabilization was Skunk Creek and a smaller tributary named Silver Creek. The City of Sioux Falls contracted with Mussetter Engineering, Inc. of Fort Collins, Colorado to develop a plan to stabilize the bank in the area west of Marion Road and south of West 12th Street in the southwest portion of Sioux Falls. The finalized plan was received in June of 2006. The construction contract was awarded to Runge Enterprises with construction administration preformed by Stockwell Engineers, Inc. of Sioux Falls. There was 10,000 linear feet of bank stabilization. About 5,440 feet of the stream banks were stabilized using soft methods of vegetation only treatment. The other 4,110 feet was stabilized using rock riprap and gabion baskets. One segment that was 450 feet in length was stabilized using bend way weirs (Figure 11). The calculated load using StepL (Table 16) resulted in a reduction of 189.7 pounds of nitrogen and 43.2 pounds of phosphorus per year entering the creeks. In addition there is 118.8 tons less sediment entering the creeks. The downstream location is 1.25 miles from the Big Sioux River.

Figure 11: Skunk Creek bank stabilization and rock spurs.

Figure 12: Skunk Creek bank stabilization.

Table 16: Skunk Creek and Silver Creek Bank Stabilization Project.

Segment Number	Length feet	Nitrogen lbs / year	Phosphorus lbs / year	Sediment tons / year
Vegetation Only	5440	10.5	4.1	6.6
M – 1	315 / 315	15.8	6.2	10.0
M – 2	400	10.1	3.9	6.3
M – 3	470	11.8	4.6	7.4
M – 4	440 / 200	16.1	6.2	10.0
M – 5	395	10.0	3.8	6.2
M - 6	375 / 375	18.8	7.2	11.8
M – 7	245	6.2	2.4	3.9
M – 8	410	10.3	4.0	6.5
M – 9	420	54.3	20.9	33.9
M – 10	200	25.8	9.9	16.2
TOTAL	10,000	189.7	73.2	118.8

The Central Big Sioux Watershed Assessment identified and area between Sioux Falls and Baltic as contributing a significant sediment load. It was decided that it would be beneficial to have an outside source conduct an evaluation of the Big Sioux River bank stability.

During August of 2007 a Big Sioux Bank Stability Project was developed and $57,800 was provided to pay for this study. Agricultural Research Service, a branch of U.S. Department of Agriculture was contracted to conduct an "Analysis of Bank Stability and Potential Load Reduction along Reaches of the Big Sioux River, South Dakota" (Appendix G). The main objective of this study was to determine rates and loadings of sediment from stream bank erosion

along main stem reaches of the Big Sioux River. This area was 131.36 km upstream of the mouth of the Big Sioux River on the Missouri River to an area 431 km upstream. This activity was to be completed by April of 2008. The analysis was received in January of 2009.

There were five location chosen for the Bank Stability and Toe Erosion Model, (BSTEM) (see Figure 13). They were near Castlewood, Estelline, Brookings, Egan, and Renner. Each site was evaluated for flow levels at the following percentiles: 90th, 75th, 50th, 25th and 10th. According to the executive summary from their report: "The model results showed that predicted eroded volumes of sediment emanating from streambanks decreased non-linearly from the 90th percentile flow year to the 10th percentile year. Predicted volumes of sediment eroded the streambanks at each site ranged from 169 to 1359 cubic meters of sediment per 100meter reach during the 90th percentile year, under existing conditions where the banks have a cover of native grass." It went on to say that "Bank failures were generally only predicted to occur during the 90th percentile flow year modeled at each site, indicating that during lower percentile flow years, hydraulic scour at the toe was the predominant erosion process, rather than mass wasting of the banks." Their recommendation went on to state that "The addition of bank-toe protection to the grassed bank resulted in a huge total reduction in average, annual loading..."

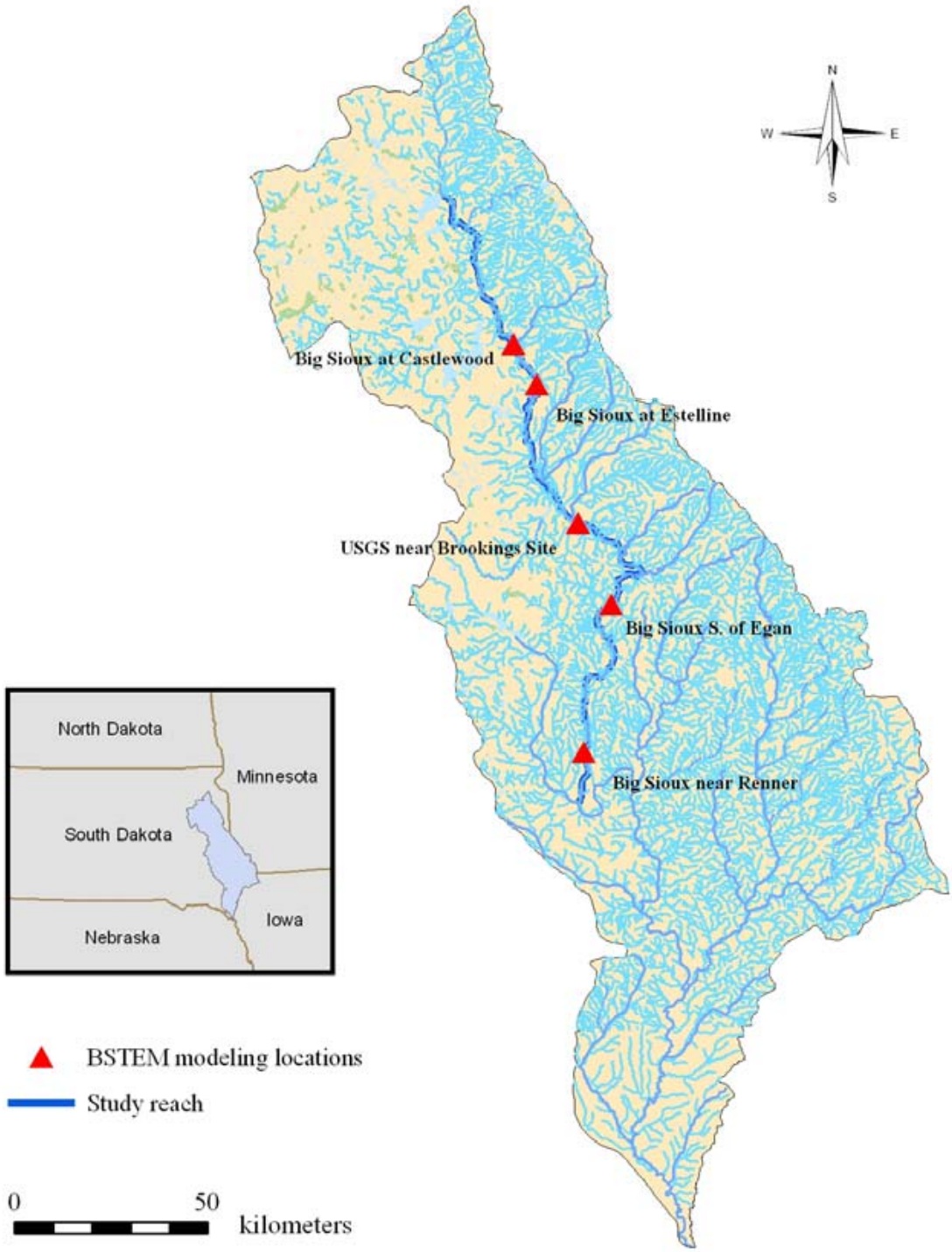


Figure 13: Bank stability and Potential Load Reduction study reach and locations.

After receiving the report, it was decided that a number of locations near Sioux Falls and on the Big Sioux River should be considered for toe stabilization. The City of Sioux Falls had access to about two million dollars in state revolving funds. This would enable work to be completed on a limited number of sites. The Department of Environment and Natural Resources, DENR selected 18 segments of the Big Sioux River in the area from Sioux Falls to Baltic as being potential bank stabilization segments. The City of Sioux Falls also requested DENR investigate seven other sites for potential restoration.

A public meeting was held April 1st, 2009 at the Renner town hall. Twelve local individuals were present representing 10 of 18 selected segments. Permission requests to enter private property were signed by the majority of the owners present and one expressed interest in enrolling in the conservation easement program. Over the summer of 2009, a team of technicians from East Dakota Water Development District and Department of Environment and Natural Resources conducted a rapid geomorphic assessment (RGA) on the sites and assigned them a ranking. DENR then assigned the segments to one of three phases. Phases one and two were designed during the fall of 2009 by City of Sioux Falls engineering staff. Phase one was bid in December and phase two was bid during January, 2010. Construction was completed by the March 31st, 2010 deadline. Conservation District trees were planted on the sites during the spring of 2010. Two more phases are expected during the winter of 2010 through the spring of 2011.

Segment 65 is shown below in Figure 14. This area was losing 3-5 feet of shoreline each year. The operator was planting corn and soybeans to the edge of the 12 foot high bank. Outside rows from previous years could be seen disappearing off the edge of the bank. Rip rap for this site was installed during the winter of 2010 (see Figure 15).

Figure 14: Preconstruction of segment 65.

Figure 15: Rip rap placed on segment 65.

Figure 16: Preconstruction picture of segment 13.

Figure 17: Segment 17 after placement of rip rap during the winter of 2010.

Figure 18: The preconstruction picture of segment 1.

Segment 1 had lost a great deal of shoreline as apparent by the large number of large sod blocks and trees that have fallen into the river. This area had permanent vegetation but it was not sufficient to protect the shoreline from erosion. This was part of the reason that the use of rock was selected for protecting the bank at the toe. The design criterion was that rock rip-rap would

go up to the bank full elevation (about the two year flood elevation). These sites are monitored to see how well the sites react with their repairs. They have handled the flooding that occurred during the spring and summer of 2010 very well, and the vegetation is growing very well on the top of the banks.

Phases one and two came in under the anticipated cost thus prompting the City of Sioux Falls and the Department of Environment and Natural Resources to move on to phases three and four.

The Spreadsheet Tool for Estimating Pollutant load, (StepL) was used to determine the load reductions achieved by doing the bank stabilization for this project. The results of these calculations can be seen in table 17 and 18.

Table 17: Big Sioux River Bank Stabilization Project Phase 1 and Reductions Achieved.

Segment Number	Length feet	Nitrogen lbs / year	Phosphorus lbs / year	Sediment tons / year
101	950	1988.4	765.5	1,462.0
103	1,064	1,952.9	1,61.4	1,61.751.84
200	139	164	63.1	89.1
1	778	2,035.5	783.7	1,496.7
9	2013	6,033.9	2,323.0	3,977.7
65	1,316	3,825.6	1,472.9	2,391
6	474	1,157.5	445.6	851.1
TOTAL	6734	17,157.8	6,605.6	11,329

Table 18: Big Sioux River Bank Stabilization Project Phase 2 and Reductions Achieved.

Segment Number	Length feet	Nitrogen lbs / year	Phosphorus lbs / year	Sediment tons / year
2	535	1,306.4	503.0	960.6
17	924	2,578.6	992.8	1,896.0
11	1,063	2,595.7	999.4	1,908.6
4	1,282	3,577.7	1,377.4	2,630.7
15	1,851	5,165.6	1,988.8	3,798.3
13	643	1,993.8	767.6	1,466
104	570	1,193	459.3	877.2
16	998	2,785.1	1,072.3	2,047.9
3	800	1,674.4	644.6	1,231.2
TOTAL	7,866	22,870.3	8,805.2	16,816.5
GRAND TOTAL PHASES 1 AND 2	15,400	40,028	15,411	28,146

See "Analysis of Bank Stability and Potential Load Reduction along Reaches of the Big Sioux River, South Dakota" in the Appendix G.

Task 4: Riparian area restoration in urban and rural settings Critical reaches of the riparian corridor along the Big Sioux River and its tributaries have been lost to urban development. Riparian corridors have been lost to municipal, industrial and agricultural development. In many cases, the riparian areas have been completely eliminated. This task will provide BMPs to restore and preserve critical riparian areas through the acquisition of easements in urban and rural areas. It will also provide additional incentive to landowners interested in enrolling in the USDA Conservation Reserve Program (CRP).

