SECTION 319 NONPOINT SOURCE PROGRAM

WATERSHED PROJECT FINAL REPORT

CENTERAL BIG SIOUX RIVER WATERSHED IMPLEMENTATION PROJECT SEGMENT 2

BARRY BERG, PROJECT COORDINATOR

SOUTH DAKOTA ASSOCIATION OF CONSERVATION DISTRICTS

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This project was completed in cooperation with the South Dakota Department of Environment and Natural Resources and the United States Environmental Protection Agency, Region 8.

Grant #9998185-09, #9998185-10, #9998185-11

EXECUTIVE SUMMARY

PROJECT TITLE: Central Big Sioux River Watershed Project Segment 2

PROJECT START DATE: 20 July, 2011

PROJECT COMPLETION DATE: 31 July, 2015

FUNDING:

Funding Sources	Original Budget	Expended
U.S. EPA Section 319 Grant	$609,530.56	$456,336.64
City of Sioux Falls	$96,000.00	$93,392.20
City of Sioux Falls SRF NPS	$2,271,673.00	$1,412,851.35
CWSRF Water Quality	$86,000.00	$86,000.00
Conservation Districts	$32,050.00	$0.00
EDWDD	$43,900.00	$1,497.12
EQIP	$1,047,999.00	$1,135,583.53
USDA	$188,600.00	$442,098.09
Local Cash and In-Kind Match	$752,335.00	$1,961,438.47
Totals:	**$5,128,087.56**	**$5,589,197.40**

The project goal was to restore and protect the beneficial uses of the Big Sioux River and its tributaries (in South Dakota) from the confluence with Stray Horse Creek in Hamlin County to the mouth to the Missouri River. Goals were completed by implementing and promoting Best Management Practices (BMPs) in the watershed that reduced sediment loading and prevented bacterial contamination. Several river segments were required to reduce Total Suspended Solids (TSS) and/or bacteria (fecal coliform or E.coli) levels and to meet the 41 separate TMDLs developed for the river and its tributaries and lakes within the watershed.

The following actions were taken during this project segment to assist in attaining the goal:

- Merging the Central Big Sioux River Watershed Implementation Project with the Lower Big Sioux River Implementation Project to eventually become the Big Sioux River Watershed Implementation Project.
- Assembling a Big Sioux River Watershed Steering Committee comprised of a board of directors representing six County Conservation Districts, City of Sioux Falls, City of Brookings, South Dakota Department of Environment and Natural Resources (SDDENR) and East Dakota Water Development District (EDWDD) to develop TMDL implementation strategies based on the watershed assessments and TMDLs to guide future project segments.
- Initiating a public education and outreach campaign to inform landowners, stakeholders, and area residents of water quality issues and BMPs important to the Big Sioux River Watershed.
- Installation of BMPs were targeted toward identified high priority sub-watersheds.

During this segment of the project, the Lower Big Sioux River Watershed Project was merged with the Central Big Sioux River Implementation Project. The combined watershed Project Implementation Proposal (PIP) was completed, reviewed, and accepted in September 2012. The decision to merge the two watershed projects was based in part on geographic location, funding, and personnel restructuring. The milestones, budget, and BMPs were combined to satisfy the load reductions needed to fulfill the TMDLs set for the Central and Lower Big Sioux River Watersheds. The combination of the two projects resulted in the Central Big Sioux River Watershed Implementation Project Segment 2 which was later changed to the Big Sioux River Watershed Implementation Project Segment 2 to reduce confusion. The Moody County Conservation District accepted the lead sponsorship of the project. Brookings, Lake, Minnehaha, Lincoln, and Union Counties remained co-sponsors for the project and regularly attend steering committee meetings along with the City of Sioux Falls, City of Brookings, SDDENR and EDWDD.

The project goal was established based on water quality information gathered during the Central and Lower Big Sioux River Watershed Assessments. Initial water quality data indicated high levels of fecal coliform and/or E-coli bacteria and TSS in several segments of the watershed.

During the Central and Lower Big Sioux River Watershed Assessments, 1,525 livestock operations were located and analyzed using the Agricultural Non-Point Source (AGNPS) pollution feedlot model. Of the 1,525 operation assessed, 492 operations were ranked at or above 50. Prioritization of animal feeding operations started with AGNPS livestock operations ranking over 50, operations that were within one mile of the Big Sioux River and impaired Tributaries, and through the use of mapping tools. Riparian Area Management (RAM) and a new Seasonal Riparian Area Management (SRAM) programs were implemented to initially target Skunk Creek, a tributary of the Big Sioux, to address E-coli and TSS. The program's success and addition of State Revolving Fund Non-Point Source funds allowed for expansion to other impaired tributaries in the watershed and the Big Sioux River itself.

A total of 10 feasibility studies and 14 Animal Waste Management Systems (AWMS) were completed along with two clean water diversions during this segment of the project. Bank stabilization was completed on 1,270 linear feet of the Big Sioux River. One drain tile Bioreactor was installed in cooperation with South Dakota State University Water Resource Institute. The Water Resource Institute had previously installed 4 Bioreactors installed and decided to add the additional Bioreactor to their study and agreed to monitor it throughout the study. Cropland BMPs implemented during this segment were: 47.5 acres of Continuous Conservation Reserve Program (CCRP), 79.2 acres of filter strips, 8,202 linear feet of grassed waterways, 6,647 linear feet of terrace restoration with 93,222 linear feet of Environmental Quality Initiative Program (EQIP) terraces and 1,490.4 acres of conservation tillage adopted. Riparian projects included: 16.8 acres of conservation easements; 73.3 acres of Conservation Reserve Program (CRP) buffers totaling 12,073 linear feet of stream protection; 17.3 acres of RAM and 585.3 acres of SRAM totaling 91,886.4 linear feet of stream protection; 6 planned grazing systems with 6 alternative water sources and 7,999 linear feet of fence. The Water Quality Credit Trading Plan is in the final stages of development and will be finalized during Segment 3 of this project. Information and Education carried out included: 66 meetings with the City of Sioux Falls, Conservation Districts, and other partners associated with the watershed project; 21 press releases/news articles/news interviews related to the goals of the project and progress/innovative ideas being implemented. EDDWD collected 993 water quality samples at various monitoring sites throughout the watershed.