The RAM program was used in conjunction with the continuous conservation reserve program (CCRP), of the conservation reserve program, (CRP). In order to facilitate the enrollment of the CRP acres, the project paid the base rate amount used by CRP to add up to 35% of the acres enrolled in the CP 21, 22 29 and 30 programs.

The following are the guidelines that have followed for this program.

1. If the land under application is eligible for a USDA CRP program, the landowner is encouraged to seek funding from the USDA. This program is only for land which is not eligible for a USDA CRP program.
    a. The land under application must be located on or in close proximity to an impaired river or stream segment. See Figures 24 – 28
    b. Impaired segments which will have a greater priority will be Sioux Falls Waste Water Treatment Facility (SF WWTF) to above Brandon BSR segment, Flandreau Creek, Beaver Creek, Pipestone Creek, and Skunk Creek. These TMDL segments require significantly large reductions in fecal coliform and/or TSS to meet the standard for designated uses.
2. The rental rate as established by the county USDA FSA office for the CRP program will be used for payment under the RAM Program.
    a. Brookings County $60.00 per acre
    b. Codington County $58.00 per acre
    c. Deuel County $58.00 per acre
    d. Hamlin County $58.00 per acre
    e. Minnehaha County $66.00 per acre
    f. Moody County $66.00 per acre
3. There are two ways that land can be enrolled in the RAM Program.
    a. If a landowner has applied for a USDA CRP Program and a small portion of land does not qualify, the landowner may apply for the RAM Program.
    b. Land not eligible for USDA CRP programs may be covered by this program as long as less than 35% of the total amount of land enrolled in both programs is under application for the RAM Program.
        i. The amount of land under application for t5he RAM Program must be adjoining land which is currently under application for a USDA CRP program and must not be more than 35% of the total amount of land under application for a USDA CRP program and the RAM Program.
        ii. The length of time for a RAM contract under this scenario will follow the length of time for the USDA CRP contract.

c. Land which does not qualify for a USDA CRP program because of current condition of the land may be enrolled in the RAM Program.
    i. Example: tree cover
    ii. Cropping history
    iii. Distance from the edge of the waters

4. The landowner will be required to follow a conservation plan for the tract of land enrolled in the RAM Program. This will be provided to the landowner by the conservation district.

Often this makes the difference whether a landowner will enroll in CRP or not. Like CRP, RAM contracts were for either 10 or 15 years.

The watershed project pays the conservation district and then the conservation district will in turn make the payments to the landowner at the end of each year.

Initially East Dakota Water Development District funded the entire amount for the Ram Program. Landowners were paid the annual rental rate times the number of acres enrolled in the RAM contract. During 2008 this payment schedule was changed to the following: one half of the contract value at the end of the first year. In years two thru nine for a ten year contract and two thru 14 for fifteen year contract will receive one half of the annual rental rate times the number of acres enrolled. In the last year of the contract, the landowner will receive the balance of the contract amount. Under this current scenario, EPA 319 funds are being paid during the time period for the watershed project. Any time outside of the project period will be paid by East Dakota Water Development District.

Table 19: Summary for the RAM Program and Resulting Acres Combined with Enrolled CRP.

Contract Number	Acres in RAM	Total with CRP acres	Duration of Agreement
Moody - 02	19.2	98.9	15
MCD -2006-2	16.2	16.2	15
Moody - 01	3.2	3.2	15
MCD -2007 -01	8.5	53.9	10
MCD -2006 -01	4.7	14.3	15
Moody – 03	6.0	15.0	15
Hamlin - 01	29.0	96.8	15
Deuel - 01	15.35	40.45	15
Moody -04	5.7	15.8	15
Brookings - 01	19.2	45.0	10
Moody - 06	46.2	130.2	10
Moody - 07	9.0	9.0	10
Hamlin - 02	12.7	41.0	10
Moody - 08	8.5	26.0	15
Hamlin - 03	6.8	CE	15
Minnehaha 01	20	20	Perpetual
TOTAL	230.25	625.75	10/15 year, 5/10 year

Table 20: Annual Load Reduction Achieved as a Result of the Enrollment in the RAM Program.

Contract Number	Pounds of Nitrogen Reduced*	Pounds of Phosphorus Reduced*	Tons of Sediment Reduced*	Fecal Load Reduced**
Moody - 02	2,140.1	483.6	20.7	1.01E+13
MCD -2006-2	790.5	261.0	184.3	
Moody - 01	360.5	109.4	70.2	
MCD -2007 -01	1,318.1	313.5	13	6.73E+12
MCD -2006 -01	659.9	157.3	7.0	3.36E+125
Moody – 03	2,276	523.9	17.2	5.61E+12
Hamlin - 01 - Load Reductions Are included with Conservation Easements				
Deuel - 01	2,196.8	523.2	13.4	9.89E+12
Moody -04	1,145.2	288.3	20.7	5.61E+12
BCD - 2009 - 01	1,666.8	391.2	14.2	8.41E+12
Moody - 06	5,542.0	1,299.0	26.3	2.86E+13
Moody - 07	1,844.0	574.3	354.2	1.35E+12
Hamlin - 02	1,746.58	410.66	7.5	9.08E+12
Moody - 08	715.9	80.1	26.6	6.73E+12
Hamlin – 03 - Load Reductions are included with Conservation Easements				
Minnehaha 01	1,116.7	366.5	257.1	
TOTALS	**23,519.1**	**5,782.0**	**1,032.4**	**9.54E+13**

*Spreadsheet Tool for Estimating Pollutant Load (StepL) was used
**Feedlot and Grazing Reductions Model (FLGR 3) was used

Conservation Easement Program, CE

Conservation easements were used to restrict or exclude livestock grazing and other farming practices in riparian areas along the BSR and its named tributaries. The program criteria include:

1. Conservation easements will be held by Northern Prairie Land Trust (NPLT).
2. The land under application must be adjacent to or in close proximity to an impaired segment of the Big Sioux River or named tributaries.
    a. Priority area include will be Sioux Falls Waste Water Treatment Facility (SF WWTF) to above Brandon BSR segment, Flandreau Creek, Jack Moore Creek, Bachelor Creek, Split Rock Creek, Beaver Creek, Pipestone Creek, and Skunk Creek. These TMDL segments require significantly large reductions in fecal coliform and/or TSS to meet the standard for designated uses. See Figures 25 – 28
3. The land offered must currently be used as grazing land for livestock or must currently be cropped up to the stream bank. Land which is currently maintained as a riparian area will be considered a lower priority.
4. Easements will be held for a minimum of thirty (30) years or perpetually (permanent).
5. Easements can be placed on lands currently under a USDA CRP contract.
6. Riparian buffers developed by the easement will be a minimum of seventy-five (75) and a maximum of one hundred-fifty (150) feet from the river of stream bank.
7. The landowner will be required to follow a conservation plan which will be provided by NPLT.

Payments were made based on the adjusted assessed land value (AALV), calculated from county taxed assessed value then multiplied by a correction factor that was provided by US Fish and Wildlife that would bring the land value in alignment with the current market value of the land. The payment amount would multiply by the calculated value by using percentage shown in the table below.

Table 21: Shows the Conservation Easement Payment Schedule.

DURATION OF EASEMENT	CRP TIME REMAINING	% OF AALV
30	0	80%
30	<5	75%
30	6 - 9	70%
30	>10	65%
PERPETUAL	0	95%
PERPETUAL	<5	90%
PERPETUAL	6 - 9	85%
PERPETUAL	>10	80%

The Big Sioux River Conservation Easement Program (CE) was the projects other approach to protect land adjacent to the River and its tributaries. The most significant difference between RAM and CE was the duration of the protection that was offered.

Figure 19: Conservation Easement closing for property located Southeast of Castlewood, SD. (Pictured are from left to right Pat Anderson, NPLT, Deb Biord, Dave Gerhold, John Johnson and Doug Feten, both with EDWDD and Dan Gerhold.)

Figure 20: Largest single conservation easement closing. (Front row: Roger Strom, WPC. Carlene Rust and Larry Rust, owners, Curtis Eggers, chairman EDWDD, back row are all board members for EDWDD and they are: Lois Brown, Robert Todd, John Johnson, Kay Kassube, John Weidler, Martin Jarrett, Vincent Flemming and Doug Feten)

The closing seen in Figure 20 was the largest single conservation easement closing. It washeld in conjunction with EDWDD monthly board meeting on April 15th, 2010.

Figure 21: Shows a conservation easement southeast of Castlewood South Dakota.

The watershed project used the StepL model to determine values for nitrogen, phosphorus and sediment reductions. Feedlot and Grazing Reductions Model (FLGR 3) was used for fecal loads found in Table 22.

Table 22: Annual Load Reduction Achieved from Enrollment in Conservation Easements.

Contract Number	Acres	Feet of Shoreline	Pounds of Nitrogen Reduced*	Pounds of Phosphorus Reduced*	Tons of Sediment Reduced*	Fecal Reductions**
B 01	25.7	6,373	237.4	37.0	19.3	8.97E+12
C 01	14.6	3,312	60.8	9.4	4.8	2.99E+12
H 01	28.92	8,354	620.1	139.9	78.4	2.09E+13
H 02	18.2	5,031	485.8	91.1	47.7	3.59E+12
H 03	36.5	7,982	467.4	58.7	23.9	7.47E+12
B 02	27.8	8,646	237.4	37.0	19.3	5.98E+12
H 04	26.4	5,807	246.0	31.8	13.4	4.78E+12
H 05	24.3	9,304	583.2	169.8	103.1	4.78E+12
H 06	18.9	5,650	537.6	156.9	95.5	3.59E+12
H 07	57.1	14,142	739.9	178.0	93.8	1.20E+13
M 01	16.0	5,722	917.1	243.1	161.88	2.22+12
H 09	31.7	8,566	1,328.2	321.0	163.9	5.98E+12
H 10	38.5	11,554	371.8	81.02	45.6	7.47E+12
H 11	46.8	16,978	1,710.3	360.9	173.0	8.97E+12
B 03	14.5	8,033	839.9	210.6	132.7	2.99E+12
H12	103.1	22,236	788.5	121.8	52.5	2.09 E+13
H13	15.4	6,194	2,997.1.0	900.8	570.16.58e+12	
H14	12.8					
H15	4.3					
TOTALS	561.52	147,60	13,168.5	3,149.0	1,798.8	1.30E+14

*Spreadsheet Tool for Estimating Pollutant Load (StepL) was used
**Feedlot and Grazing Reductions Model (FLGR 3) was used

Objective 3: Increase public awareness of water quality issues in general, and project activities and results in particular, throughout the Big Sioux River watershed.

Task 5: Information and Education

The watershed project employed a number of methods to reach the public and create awareness of the watershed project. The web site can be reached at www.eastdakota.org. A portion of the material from the web site is included in Appendix D.

OUTREACH PROGRAM

BROCHURES

"Big Sioux River Watershed Project – Animal Waste Management System"
"Big Sioux River Watershed Project - Riparian Buffer Management"
"Big Sioux River Watershed Project - Conservation Easement Program"
"Big News on the Big Sioux – Your Guide to Water Quality Issues in Eastern South Dakota"
"Time for Clean Water – South Dakota Pollution Prevention Guide"
"Keep the Green out of the Lakes use Zero Phosphorus Fertilizer"
"Conservation Easements – Central Big Sioux River Watershed Program"
"RAM – Riparian Area Management – Central Big Sioux River Watershed Program"
"Conservation Easements – Central Big Sioux River Watershed Program"

VIDEO

"East Dakota Water Development District" – video
"East Dakota Water Development District" – PSA

MAGAZINE ARTICLE

Magazine Title Article Title
Quality on Tap - Big Sioux Community Water System - "Central Big Sioux Watershed Project"
Quality on Tap - Big Sioux Community Water System - "Water Development Districts and Watershed Project"

PUBLIC OPINION SURVEY

2006 Big Sioux River Opinion Survey was conducted by Paulsen Marketing Communications who telephoned 149 respondents were from people owning land along the Big Sioux River (land owner group) and persons randomly selected from the towns of Brookings, Watertown, Brandon and Sioux Falls (urban group). See copy in Appendix H-2 through H-4 at http://denr.sd.gov/dfta/wp/wqinfo.aspx#Project under Big Sioux.

LANDOWNER MEETINGS

Big Sioux Watershed Project Updates:

Location	Attendance Number	Date
Brookings County Extension Office	18	January 16, 2007
Dell Rapids Town Hall	25	February 22nd, 2007
Castlewood Town Hall	24	March 7th, 2007
Brandon Town Hall	17	March 21st, 2007

Figure 22: Public meeting held in Castlewood, South Dakota.

Figure 23: Landowner meeting in Brandon, SD.

DISPLAYS

Sioux Empire Farm Show – Sioux Falls	January 24-27, 2007
Hamlin Conservation hosted Grazing Workshop - Hayti	January 29, 2009
Moody County Farm Show – Flandreau	March 6th, 2009

Meetings attended where Presentations were made

South Dakota Lakes and Streams	September 19th, 2008
	March 6th, 2009
Brookings Conservation District	December 6, 2006
	February 5th, 2009
	May 5th, 2009
Moody Conservation District	December 18th, 2007

Hosted meeting and was an active participant:

Bank Stabilization on the Big Sioux River	April 1st, 2009
Central Big Sioux Watershed Project Steering Committee	December 7th, 2005
	October 6th, 2005
	November 16th, 2005
	February 8th, 2006
	February 21st, 2006
	February 28th, 2008
	October 17th, 2008
Held two Bid Opening –	October 20th, 2008
	August 28th, 2009

Conservation Easement Closing – held 18 meetings to complete easement contracts

East Dakota Water Development District – Presented about 60 Monthly Project updates

Non-point Source Project Coordinators Workshop

North Dakota / South Dakota Non-point Source Project Coordinators Workshop

Aberdeen, SD	February 12-13, 2007
Spoke on Central Big Sioux Project Survey	
Pierre, SD	March 30-31, 2010
Spoke on the Conservation Easement Program and the RAM Program.	

TOURS

Figure 24: Riparian Buffer Conservation Tour – Minnehaha and Moody Counties.

Riparian Buffer Conservation Tour, Co- sponsors	July 31, 2007
EPA/DENR	Sep 21-22, 2010

NEWSPAPER NEWS RELEASES

See Appendix E.

NEWSLETTERS with Articles on the Watershed Project

Sponsor	Date
"For Land's Sake" – Codington Conservation District	Fall, 2006
"Conservation Comments" – Hamlin Co. Conservation District	Fall, 2007

Better Management Practices to Improve Water Quality in the Central and Upper Big Sioux Watershed by SDSU Plant Science Department

An effort was made to provide additional tools to the SDSU Extension Educators in Eastern South Dakota. A project was developed entitled "Better Management Practices to Improve Water Quality in the Central and Upper Big Sioux Watershed". Tables 23 and 24 reflect the acres of land shown in each of the counties maps.

Table 23: Cropland Acres within the Priority Area.

COUNTY	Total Cropland (Acres)	Priority Cropland (Acres)
Brookings	107,015	6,718
Codington	38,674	11,040
Minnehaha	205,334	80,641
Moody	124,347	18,058
Total	475,370	116,457

Data provided by SDSU

Table 24: Rangeland Acres within the Priority Area.

COUNTY	Total Rangeland (Acres)	Priority Rangeland (Acres)
Brookings	21,944	9,273
Codington	14,602	5,777
Minnehaha	44,195	18,166
Moody	31,162	12,396
Total	111,903	45,612

Data provided by SDSU

SDSU produced an Extension Toolbox that contained the following documents:

FS925_E.pdf: Livestock Development and Water Quality
FS 933.pdf: Calibration of Pesticide Spraying Equipment
FS 935.pdf: Recommended Soil Sampling Method
FS 940.pdf: Monitoring Rangeland and Pastures
FS 941.pdf: Nitrogen BMP for Corn in SD
FS 944.pdf: Better Management Practices for Improved Profit… & Water Quality
FS 951.pdf: Issues of Carbon Sequestration
EC 750.pdf: Fertilizer Recommendation Guide
EC 929.pdf: BMP for Corn Production in SD
EDWDD_AW.pdf: Big Sioux River Watershed Project – Animal Waste Management System
EDWDD_EASE.pdf: Big Sioux River Watershed Project – Riparian Buffer Management
EDWDD_RB.pdf: Big Sioux River Watershed Project – Conservation Easement Program
ExEx 1010.pdf: Surface Water Pollution from Livestock Production
ExEx 8091.pdf: Waste Pesticides
ExEx 8166.pdf: Crop Nutrient Consideration for Wet or Flooded Fields

One of the produces was a series on county maps that depicted the priority areas within the Big Sioux Watershed. These maps illustrate where an increased efforts were to be made to implement several best management practices. See the next five figures.

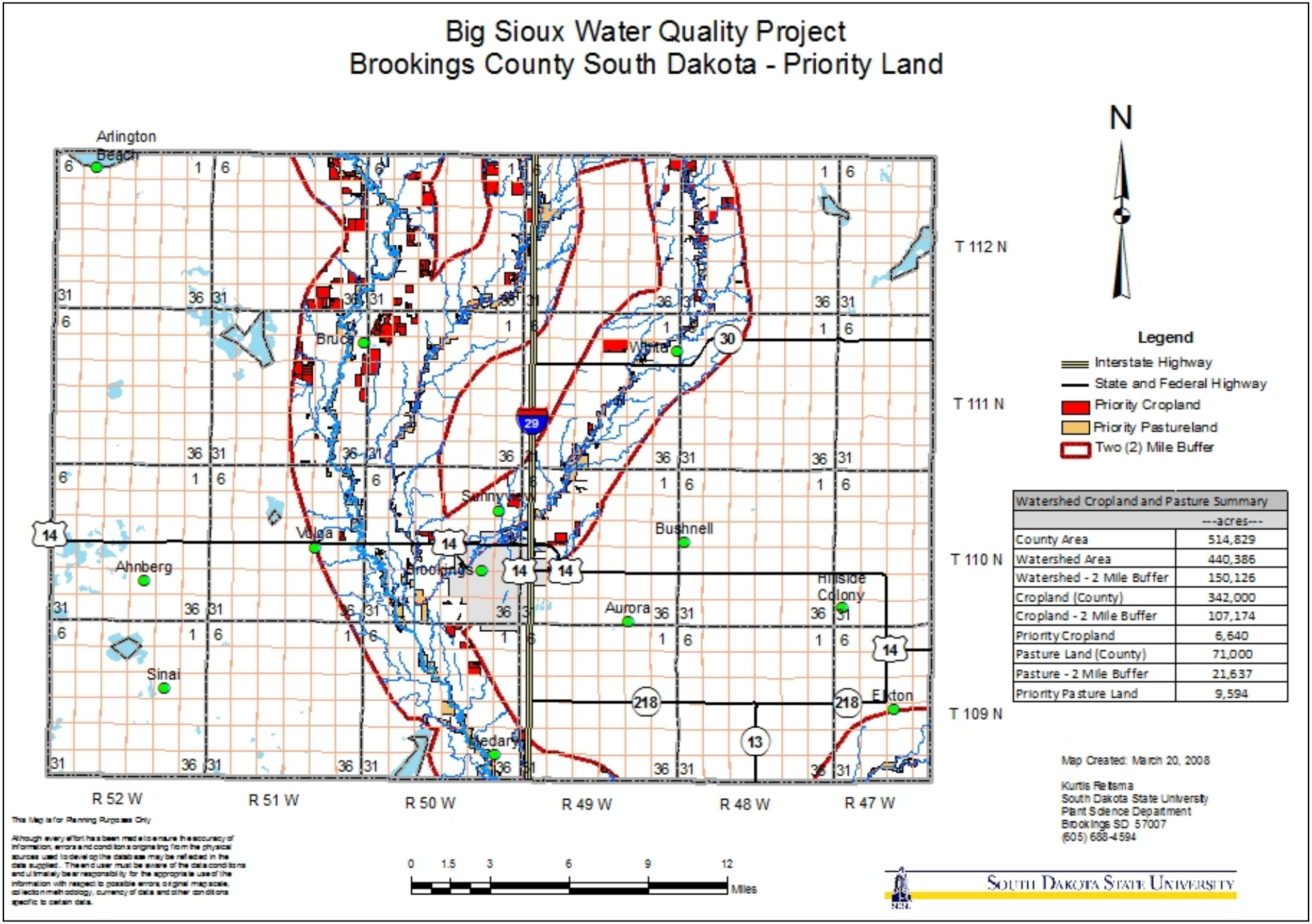


Figure 25: Priority areas in Brookings County.

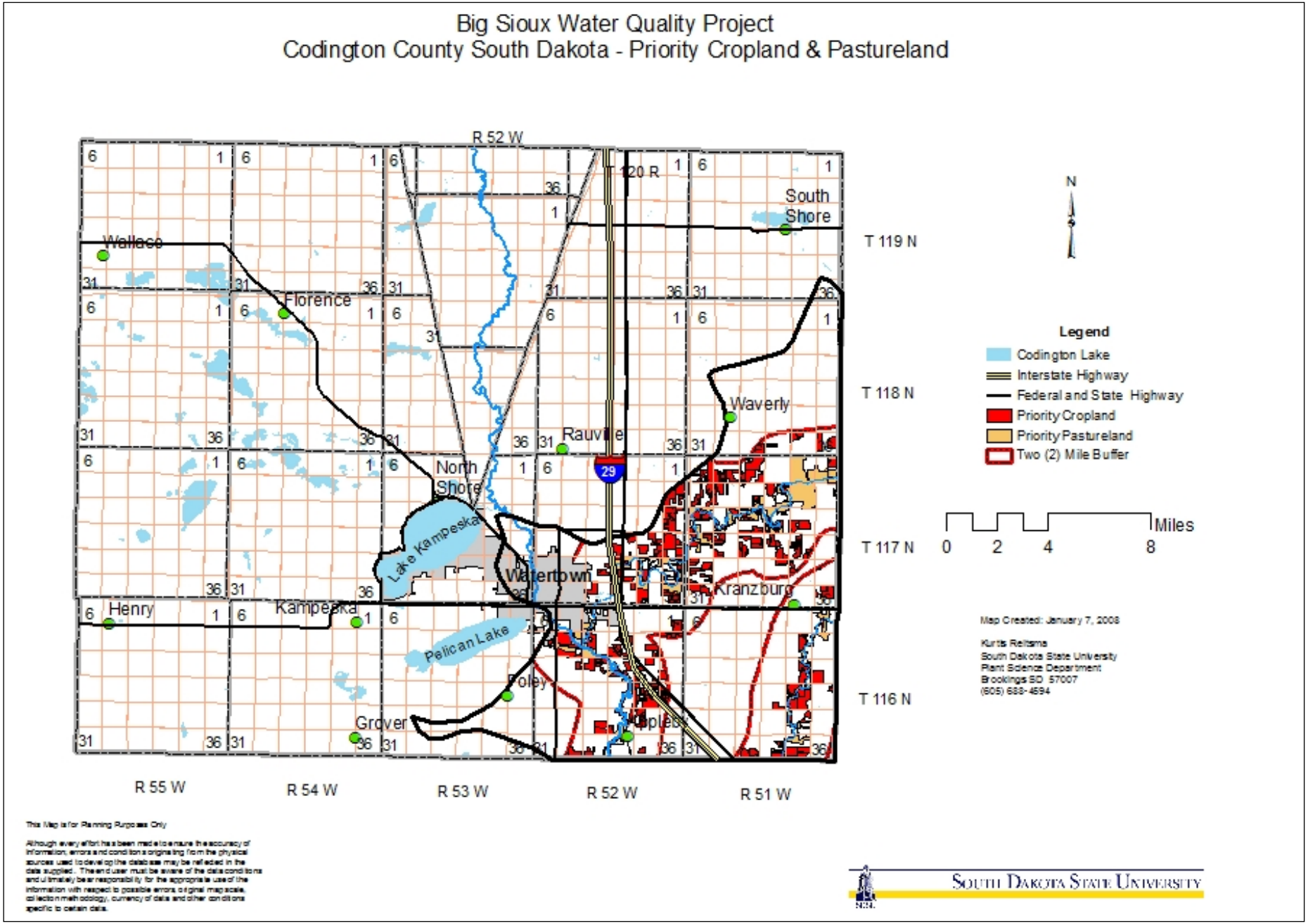


Figure 26: Shows priority areas in Codington County.