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INTRODUCTION

The Central Big Sioux River Watershed Implementation Project was a 10-year Total Maximum Daily Load, (TMDL) implementation strategy that was to be completed in multiple segments. The project goal 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 and Lower Big Sioux River Watershed Assessments identified various segments of the Big Sioux River and certain tributaries between Watertown, South Dakota and Sioux City, Iowa as failing to meet designated uses due to impairments from TSS, dissolved oxygen (DO), Chlorophyll-a, fecal coliform and/or E-coli bacteria. Several TMDLs were developed for these segments (See Table 1). Activities were to improve and/or maintain current sediment and bacterial loadings targeted sub-watersheds within the project area. East Dakota Water Development District continued with water quality sampling throughout the project segment in effort to collect several years of data that would be used in future modeling and decision making. The monitoring sites are shown in relation to the watershed (Figure 4). An information and education campaign was launched in partnership with the City of Sioux Falls to keep the public informed of project activities and to provide information on BMPs and water quality issues within the city itself and the surrounding watershed.

In addition to the river segments and creeks specifically noted in Table1, additional sub-watersheds were found to be contributing impairments to downstream water bodies. In some instances, addressing pollution sources in areas not technically impaired (due to a lack of a defined beneficial use or uses) may be necessary to meet TMDLs.

The Big Sioux River basin is located in northwest Iowa, southeastern South Dakota, and southwest Minnesota (Figure 2). The lower portion of the Big Sioux River forms the border between Iowa and South Dakota from the Iowa/Minnesota border to the Missouri River. Since a major portion of the basin is located in both Minnesota and Iowa, TMDLs were based in part on data from those portions of the watershed that have been assessed by their respective states. Implementation projects in both Minnesota and Iowa will need to address impairments to their contributing watersheds and apply BMPs based on respective loadings in order to attain the TMDLs that have been developed. This project focused on the South Dakota portion of the watershed (Figure 3).

Several water bodies, over a substantial geographic area, are impaired within the Big Sioux River watershed. The impairments impact the use of the river and streams for boating, fishing, swimming and other recreational uses. Further, while the impairments have not yet affected use of the river as a domestic water supply, the increased loading may require more extensive purification treatment in the future. The City of Sioux Falls periodically extracts its drinking water from the Big Sioux River. Correcting these problems will have an impact well beyond the current recreational and aesthetic problems.

The Central Big Sioux River, North-Central Big Sioux River/Oakwood Lakes Watershed and Lower Big Sioux River Assessment Projects identified several sources of TSS and bacteria (fecal and E. coli) that constitute the primary impairments in the area. Excessive TSS, i.e., fine sediment suspended in the waters of the river and its tributaries, are found primarily in the Big Sioux River and Skunk Creek. Segments not technically exceeding the applicable standard still

have levels that contribute to impairments downstream. TSS levels in most tributaries are below beneficial use standards, suggesting that current land-use practices within these areas do not result in sediment loading. The exception is found in southern Minnehaha, Lincoln and northern Union Counties where natural conditions may exacerbate human impacts on sediment loading. Consequently, BMPs aimed at sediment reduction were focused on the Big Sioux River Main-stem and major tributary sub-basins. Riparian area management and terrace restoration were identified as the principle BMPs.

Table 1: Beneficial Use Impairments Identified in the Central Big Sioux River Watershed (2014 South Dakota Integrated Report for Surface Water Quality).

Impaired Water Body	Impaired beneficial use	Cause
Big Sioux River		
Near Volga to Bookings	WWSFLP	TSS
Brookings to Moody Co. Line	WWSFLP	TSS
S2-104N-49W to I-90	IR, WWSFLP	FCB & EC, TSS
I-90 to Diversion return	IR, LCR, WWSFLP	FCB & EC, TSS
Diversion return to SF WWTF	IR, LCR, WWSFLP	FCB & EC, TSS
SF WWTF to above Brandon	IR, WWSFLP	FCB & EC, TSS
Above Brandon to Nine Mile Creek	IR, LCR, WWSFLP	FCB & EC, TSS
Nine Mile Creek to near Fairview	IR, WWSFLP	FCB & EC, TSS
Fairview to Alcester	IR, LCR, WWSFLP	FCB & EC, TSS
Near Alcester to Indian Creek	IR, LCR, WWSFLP	FCB & EC, TSS
Indian Creek to Mouth	IR, WWSFLP	FCB & EC, TSS
Beaver Creek 2 (Minnehaha)	LCR, WWSFLP	FCB, TSS
Beaver Creek 1 (Lincoln)	LCR	FCB
Peg Munky Run	LCR	FCB
Pipestone Creek	IR	FCB & EC
Six Mile Creek	LCR, WWMFLP	FCB & TSS
Skunk Creek	LCR, WWMFLP	FCB, TSS
Split Rock Creek	IR	FCB
Brule Creek	LCR	EC
East Brule Creek	LCR, WWMFLP	FCB, TSS
Willow Creek	LCR	FCB
Lake Alvin	WWPFLP	Temperature
East Oakwood Lake	IR, LCR, WWSFLP	PH, Chlorophyll-a
Lake Herman	IR, LCR, WWSFLP	Chlorophyll-a
Lake Madison	IR, LCR, WWSFLP	Chlorophyll-a
West Oakwood Lake	IR, LCR, WWSFLP	Chlorophyll-a

LCR - limited contact recreation standard = 2,000 colonies per 100 milliliters of water;
EC - E. *coli* bacteria;
FCB - fecal coliform bacteria
WWSFLP - warm water semipermanent fish life propagation-applicable standard varies with water body;
WWMFLP - warm water marginal fish life propagation - applicable standard varies with water body;
WWPFLP - warm water permanent fish life propagation – applicable standard varies with water body;
TSS - total suspended solids;
IR - immersion recreation standard = 400 colonies per 100 milliliters of water;
DO - dissolved oxygen.