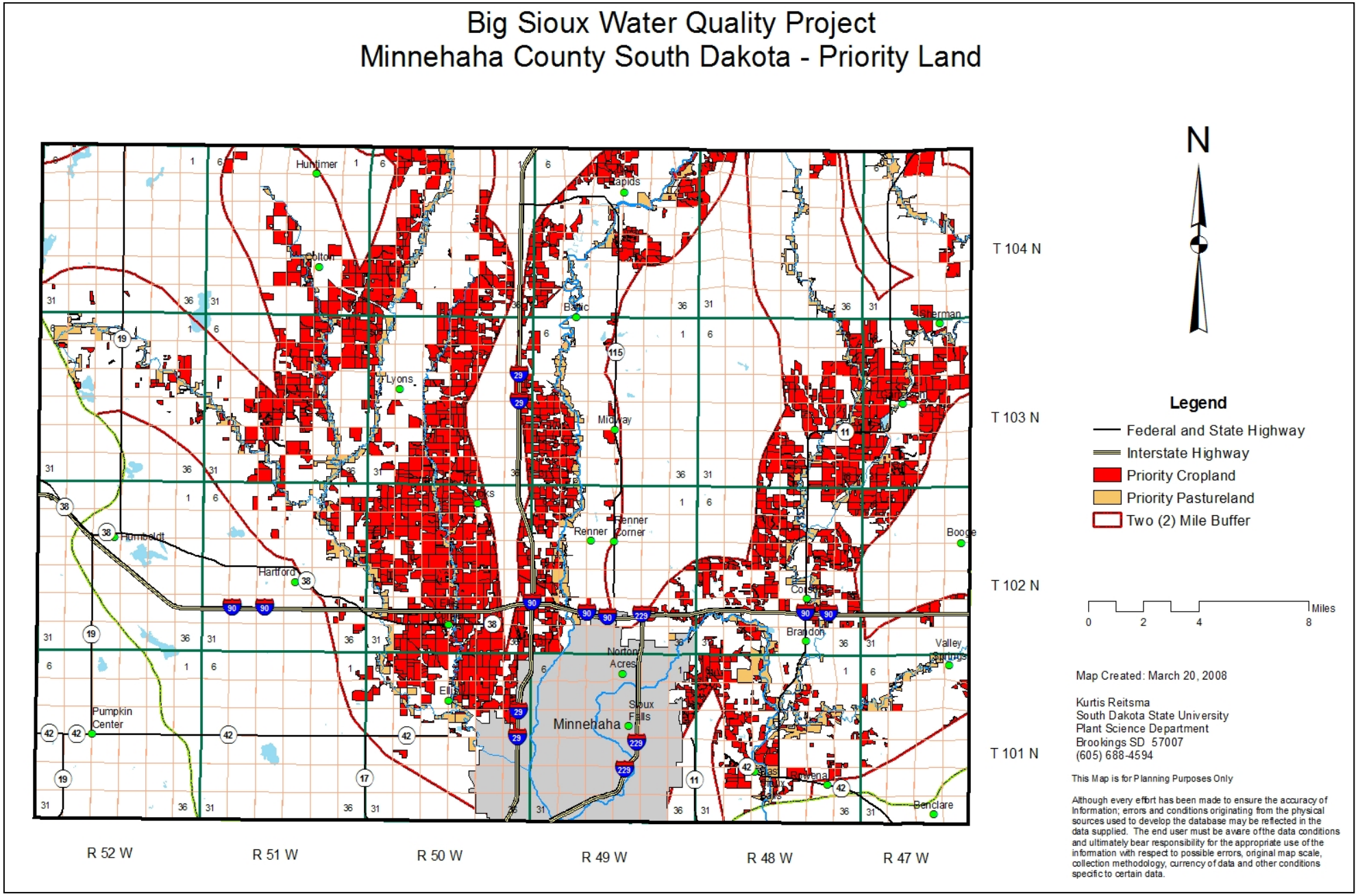


Figure 27: Priority areas in Minnehaha County.

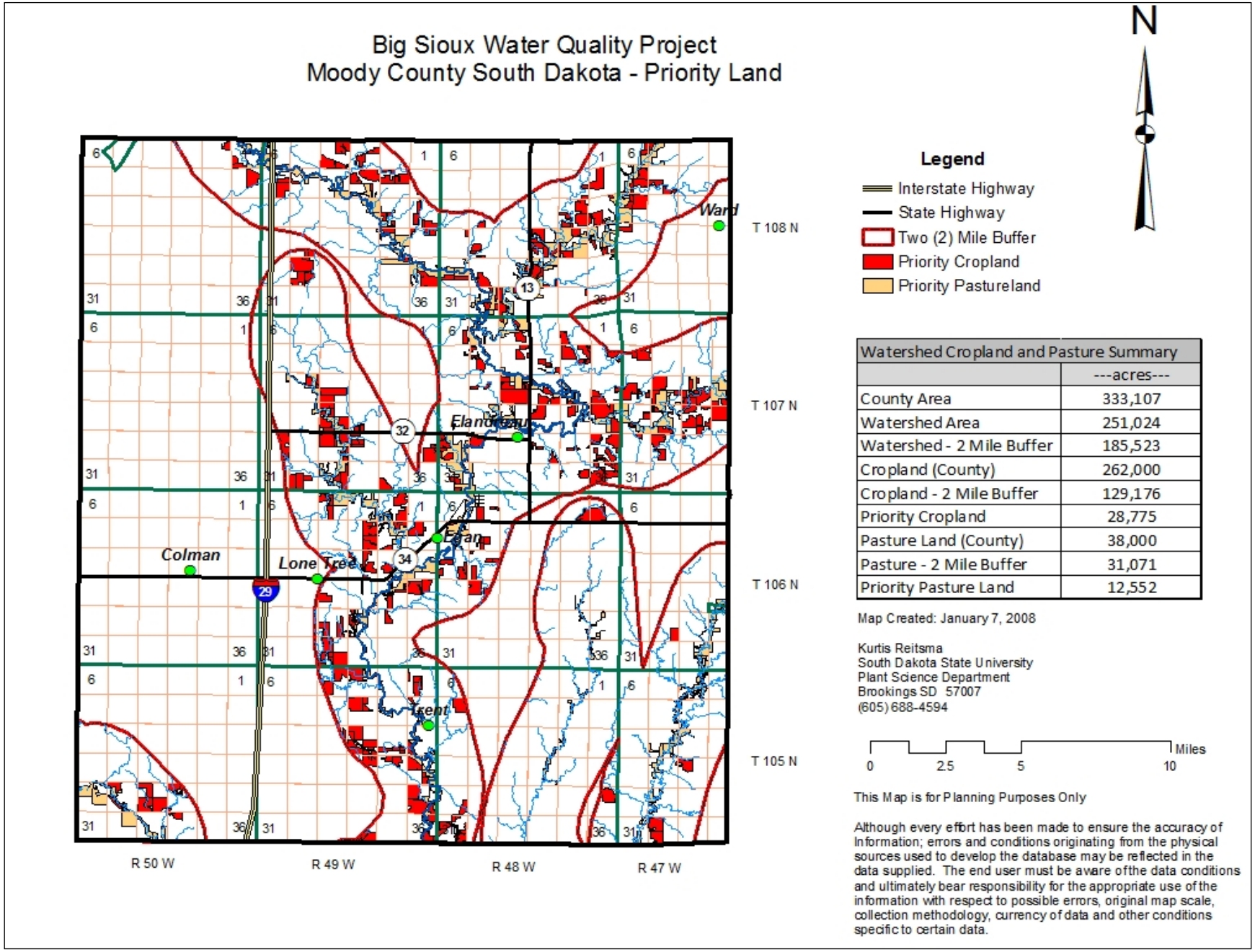


Figure 28: Priority areas in Moody County.

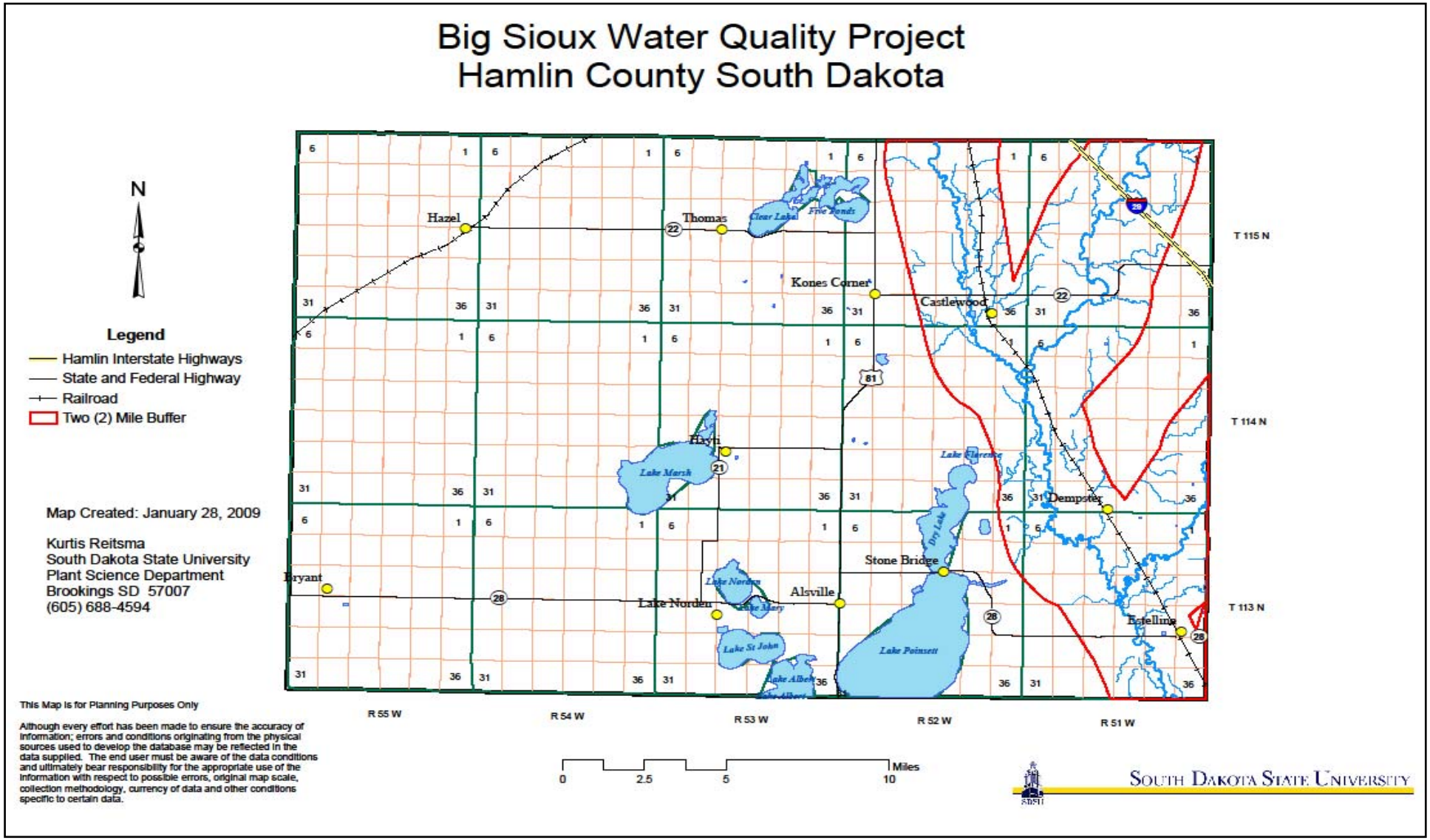
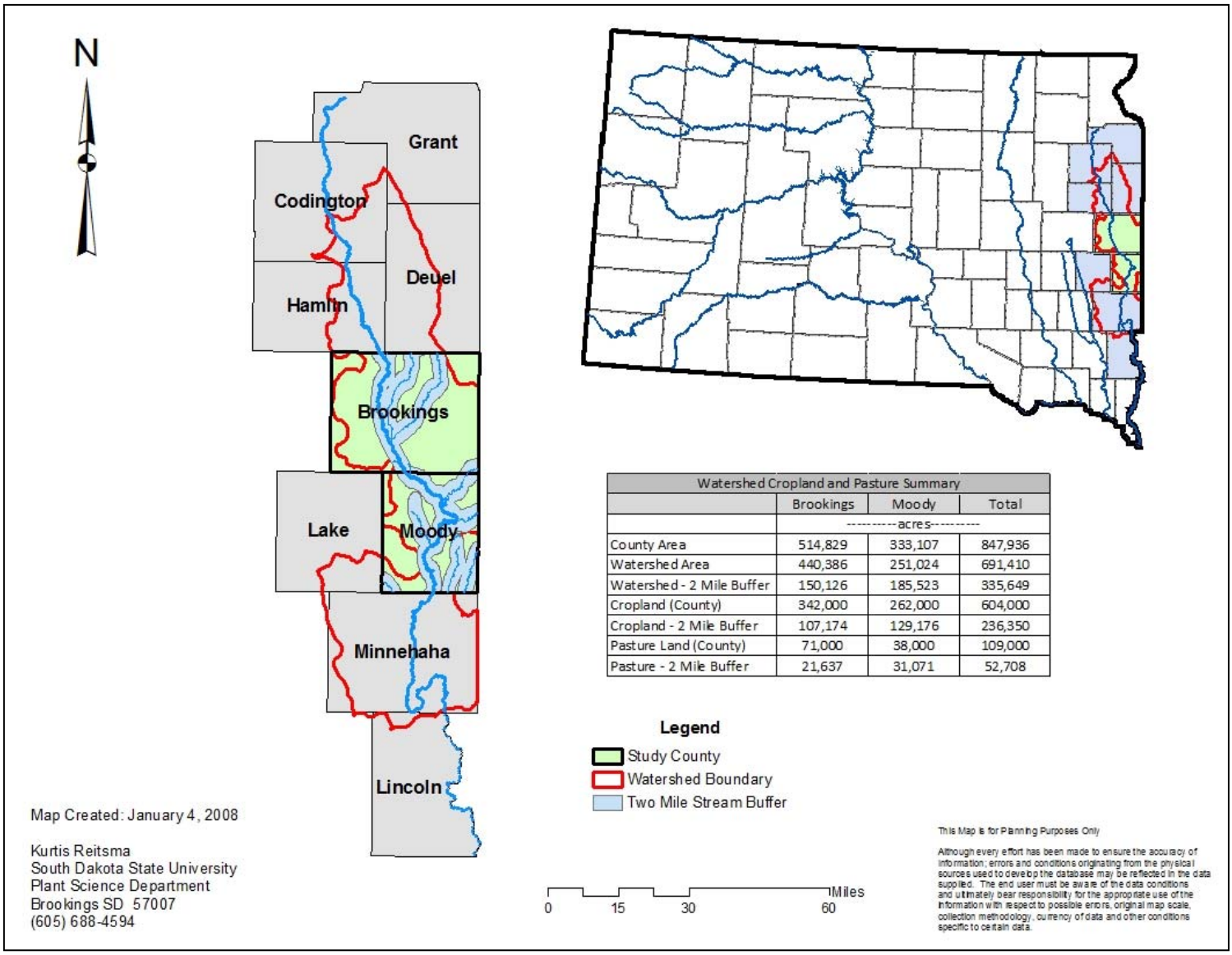


Figure 29: Priority areas in Hamlin County.



Watershed Cropland and Pasture Summary			
	Brookings	Moody	Total
	---------acres----------		
County Area	514,829	333,107	847,936
Watershed Area	440,386	251,024	691,410
Watershed - 2 Mile Buffer	150,126	185,523	335,649
Cropland (County)	342,000	262,000	604,000
Cropland - 2 Mile Buffer	107,174	129,176	236,350
Pasture Land (County)	71,000	38,000	109,000
Pasture - 2 Mile Buffer	21,637	31,071	52,708

Figure 30; Study area use in the Better Management Practices to Improve Water Quality Study.

The Water Quality study was focused on the counties of Brookings and Moody. A copy of the report titled "Better Management Practices to Improve Quality in the Central and Upper Big Sioux Watershed," produced by SDSU Extension can be found in Appendix H.

Objective 4: Conduct water quality sampling to monitor project impacts on impaired water bodies.

Task 6: Water quality sampling to monitor project impacts Monitor water quality at 24 river and tributary locations.

The fourth objective of the watershed project was to conduct water quality monitoring to assess project impacts on impaired water bodies. To achieve this goal the project worked with a number of monitoring site that are show in Figure 31.

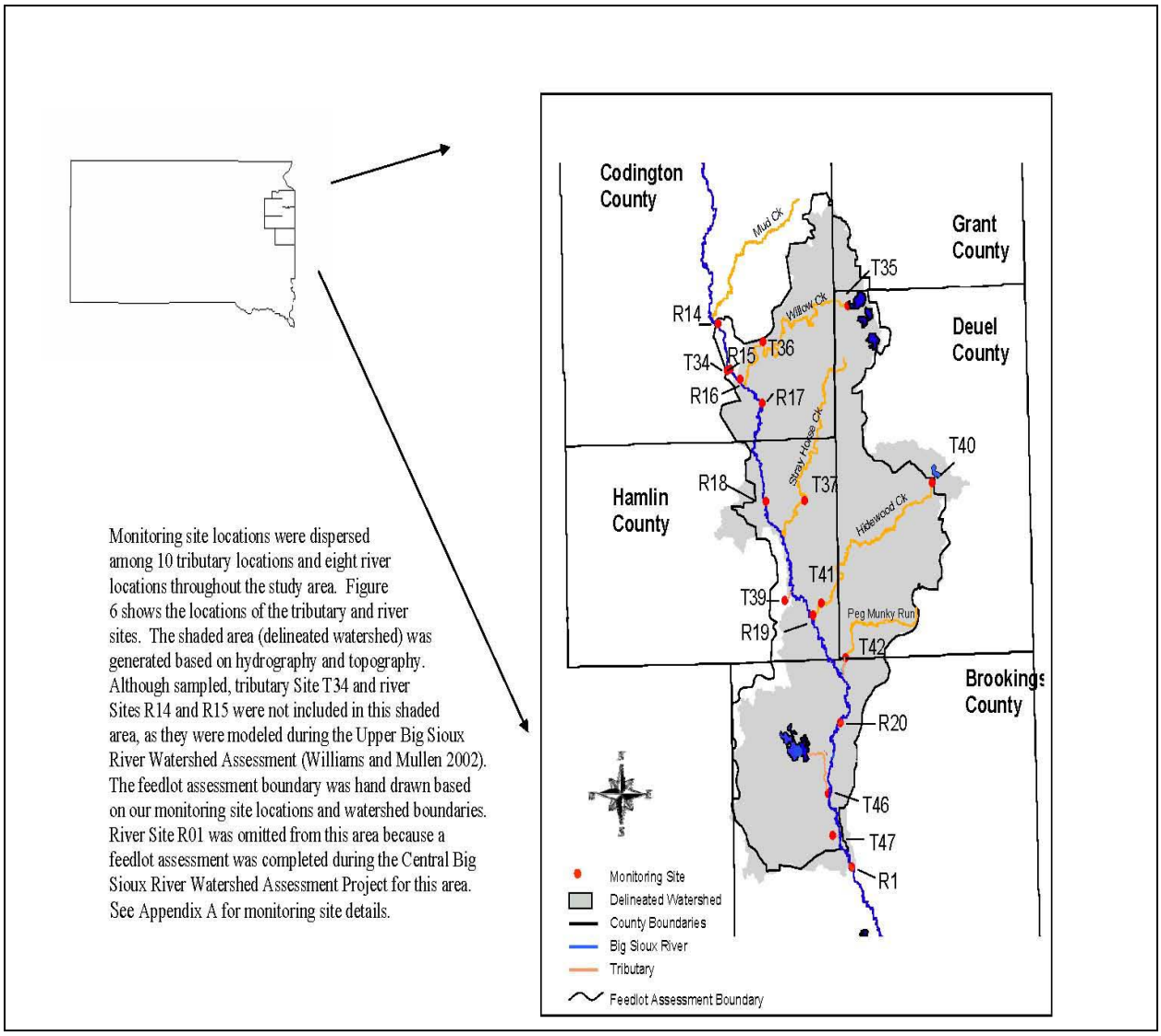


Figure 31: Monitoring Site Locations of the North Central Big Sioux River Watershed Project. **(**Monitoring sites shown are those used during the Assessment Project.)

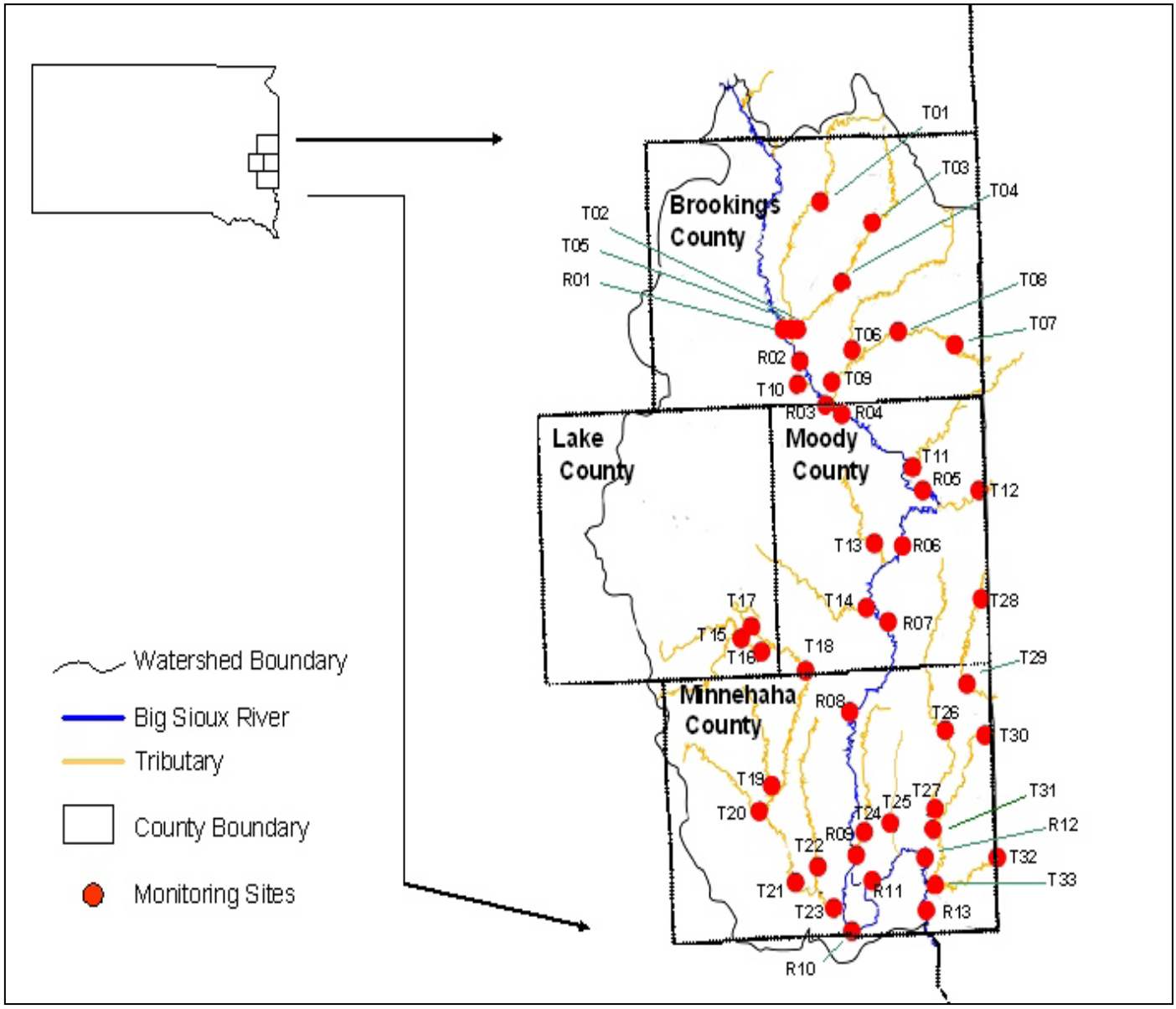


Figure 32: Monitoring Site Locations of the Central Big Sioux River Watershed Project. (Monitoring sites shown are those used during the Assessment Project.)