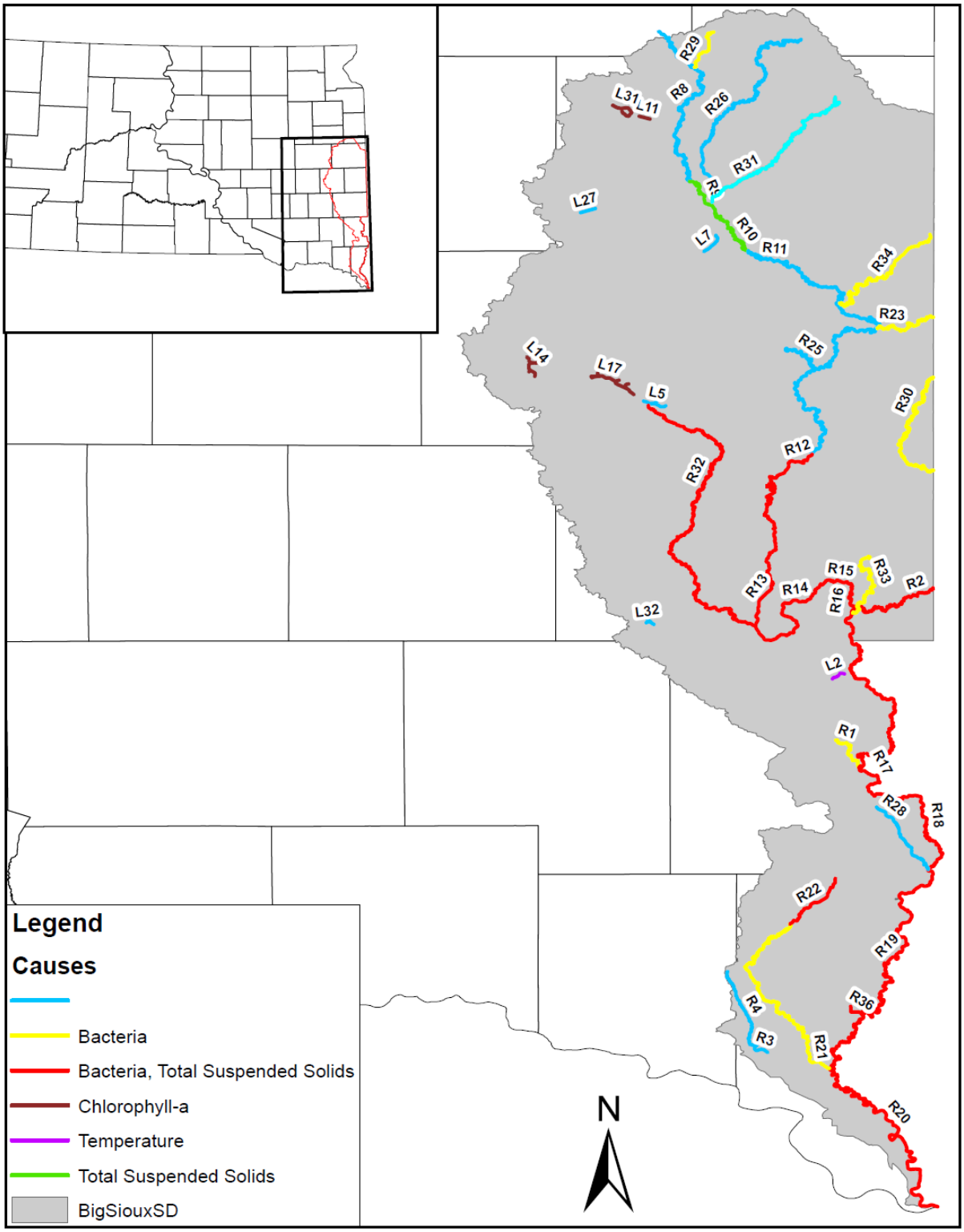


Figure 1: Big Sioux River Impaired Segments

Bacteria (fecal and E. coli) impairments were encountered throughout the study area, although the highest levels were detected in the southern end of the watershed. The source of the bacteria is believed to be primarily domestic livestock, although human, pet and wildlife sources have been found to contribute a portion of the total load encountered. Bacteria levels were analyzed at

several river/stream flow conditions in an effort to determine the timing of major loadings. The most significant loadings were measured during high flow events, which were coincident with either major storms or spring snow melt. The bacteria encountered there were carried into the receiving waters by runoff, most likely from animal feeding operations. One thousand five hundred twenty five (1,525) animal feeding operations were inventoried and assessed using the AGNPS Feedlot Subroutine throughout the watershed. Four hundred ninety two (492) of the feedlots had AGNPS ratings of 50 or higher, and are candidates for improvement to reduce loadings. However, elevated levels of bacteria were also encountered during periods of low flow, often many weeks after a runoff event. Under these conditions, animal feeding operations would not be expected to contribute, and the source is likely to be animals grazing in close proximity to the river and creeks. BMPs to address the bacterial impairments include installation of animal waste management systems at existing feedlots and restricting access to the water bodies by grazing animals.

Details and additional information of the results of the Central Big Sioux River Watershed Assessment Project; the North-Central Big Sioux River/Oakwood Lakes Watershed Assessment Project and the Lower Big Sioux River Watershed Assessment Project can be found in the Final TMDL reports. Visit the Department of Natural Resources webpage at the following address: http://denr.sd.gov/des/sw/surfacewaterquality.aspx for additional information.

See Milestone Table pg. 26

The Big Sioux River Watershed Project encompasses the Big Sioux River (in South Dakota) between the Brookings/Hamlin County Line in the north and Sioux City Iowa in the south. The project watershed area is approximately 2,107,000 acres (see Table 2).

Table 2: Big Sioux River and its Basin Features.

Waterbody Name:	Big Sioux River, 18 impaired stream segments and 2 impaired lakes
Hydrologic Unit Code:	Big Sioux River – 10170202, 10170203
SD DENR Waterbody ID:	SD-BS-R-BIG_SIOUX_04-17
Location:	S27, T113N, R51W to S30, T89N, R47W
Impaired Beneficial Use and Cause:	See Table 2.1
Major Tributaries (South Dakota):	Peg Munky Run, North Deer Creek, Skunk Creek, Beaver Creek, Brule Creek
Major Tributaries (Minnesota):	Beaver Creek, Pipestone Creek, Split Rock Creek, Rock River
Major Tributaries (Iowa):	Rock River, Sixmile Creek, Indian Creek, Broken Kettle Creek
Receiving Waterbody:	Missouri River
Big Sioux River Segment Length:	311 miles
Watershed Area: **Total** **South Dakota** **Minnesota** **Iowa**	 3,921,000 acres 2,107,000 acres 937,000 acres 877,000 acres

The Big Sioux River and major tributaries are permanent water courses within the project area. There are also numerous intermittent tributaries which carry water only during spring snow melt or rainfall events. The Big Sioux River ultimately drains to the Missouri River at Sioux City, Iowa. The river also receives storm sewer discharges or otherwise enhanced runoff from several communities along its course in South Dakota including the cities of Brookings, Flandreau, Dell Rapids, Sioux Falls, Brandon, Canton and Hudson. Cites along the River on the Iowa side include Hawarden and Akron. Sections of the stream have been impacted by channelization (straightening and/or artificial stabilization) and numerous road crossings over the river and tributaries.

Many segments of the river do not fully support the designated uses, particularly with regard to limited contact or immersion recreation (Table 1). The 1998 South Dakota 303(d) Waterbody List, and subsequent versions in 2006 and 2008, identified this portion of the Big Sioux River watershed as impaired and a priority for TMDL development. Fifteen impairments were known at the start of the studies, seven for total TSS, six for bacteria, one for nitrate and one for trophic state index (East Oakwood Lake). Since the completion of the Lower and Central Big Sioux River Watershed Assessment Projects, a total of 40 impairments have been identified: 19 for fecal and E. coli; 15 for TSS; one for temperature; one for PH and 4 for Chlorophyll-a. A total of 41 separate TMDL reports have been prepared as a result of the assessment projects. The reports formed the basis for the Big Sioux River Watershed Implementation Project.

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 Big Sioux River 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 Big Sioux River 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. Land use in the watershed is primarily agricultural. Row crops, such as corn and soybeans, dominate, but significant tracts are also in grass and/or pasture land. The watershed assessments identified approximately 1,525 animal feeding operations located within the confines of the project area. Significant residential development has taken place around the cities of Sioux Falls, and Brookings, and smaller communities in the region are experiencing similar growth. Total population in the project area is roughly 250,000.