These areas represent locations that were used during the assessment phases of the watershed project. The following are the site used during the implementation phase. The following tables are the sites and descriptions to the project monitoring.

Table 25: Monitoring Sites along the Big Sioux River.

RIVER SITES 2006-08	SITE NAME	RIVER SITES 2009
R1	Brookings WQM 62	Not Monitored in 2009
R3	Brookings WQM 2	Not Monitored in 2009
R4	Brookings USGS gage	R4
R5	Flandreau –BS 18	Not Monitored in 2009
R6	At Egan	R6
R7	At Trent	R7
R8	Dell Rapids –WQM 3	Not Monitored in 2009
R9	At Diversion (Hwy 38)	Not Monitored in 2009
R10	At Western Avenue	R10
R11	At USGS North Cliff	Not Monitored in 2009
R13	Near Gitchie Manitou	R13
R14	near Watertown	R14
R15	At Broadway	R15
R16	At 20th Avenue	R16
R17	Below Watertown	R17
R18	At Castlewood	R18
R19	At Estelline	R19
R20	At Bruce	R20

Table 26: Monitoring Sites along the Tributaries to the Big Sioux River.

TRIBUTARY SITES 2006-08	SITE NAME	TRIBUTARY SITES IN 2009
T02	Lower North Deer Creek	Not Monitored in 2009
T04	Middle Six Mile Creek	Not Monitored in 2009
T05	Lower Six Mile Creek	Not Monitored in 2009
T11	Spring Creek	Not Monitored in 2009
T12	Flandreau Creek	Not Monitored in 2009
T13	Jack Moore Creek	Not Monitored in 2009
T14	Bachelor Creek	Not Monitored in 2009
T19	Colton Creek	Not Monitored in 2009
T20	West Branch Skunk Creek	Not Monitored in 2009
T21	Middle Skunk Creek	Not Monitored in 2009
T22	Willow Creek (Minnehaha Co.)	Not Monitored in 2009
T23	Skunk Creek	Not Monitored in 2009
T33	Lower Beaver Creek	Not Monitored in 2009
T35	Willow Creek – Waverly	Not Monitored in 2009
T36	Willow Creek - Watertown	Not Monitored in 2009
T37	Stray Horse Creek	Not Monitored in 2009
T40	Hidewood Creek – Clear Lake	Not Monitored in 2009
T41	Hidewood - Estelline	Not Monitored in 2009
T42	Peg Munky Run	Not Monitored in 2009

The next four charts show the results of the monitoring data that was collected. Samples were collected to determine the levels of the suspended solids and fecal coliform bacteria in the water. The samplers determined the water temperature, air temperature, pH, specific conductivity, salinity, dissolved oxygen, turbidity and samples were taken for nitrates testing. The results shown in the chart are divided into the middle Big Sioux River and the Lower Big Sioux River.

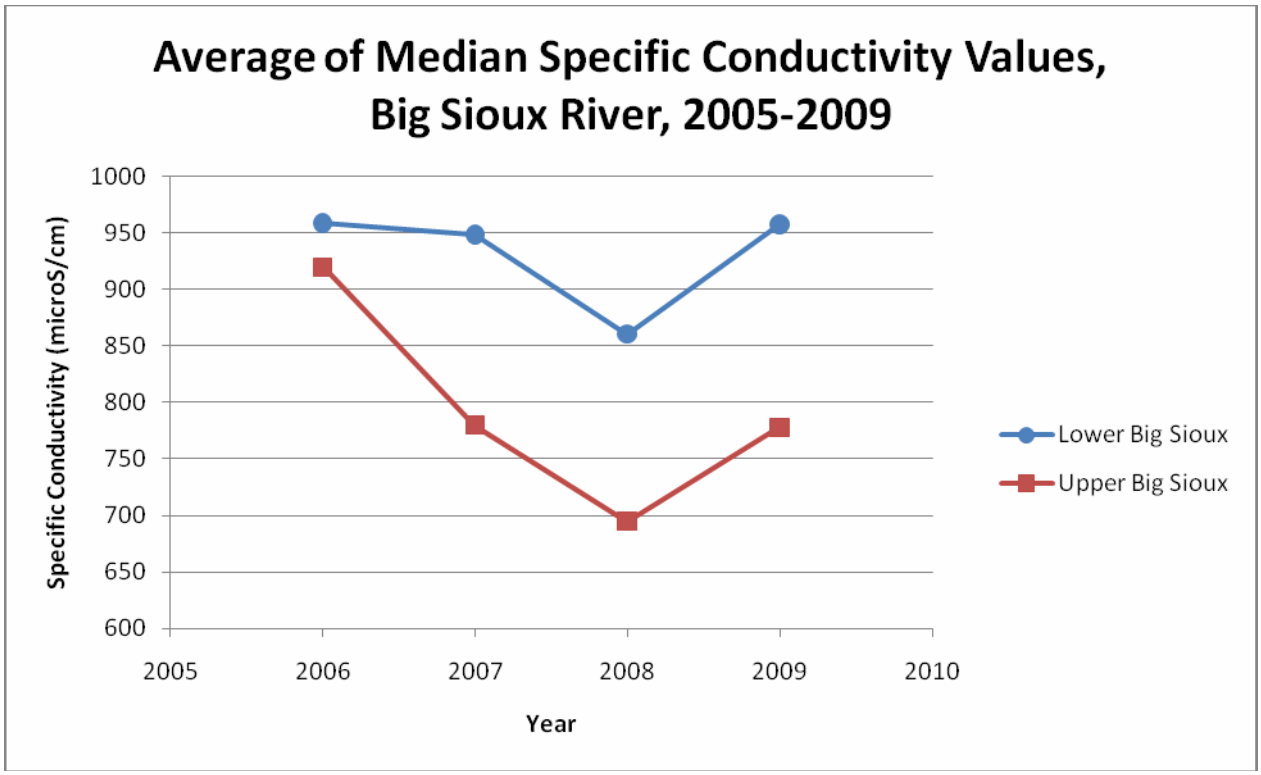


Figure 33: Average of Median Specific Conductivity Values.

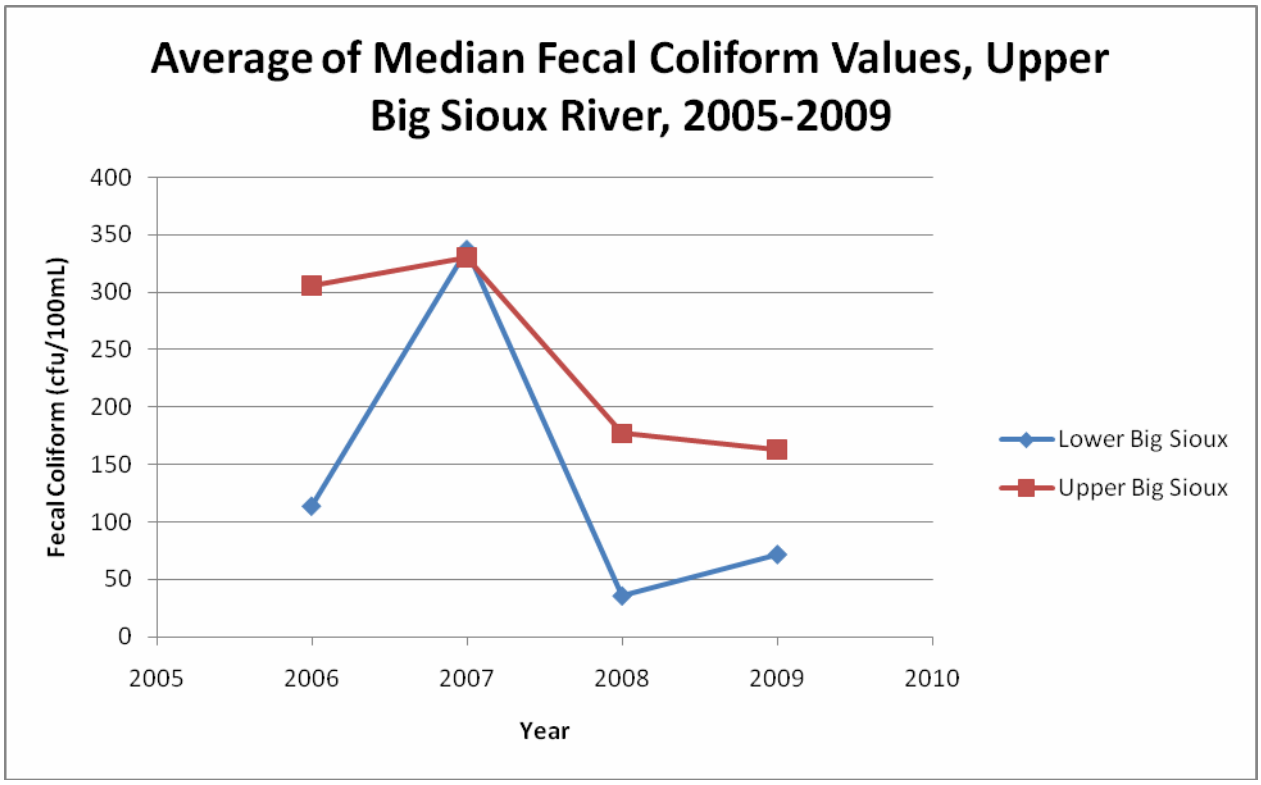


Figure 34: Average of Median Fecal Coliform Values.