Entire Big Sioux River Watershed

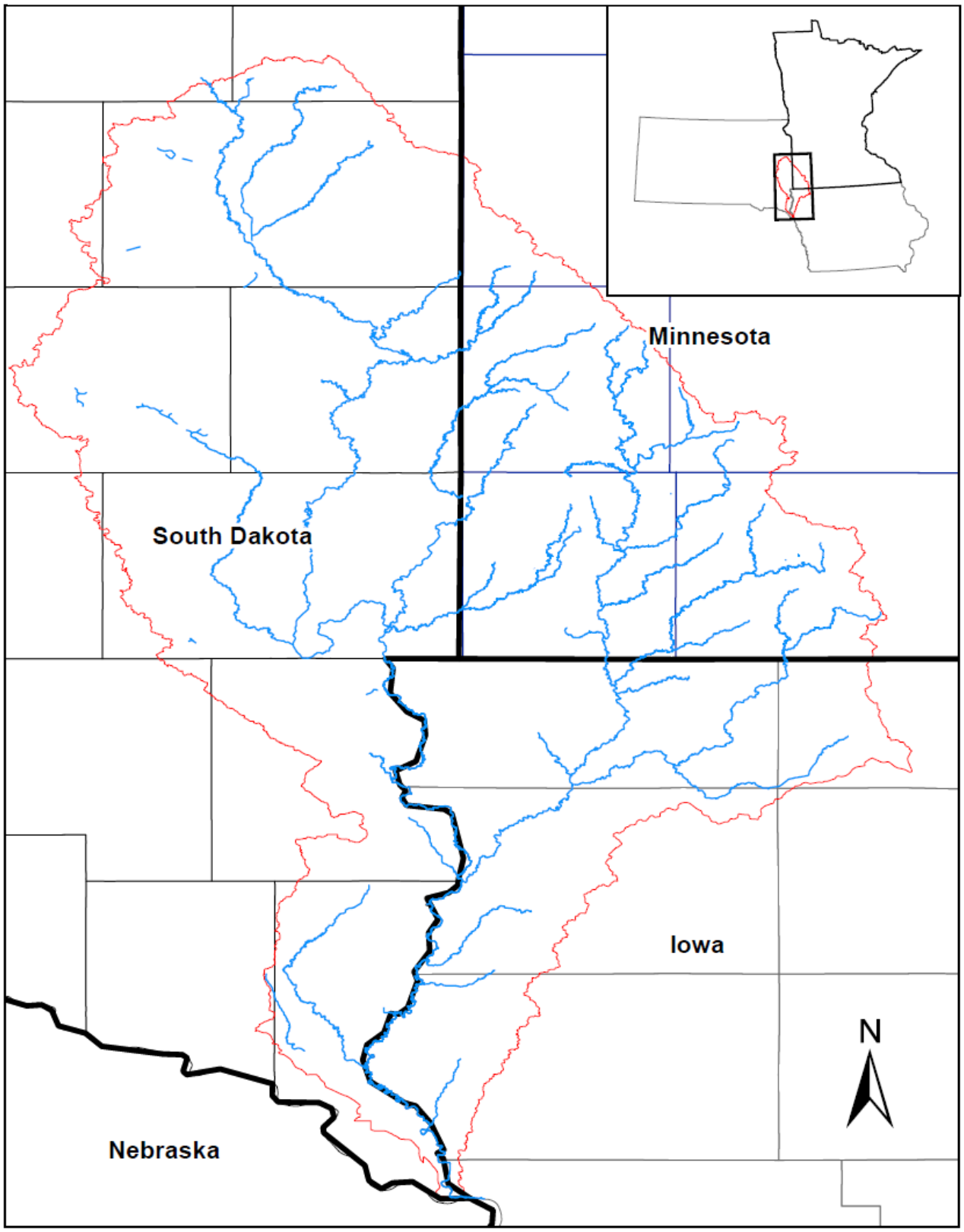


Figure 2: Entire Watershed

Big Sioux River Watershed

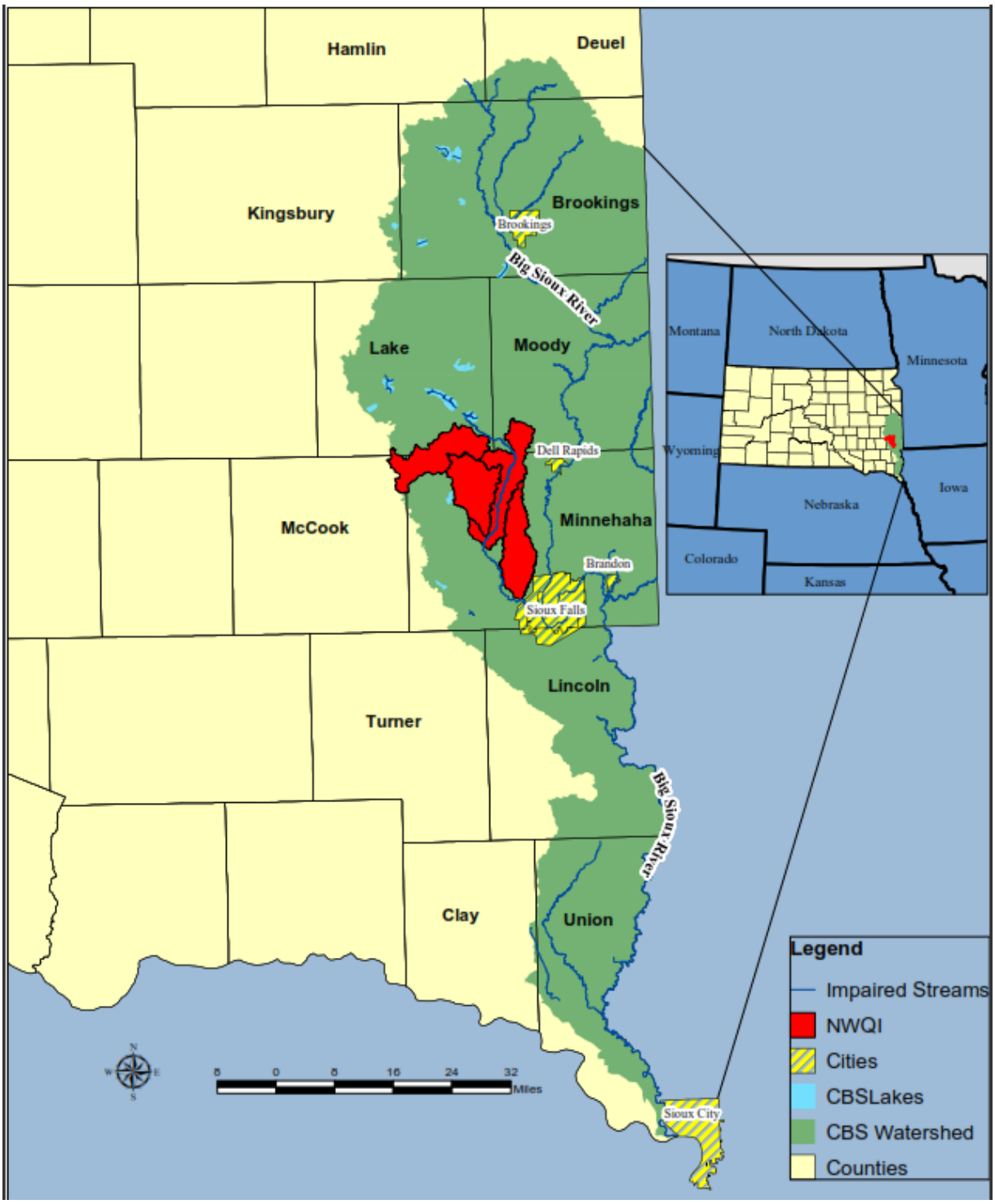


Figure 3: Project Area

Big Sioux River Project Area

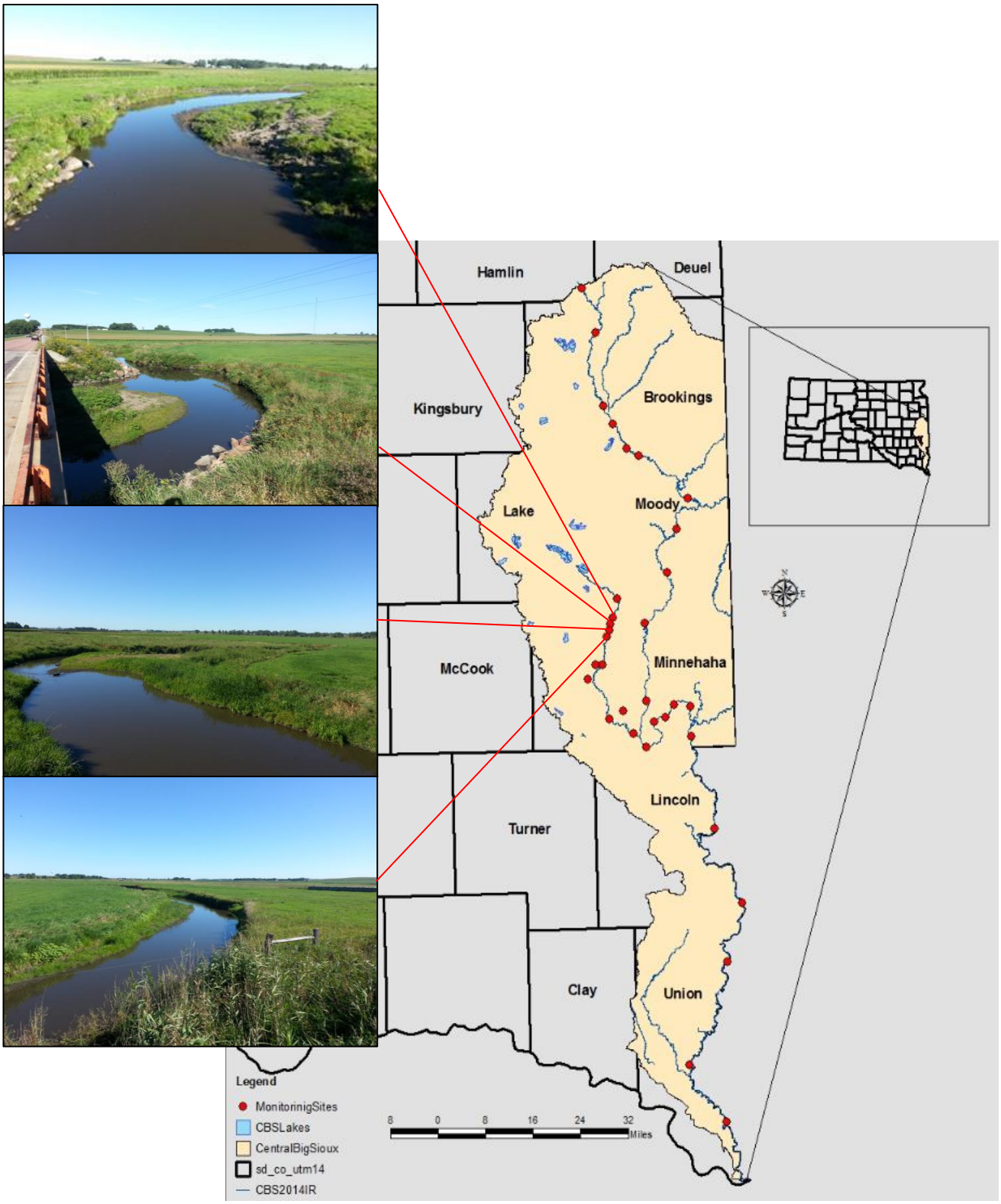


Figure 4: Current Water Quality Monitoring Project

Several of the monitoring sites shown in (Figure 4) were used during the Central Big Sioux River Watershed Assessment Project, many of which were reused during the current project to assess the impact of various BMPs.

The Central Big Sioux River and the North-Central Big Sioux River/Oakwood Lakes Watershed Assessment Projects were initiated at the request of local organizations and citizens concerned about water quality problems in the Big Sioux River between the communities of Watertown and Brandon. The main issues were related to high suspended sediment loads that adversely affected fish populations (both numbers and diversity) and high bacterial loads that limited water use for swimming and boating.

The watershed assessments included:

- River and tributary water monitoring from 1999 through 2003;
- Quality assurance/quality control for water quality samples;
- River and tributary stage and discharge determinations;
- Biological monitoring (fish and insects);
- Watershed modeling using a sediment delivery model; and
- Review of previous water quality data collected for the watershed.

The assessment project confirmed that most segments of the Big Sioux River, and many of the tributaries, were impaired due to high levels of bacteria. The limited contact standard of 1,178 colonies per 100 ml of water, which is applicable to the entire river stretch, was most often exceeded during high flow events, suggesting runoff from feed lots as a source. However, high E. coli counts at low flow rates suggest that animal grazing in or near the river and its tributaries is a significant influence. The E. coli problem becomes particularly acute below the community of Dell Rapids, where the more stringent immersion recreation standard (235 colonies per 100 ml) is also applicable. For most of the watershed below this point, reductions in excess of 75% to 95% are needed to meet the beneficial use standards. In this area, both feedlots and riparian area grazing are known issues.

Table 3: Fecal and E. coli Bacteria Reductions Needed by TMDL Segment.

Site ID	High Flow Reduction Needed (cfu/day)		Moist Flow Reduction Needed (cfu/day)		Mid Flow Reduction Needed (cfu/day)		Dry Flow Reduction Needed (cfu/day)	
	FCB	EC	FCB	EC	FCB	EC	FCB	EC
R-1 (Beaver Creek 01) **	8.74E+13	None	1.48E+12	None	None	None	6.30E+10	None
R-2 (Beaver Creek 02) **	3.12E+13	None	None	None	None	None	None	None
R-12 (Big Sioux 08) *	6.22E+12	None	2.12E+12	None	2.77E+12	None	2.48E+12	None
R-13 (Big Sioux 10) *	1.06E+13	None	1.82E+13	None	2.09E+12	None	9.17E+11	None
R-14 (Big Sioux 11) *	3.18E+13	None	1.28E+13	None	3.21E+12	None	1.54E+12	None
R-15 (Big Sioux 12) *	4.15E+13	None	1.59E+13	None	3.20E+12	None	1.29E+12	None
R-16 (Big Sioux 13) *	8.85E+12	5.20E+12	None	None	None	None	None	None
R-17 (Big Sioux 14) *	2.61E+13	1.53E+13	None	None	None	None	None	None
R-18 (Big Sioux 15) *	2.18E+14	1.28E+14	1.92E+13	1.13E+13	None	None	None	None
R-19 (Big Sioux 16) *	9.05E+13	5.31E+13	6.96E+12	4.09E+12	None	None	None	None
R-20 (Big Sioux 17) *	7.45E+14	4.38E+14	None	None	None	None	None	None
R-22 (East Brule Creek 01) *	7.98E+14	None	1.09E+13	None	1.12E+12	None	4.56E+11	None
R-29 (Peg Munkey Run 01) *	1.76E+15	None	None	None	6.79E+10	None	1.77E+09	None
R-30 (Pipestone Creek 01) **	5.31E+12	None	None	None	6.87E+11	None	None	None
R-31 (Six Mile Creek 01) **	1.10E+10	None	None	None	None	None	None	None
R-32 (Skunk Creek 01) **	4.12E+14	None	None	None	None	None	None	None
R-33 (Split Rock Creek 01) **	1.28E+14	None	3.62E+12	None	5.67E+11	None	None	None
R-36 (Union Creek 01) *	5.84E+15	None	4.00E+16	None	4.70E+15	None	5.50E+12	None

*** margin of safety included in calculation**

**** margin of safety not included in calculation**

TSS impairments are limited to the Big Sioux River below Brookings. Excessive TSS levels in the tributaries only occur in the lower part of Skunk Creek and the Pipestone Creek/Split Rock Creek system. Degraded riparian areas and stream bank erosion are believed to be the primary source of sediment, along with remobilization of in-stream sediment. Low sediment inputs from most tributaries indicate current land-use practices are successfully limiting erosion. High sediment levels found in the tributaries that span eastern and central Minnehaha County are attributed to the relatively high erosion potential of the soils in the area.

In several instances, some of the sub-watersheds assessed during the study had no applicable water quality standard. However, the loadings resulting from these sub-watersheds will need to be addressed if subsequent downstream water bodies are to be brought into compliance.

Since the start of Segment 2 of this project NRCS has selected four HUC 12s for the National Water Quality Initiative (NWQI) within the watershed. Due to NWQI requirements more intense monitoring of the HUCs had to be incorporated into the project. The 22 Big Sioux River monitoring sites and 11 tributary sites are shown in Figure 4. Of the 11 tributary sites, four were added to monitor the impacts of BMPS in the NWQI area. Also shown in Figure 4 are the NWQI monitoring sites in relation to their location in the watershed.

Table 4: TSS Reductions Needed by TMDL Segment.

Site ID	High Flow Reduction Needed	Moist Flow Reduction Needed	Mid Flow Reduction Needed	Dry Flow Reduction Needed
	TSS (tons/year)	TSS (tons/year)	TSS (tons/year)	TSS (tons/year)
R-1 (Beaver Creek 01)	None	None	None	None
R-2 (Beaver Creek 02)	None	None	None	None
R-12 (Big Sioux 08)	25039	None	None	None
R-13 (Big Sioux 10)	None	8,505	None	None
R-14 (Big Sioux 11)	871,218	None	None	None
R-15 (Big Sioux 12)	237,652	None	None	None
R-16 (Big Sioux 13)	Assessment Initiated	Assessment Initiated	Assessment Initiated	Assessment Initiated
R-17 (Big Sioux 14)	Assessment Initiated	Assessment Initiated	Assessment Initiated	Assessment Initiated
R-18 (Big Sioux 15)	556,880	239,257	1,095	621
R-19 (Big Sioux 16)	1,448,576	273,568	13,322	10,768
R-20 (Big Sioux 17)	5,627,315	147,570	30,843	212,067
R-22 (East Brule Creek 01)	Assessment Initiated	Assessment Initiated	Assessment Initiated	Assessment Initiated
R-29 (Peg Munkey Run 01)	None	None	None	None
R-30 (Pipestone Creek 01)	None	None	None	None
R-31 (Six Mile Creek 01)	None	None	None	None
R-32 (Skunk Creek 01)	Initiated	Initiated	Initiated	Initiated
R-33 (Split Rock Creek 01)	TMDL Reduction Met	TMDL Reduction Met	TMDL Reduction Met	TMDL Reduction Met
R-36 (Union Creek 01)	None	None	None	None

Project Goals, Objectives, Tasks and Activities

Objective 1: Reduce bacteria (fecal, E.coli) 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: <u>Livestock Nutrient Management</u>. Assist livestock producers to install 10 Animal Waste Management Systems (AWMS) at critical locations within the project area to reduce bacterial and sediment loading.

Products: Feasibility studies on 13 animal feeding operations; engineering designs and plans for 12 AWMSs; prepared by third-party engineering firms/technical service providers or United States Department of Agriculture, Natural Resource Conservation Service engineers (USDA-NRCS), 6 clean water diversions, and 10 AWMS installed for existing high priority feedlots or feeding areas.

Milestones:	**Planned**	**Completed**
Feasibility Studies	13	10
Engineering Design	12	14
AWMS Installed	10	7
Clean Water Diversions	6	2

Accomplishment: Three feasibility reports were started with the interim project with two reports being completed. The third report was completed in this segment of the project along with 9 additional feasibility reports completing a total of 10 reports. Fourteen designs have been completed with 7 AWMS's constructed. Two clean water diversions were installed as supporting practices with two of the AWMS's. Producers interested in AWMSs were taken on two separate tours to look at barns that were built with assistance from the project. It gave them the opportunity to discuss pros and cons of the barns and see the different configurations. This also allowed them to see the finished product and if it was something that would fit their operation. Only one conventional open lot system was constructed while Mono-slope confinement barns constituted 6 of the AWMS's that were implemented. Several other AWMS's were under construction toward the end of Segment 2 and are scheduled to be completed in Segment 3 of the project. Figures 5 – 7 are before and after pictures of a few of the systems that were constructed in the watershed.