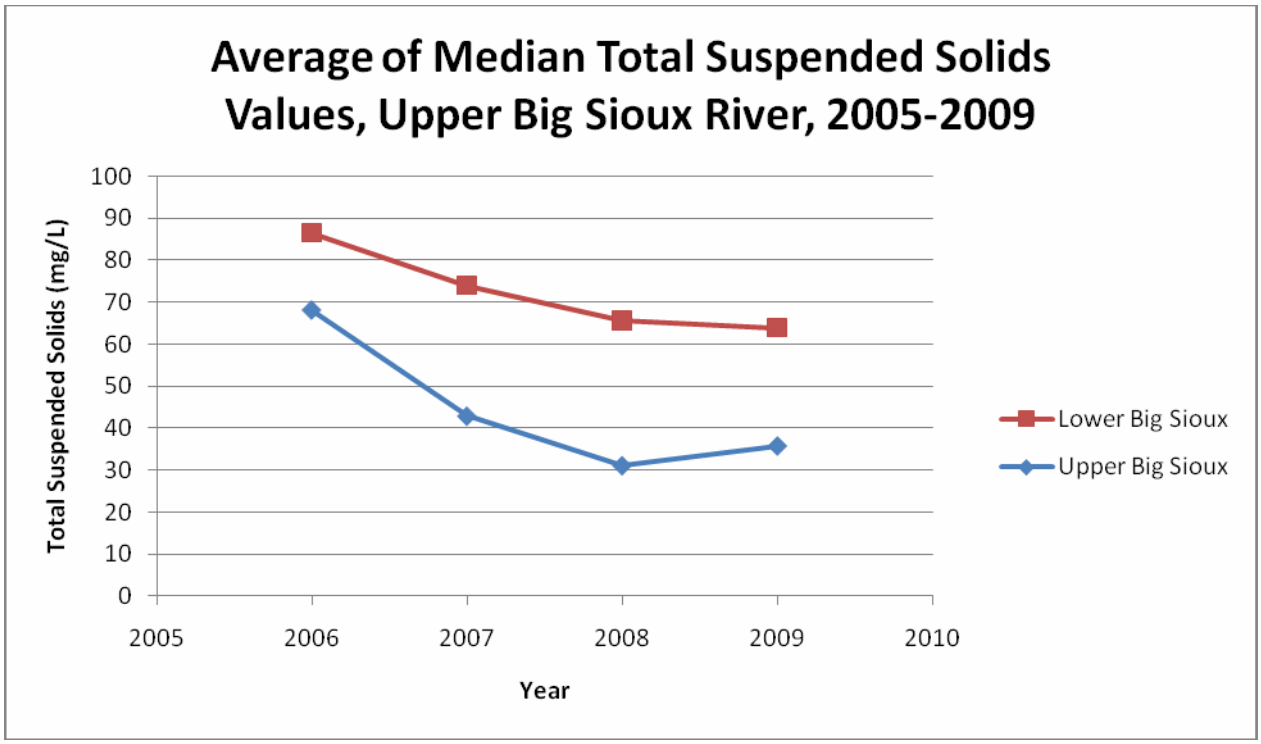


Figure 35: Average of Median Total Suspended Solids Values.

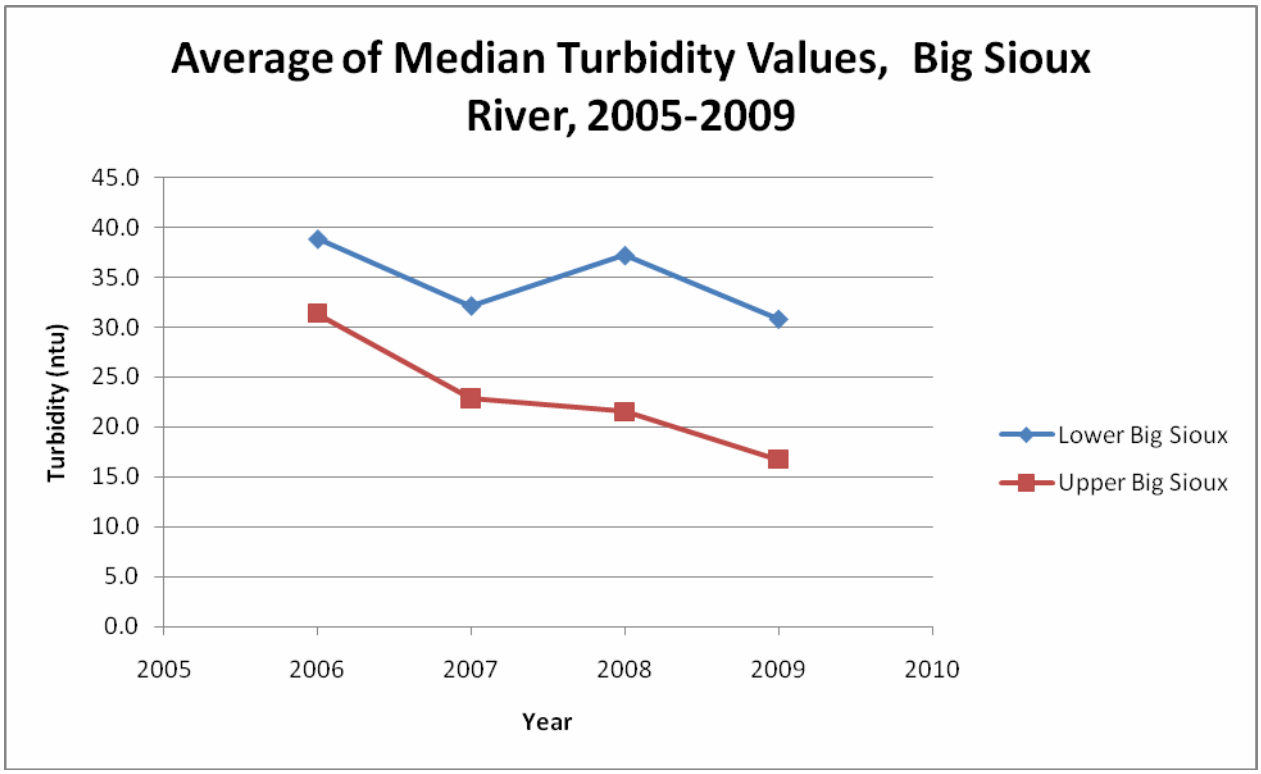


Figure 36: Average of Median Turbidity Values.

Even though the construction activities for the watershed project were completed March of 2010 the East Dakota Water Development District will continue to monitor during 2010. The data that was collected can be found in Appendix I of this report at http://denr.sd.gov/dfta/wp/wqinfo.aspx#Project.

The watershed project used "Step L" for the nitrogen and phosphorus load reduction determinations with the exception of the riparian area management that was used for pasture adjacent to the water body. For these areas we used the average weight for a cow calf pair, number of days in the pasture prior to the enrollment and the number of pounds of nitrogen and phosphorus produced per day and then reduced it by a factor to allow the nutrients that never reached the water way. For our purposes a one thousand pound animal produced the following: N = 0.37 lbs/day and P= 0.09 lbs/day.

Table 27: Pathogen and Phosphorus Reduction Target and Achieved for TMDL Segments.

	Pathogen (Coliform)		Phosphorus LB/Year	
TMDL Segment	Target	Achieved	Target	Achieved
Hidewood Creek	59%	9.43E+10		3,925.1
Stray Horse Creek	99%	8.75E+12		7,624.8
Peg Munky Run	38%	0		0
Spring Creek	45%	0		0
Flandreau Creek	91%	0		0
Jack Moore Creek	82%	0		0
Six Mile Creek	12%	8.41E+12		0
North Deer Creek	34%	0		391.2
Skunk Creek	95%	1.02E+13		1,966.2
Pipestone Creek	87%	8.98E+10		4,101.5
Beaver Creek	86%	0	1,711,539	0
Split Rock Creek	96%	1.01E+13	7,421,467	366.5
Willow Creek	45%	9.85E+13		9.4
BSR- SF WWTF to above Brandon	39%	0	19,948,392	0
BSR – near Dell Rapids to below Baltic	29%	5.03E+13		24,415.6
BSR – I-29 to near Dell Rapids		0	2,458,972	2,875.0
BSR – Brookings to I-29		1.51E+13	1,745,635	247.6
BSR – Stray Horse Creek to near Volga	45%	8.43E+13		1,660.4
BSR – Willow Creek to Stray Horse Creek	30%	2.65E+13		3,115.7
BSR – Lake Kampeska to Willow Creek	33%	1.12E+11		684.0
TOTAL		3.12E+14	31,086,005	51,383

Table 28: Nitrogen and Total Suspended Solid Reduction Target and Achieved for TMDL Segments.

	Nitrogen LB/Year		TSS Tons/Year	
TMDL Segment	Target	Achieved	Target	Achieved
Hidewood Creek		17,316.4		36.3
Stray Horse Creek		44,806.3		273.8
Peg Munky Run		0		0
Spring Creek		0		0
Flandreau Creek		0		0
Jack Moore Creek		0		0
Six Mile Creek		0		0
North Deer Creek		1,666.8		14.2
Skunk Creek		8,985.6		163.6
Pipestone Creek		18,219.6		42.5
Beaver Creek	14,013,904	0	19,613	0
Split Rock Creek	60,949,551	1,116.7	79,207	257.1
Willow Creek		60.8		4.8
BSR- SF WWTF to above Brandon	61,947,219	0	43,722	0
BSR – near Dell Rapids to below Baltic		69,249.0		28,534.6
BSR – I-29 to near Dell Rapids	9,696,928	11,883.6	735,227	515.2
BSR – Brookings to I-29	2,383,821	1,077.3	369	152.0
BSR – Stray Horse Creek to near Volga		7,656.8		636.1
BSR – Willow Creek to Stray Horse Creek		13,163.1		681.3
BSR – Lake Kampeska to Willow Creek		3,040.1		8.4
TOTAL	148,991,423	198,242	878,138	31,320

To evaluate the net impact of the watershed project at various points along the Big Sioux River one needs to include reductions achieved above lower segments and the tributaries. This is covered in the following tables by adding total reductions for each segment plus all those above it.

Table 29: Pollutants for TMDL Segment Big Sioux River Lake Kampeska to Willow Creek.

	Pollution Reduction		Units	TMDL
	Targeted	Achieved		
Pathogen (Coliform)	33%			Yes
Phosphorus		684	Pounds/year	No
Nitrogen		3,040.10	Pounds/year	No
Suspended Solids		8.4	Tons/year	No

Table 30: Pollutants for TMDL Segment Big Sioux River Lake Kampeska to Stray Horse Creek.

	Pollution Reduction		Units	TMDL
	Targeted	Achieved		
Pathogen (Coliform)	30%			Yes
Phosphorus		3,809.1	Pounds/year	No
Nitrogen		16,264.0	Pounds/year	No
Suspended Solids		694.5	Tons/year	No

Table 31: Pollutants for TMDL Segment Big Sioux River Lake Kampeska to I-29.

	Pollution Reduction		Units	TMDL
	Targeted	Achieved		
Pathogen (Coliform)				No
Phosphorus		17,658.2	Pounds/year	No
Nitrogen		88,787.6	Pounds/year	No
Suspended Solids	369	1,806.9	Tons/year	Yes

Table 32: Pollutants for TMDL Segment Big Sioux River Lake Kampeska to near Dell Rapids.

	Pollution Reduction		Units	TMDL
	Targeted	Achieved		
Pathogen (Coliform)				No
Phosphorus		20,533.2	Pounds/year	No
Nitrogen		100,671.2	Pounds/year	No
Suspended Solids	735,227	2,322.1	Tons/year	Yes

Table 33: Pollutants for TMDL Segment Big Sioux River Lake Kampeska to below Baltic.

	Pollution Reduction		Units	TMDL
	Targeted	Achieved		
Pathogen (Coliform)	29%			Yes
Phosphorus		44,948.8	Pounds/year	No
Nitrogen		169,920.2	Pounds/year	No
Suspended Solids		30,856.7	Tons/year	No

Table 34: Pollutants for TMDL Segments Big Sioux River Lake Kampeska to above Brandon.

	Pollution Reduction		Units	TMDL
	Targeted	Achieved		
Pathogen (Coliform)	39%			Yes
Phosphorus		51,383.0	Pounds/year	No
Nitrogen		198,242.1	Pounds/year	No
Suspended Solids	43,722	31,319.9	Tons/year	Yes

BUDGET

There have been a number of adjustments to the budget during the five years of the watershed project. Many of these adjustments have been driven by interest of landowners and operators of the land within the project area. These changes were approved by DENR and EPA prior to the adoptions of the new budget.

Table 35: Initial Budget.

Activity	EPA 319	Land-owner	SRF	Cons. Dist.	EDWDD	Balance
Obj.1/Task 1 AWMS						
Conv. AWMS Engineering	29,250	11,250			4,500	45,000
Conv. AWMS Construction	225,000	75,000				300,000
Alter. AWMS Engineering	19,500	7,500			3,000	30,000
Alter. AWMS Construction	135,000	45,000				180,000
Obj.1/Task 2 Water Access Restrictions						
Riparian Area Fencing		5,000		10,000	5,000	20,000
RWS Pasture Taps		21,875		43,750	21,875	87,500
Shallow Wells		25,000		50,000	25,000	100,000
Bachelor Creek Rock Crossing						
Obj. 2/Task 3 Bank Stabilization						
Skink Creek			2,284,535			2,284,535
Big Sioux River			200,000			200,000
Tributary Streams						
Bank Stabilization						
Obj. 2/Task 4 Riparian Area Protection						
Urban riparian easements			580,000			580,000
Rural riparian easements	199,375		1,304,000		96,625	1,600,000
CRP incentive (RAM)	39,375				13,125	52,500
Obj.3/Task5 Information & Education						
Public Outreach & Education	30,000				20,000	50,000
SDSU Extension						
Obj.4/Task 6 Water Quality Sampling						
WQ Sampling					31,500	31,500
QA/QC Samples						
Project Staffing & Administration						
EDWDD Staff	37,500				37,500	75,000
Contractual Services						
Conservation District Staff	75,000			25,000		100,000
SE Council of Government			150,232			150,232
Travel	20,000					20,000
Supplies & Materials	15,000					15,000
Totals	**825000**	**190625**	**4518767**	**128750**	**258125**	**5921267**

Table 36: Expenditures.

Activity	EPA 319	Land-owner	SRF	Cons. Dist.	EDWDD	Balance
Obj.1/Task 1 AWMS						
Conv. AWMS Engineering	20,143.44	5,518.80			2,091.36	27,753.60
Conv. AWMS Construction	306,839.25	218,817.00	3,801.22			529,457.47
Alter. AWMS Engineering	49,692.09	9,641.30			12,092.85	71,426.24
Alter. AWMS Construction	307,286.23	270,800.50	59,410.74		99,040.06	736,537.53
Obj.1/Task 2 Water Access Restrictions						
Riparian Area Fencing						
RWS Pasture Taps		6,911.94		3,947.96	2,551.46	13,411.36
Shallow Wells						
Bachelor Creek Rock Crossing	16,954.94	5,651.63				22,606.57
Obj. 2/Task 3 Bank Stabilization						
Skunk Creek			1,568,249.04			1,568,249.04
Big Sioux River			40,749.10			40,749.10
Tributary Streams			0			0
Bank Stabilization			1,173,533.26			1,173,533.26
Obj. 2/Task 4 Riparian Area Protection						
Urban riparian easements			0			0
Rural riparian easements	602,449.91		251,343.74		6,668.94	860,462.59
CRP incentive (RAM)	54,231.16				120,315.84	174,547.00
Obj.3/Task5 Information & Education						
Public Outreach & Education	29,054.65			142.5	14,712.19	43,909.34
SDSU Extension	43,755.18				16,234.50	59,989.68
Obj.4/Task 6 Water Quality Sampling						
WQ Sampling	20,000.00				10,530.66	30,530.66
QA/QC Samples						
Project Staffing & Administration						
EDWDD Staff	163,350.85				4,201.74	167,552.59
Contractual Services	58,295.57				1,883.49	60,179.06
Conservation District Staff	4,426.41			1,458.01		5,884.42
SE Council of Government			42,284.81			42,284.81
Travel	20,500.00				4,150.74	24,650.74
Supplies & Materials	8,772.14					8,772.14
Totals	**1,705,751.82**	**517,341.17**	**3,139,371.91**	**5,548.47**	**294,473.83**	**5,662,487.20**

The City of Sioux Falls has requested and received a revised project end date for their project. The plan for the City is to continue to develop the plans for phases 3 and 4 of their Big Sioux River bank stabilization. The completion of the City of Sioux Falls sponsored activity will not be contained in this report.

SUMMARY OF PUBLIC PARTICIPATION

The Central Big Sioux Watershed Project Steering Committee shared in the success of the watershed project. The project was dependent on bring in conservation districts, in each county that comprised the Central Big Sioux Watershed, on board. They needed to have ownership in the project for them to bring it to the landowners and operators in their counties. During 2005 there were a number of meetings with the steering committee that was made up of one board member and the full time employee of each of the conservation districts for the counties of Brookings, Codington, Deuel, Hamlin, Moody, Minnehaha counties. There were two members from the SD Association of Conservation District. Other people that were included were the USDA – NRCS - district conservationist from the participating counties. Staff with Northern Prairies Land Trust was included.

East Dakota Water Development District provided the sponsorship that made the Watershed Implementation project possible. They sponsored the watershed assessment project that demonstrated the need for the implementation project. They provided office space, local match and administrative assistance to the project.

Department of Environment and Natural Resources provided the administration of the Clean Water Act Section 319 Project Grants and the Clean Water State Revolving Funds. Section 319 funds were used throughout the watershed project whereas the State Revolving funds were limited to being used for part of Agricultural Waste Management, Conservation Easements, and Bank Stabilization Projects was funded by the State Revolving Funds.

Department of Agriculture provided the Coordinated Soil and Water Grant funds and its administration. This grant was applied for by the Moody County Conservation District.

South Dakota State University, SDSU, worked on a project to bring SDSU Extension Educators into the project with a study involving the "Better Management Practices to Improve Water Quality in the Central and Upper Big Sioux Watershed.

State Historical Preservation Office, SHPO, was the contact agencies to ensure that Cultural resources were not adversely impacted.

Conservation Districts from Brookings, Codington, Deuel, Hamlin, Minnehaha and Moody Counties provide supported project by providing the local contacts within the communities, served on the steering committee and financial assistance in making landowner payments for the RAM Program.

Northern Prairies Land Trust did much of the work on the conservation easement – site evaluation, document preparation, easement compliance, posting and preliminary survey

City of Sioux Falls applied to DENR for the State Revolving Funds and serve as the intermediary for the securing of these funds. The Bank Stabilization project was handled through the City. Their engineering department completed designs for the bank stabilization.

USDA Natural Resource Conservation Services, NRCS, and Farm Services Agency, FSA, provided technical and financial assistance for BMP installation through the Conservation Reserve Program, CRP, and Environmental Quality Incentives Program (EQIP).

During 2006, a public opinion survey was conducted by the Paulsen Marketing Communications of Sioux Falls, SD. Efforts were made to contact 136 people from a list provided by East Dakota Water Development District. There were 42 people that agreed to participate in the survey. Landowners and operators provided cash and in-kind labor toward the construction of animal waste management systems. They provided the management activities associated with the vegetation on the riparian management areas and conservation easements.

ASPECTS OF THE PROJECT THAT DID NOT WORK WELL

One must remember that the participation of landowners and operators in the watershed is purely voluntary. Thus motivation for the owners and operators come in the form of financial incentives. The conservation easements and the riparian area management, RAM, can work well with this scenario but that is not the case when looking at animal waste management systems. Most of the feedlots are not easily altered to make them environmentally friendly. Many require the owner to relocate his system to a better location. This costs the owner a great deal of money and the operator is going to be faced with the difficulty of trying to feedlot livestock while construction is taking place.

The owner/operators of feedlots are unfamiliar with the process of constructing new or altering old feedlots. They need to have someone that can spend a great deal of time with them to help throughout the building process. The current system does not provide that level of personal attention.

Landowners are faced with an economic challenge of farming and feeding livestock with there current systems. The watershed project tries to motivate these individuals to change their system, and spend at a minimum 25 to 50 percent of project costs out of their own money to make changes. The owners age and if they have family that will continue the feeding operation are also factors. Landowners need to take ownership in the new system and have a financial commitment in the system or it will not be used properly, and increasing the cost share would be a mistake. In many of these cases, without State and Federal pressure to force landowners to either change there system or cease operation, owners are likely not comply with project objectives.

FUTURE ACTIVITY RECOMMENDATIONS

Animal Waste Management Systems to be successful will need state and federal enforcement of the deadline to meet the Clean Water Act goals. The changing of the systems is going to be expensive and there needs to be a large pool of funds available to provide assistance. The primary area of emphasis needs to be place within two miles of the river or major tributaries. The assisting agency needs to be local contacts to effectively be available to provide the level of assistance that they need. Until the owners and operators feel that they need to change their systems or face closure the majority will not make any significant changes to how they are currently operating their systems.

Conservation Easements and Riparian Area Management (RAM the CRP counterpart) can be very effective and reasonable cost ways to provide a buffer system between the sources of non point pollution and the water bodies. The duration of the buffers needs to some flexibility to be able to meet the owner's needs. There should be a range of options from ten years up to a perpetual option available. The payment rates need to be based on the land value, land use history and duration of the contract. There needs to be an organization that is responsible to monitor the land to ensure that the contract is being complied with. This program can be effectively administered on a regional level.

Monitoring program needs to be established to determine if the installation of the best management practices are getting the desired results.

An ongoing information and education program will be needed to create awareness of the needs for water quality improvements and educate the people of the latest technology and programs that are available.

Acronyms and Abbreviations
There are dozens of acronyms and abbreviations used throughout this report. Refer back to this list to help you navigate through the alphabet soup.

AFO: Animal Feeding Operation – facility where animals are confined, fed, or maintained for a total of 45 days in any 12 month period, and where vegetation is not sustained in the normal growing season over any portion of the lot or facility
ARSD: Administrative Rules of South Dakota – legal statutes that specify standards or requirements
AGNPS: Agricultural Non-Point Source – an event-based, watershed-scale model developed to simulate runoff, sediment, chemical oxygen demand, and nutrient transport in surface runoff from ungaged agricultural watersheds
AnnAGNPS: Annualized Agricultural Non-Point Source model
AU: Assessment Unit
BMP: Best Management Practice – an agricultural practice that has been determined to be an effective, practical means of preventing or reducing nonpoint source pollution
BSR: Big Sioux River
CAFO: Concentrated Animal Feeding Operation
CCMP: Comprehensive Conservation and Management Plan
Cfs: Cubic Feet per Second
CFU: Colony Forming Units – a count of the number of active bacterial cells
CNMP: Conservation Nutrient Management Plan
COD: Chemical Oxygen Demand
CREP: Conservation Reserve Enhancement Program
CRM: Crop Residue Management
CRP: Conservation Reserve Program
CSP: Conservation Security Program
CWA: Clean Water Act
DO: Dissolved Oxygen
EDWDD: East Dakota Water Development District
EPA: [U.S.] Environmental Protection Agency
EQIP: Environmental Quality Incentives Program
FCB: Fecal Coliform Bacteria
FLGR 3: Feedlot and Grazing Reductions Model
FSA: Farm Service Agency
GAP: Gap Analysis Project
GIS: Geographic Information System
GPS: Global Positioning System
HUC: Hydrologic Unit Code
I/E: Information/Education
IR: Immersion Recreation
Kg/ha/yr: Kilograms per Hectare per year
Kg/yr: Kilograms per Year
LCR: Limited Contact Recreation
LULC: Land Use/Land Cover
MOS: Margin of Safety
Mg/L: Milligrams per Liter

NPS: Nonpoint Source
NPDES: National Pollution Discharge Elimination System
NRCS: Natural Resources Conservation Service
O&M: Operation and Maintenance
PSA: Public Service Announcement
QA: Quality Analysis
QC: Quality Control
RUSLE: Revised Universal Soil Loss Equation
SCS: Soil Conservation Service
SD: South Dakota
SDDENR: South Dakota Department of Environment and Natural Resources
SDGFP: South Dakota Game Fish and Parks
SDSU: South Dakota State University
SOP: Standard Operating Procedure
SPARROW: Spatially Referenced Regression on Watershed Attributes
SRF: State Revolving Fund
STEPL: Spreadsheet Tool for Estimating Pollutant Load
TDS: Total Dissolved Solids
TKN: Total Kjeldahl Nitrogen
TMDL: Total Maximum Daily Load – a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and an allocation of the amount to the pollutant's sources
TP: Total Phosphorus
TSI: Carlson's Tropic Status Index
TSP: Technical Service Provider
TSS: Total Suspended Solids
USDA: U.S. Department of Agriculture
USFWS: U.S. Fish and Wildlife Service
USGS: United States Geologic Survey
USLE: Universal Soil Loss Equation
WHP: Wellhead Protection
WQ: Water Quality – term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.
WQS: Water Quality Standard
WPC: Watershed Project Coordinator
WRDA: Water Resources Development Act
WRI: Water Resource Institute
WWFLP: Warm Water Fish Life Propagation
WWTP: Wastewater Treatment Plant