Figure 5: Before and after Deep Pit Barn.

Figure 6: Before, Open lots

Figure 7: After, Manure Pack Barn & Conventional Open Lot System

Task 2: <u>Riparian Area Protection</u>. 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.

Products: 100 Acres of riparian area management, 500 acres of seasonal riparian area management, 100 acres of riparian area easements, two prescribed grazing management plans developed and 1,270 linear feet of bank stabilization, and rehabilitation of existing stabilization structures as needed.

Milestones:	**Planned**	**Completed**
Riparian Area Management (RAM)	100 ac.	17.3 ac.
Seasonal Riparian Area Management (SRAM)	500 ac.	585.3 ac.
Riparian Area Easements	100 ac.	16.8 ac.
Prescribe grazing management plans	2 plans	3 plans
Bank Stabilization	1,270 LF.	1,270 LF.

Accomplishment: Two producers were contacted and plans started for CCRP buffers, RAM and easements along the Big Sioux main stem during the interim project. The process has been continued in segment two of this project and completed in the fall of 2012. The end result was a 16.8 acre easement with Northern Prairies Land Trust, 9.9 acres of RAM and 18.7 acres of CRP on the Big Sioux River. The project completed 7,908 linear feet of fence to exclude the livestock from the river. Three water tanks were used for alternative water that was already constructed during the interim project. The two projects together protected 6,329 linear feet of the river. Other CRP projects completed on the Big Sioux River included an additional 73.3 acres and 12,073 linear feet of riparian area protected. RAM was completed on two sites along Skunk Creek. One site was a buffer for cropland and did not require an exclusion fence. The other site required 1,682 of fencing with two alternative water developments. Together both sites protected 3,324 linear feet of Skunk Creek (Figure 8 & 9). Three grazing management plans were developed for the sites as well. One plan was started in Segment 2 for CRP and Ram on Willow Creek and will be completed in Segment 3.

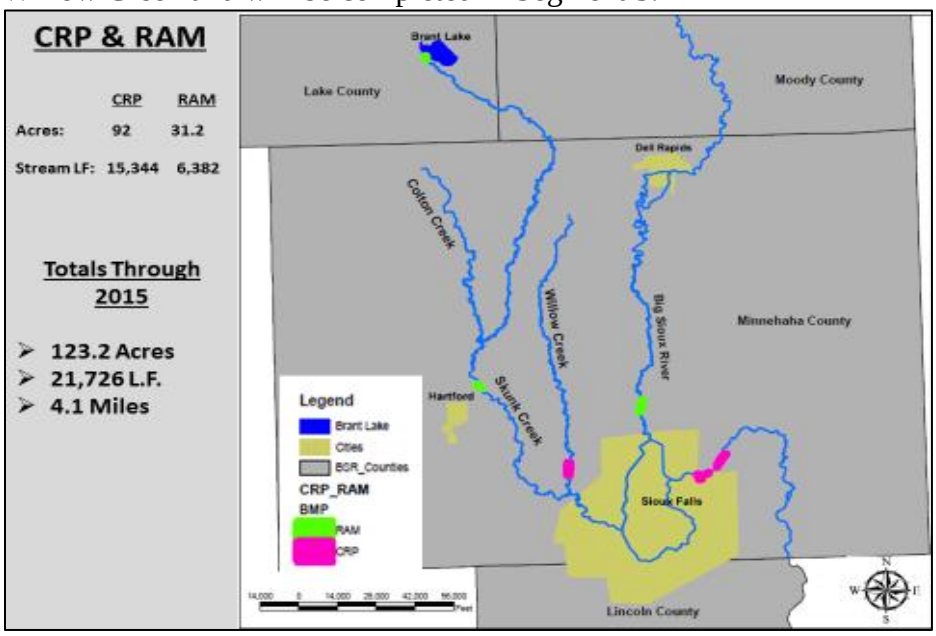


Figure 8: CRP/Easement/RAM Areas

Seasonal Riparian Area Management (SRAM) was a new program developed in Segment 2 of the Central Big Sioux River Watershed Project. Enrollment of land immediately adjacent to Skunk Creek and within the 100 year flood plain was eligible for the program. Livestock producers enrolling pasture into the program were paid $60 per acre to defer grazing from April through September but be allowed to dormant graze from October through April as long as a minimum vegetative stand of 4 to 6 inches remains. If requested, alternative water was provided during the dormant grazing period to minimize impacts on the riparian area. Haying was allowed from April through September for the acres enrolled to utilize the forage and maintain the vigor of the vegetative stand. Fencing, pipelines and tanks were eligible for cost share not to exceed 75 percent project incentives with 25 percent producer match. The program has been piloted and evaluated on Skunk Creek for two years in Segment 2 and has shown a considerable amount of success in reduction of E-coli. Due to the success and acceptance of the SRAM program, it is planned to be expanded to the rest of the project watershed with emphasis still on the major tributaries in the Skunk Creek basin. It has been one of the most aggressive and accepted programs that has been implemented in the Big Sioux River Watershed. Figures 1- 6 below are before and after pictures of photo points where the SRAM program was implemented.

During Segment 2, 585.3 acres were enrolled in the SRAM program totaling 57,458 linear feet of stream bank protection. Most of the producers opted to just hay the SRAM acres and not carry out a fall grazing. One producer that wanted to conduct fall grazing was assisted with installing an alternative water source, a rock crossing and 1,062 linear feet of fence.

Figure 9: Pasture Before and After SRAM

Figure 10: SRAM Before and After

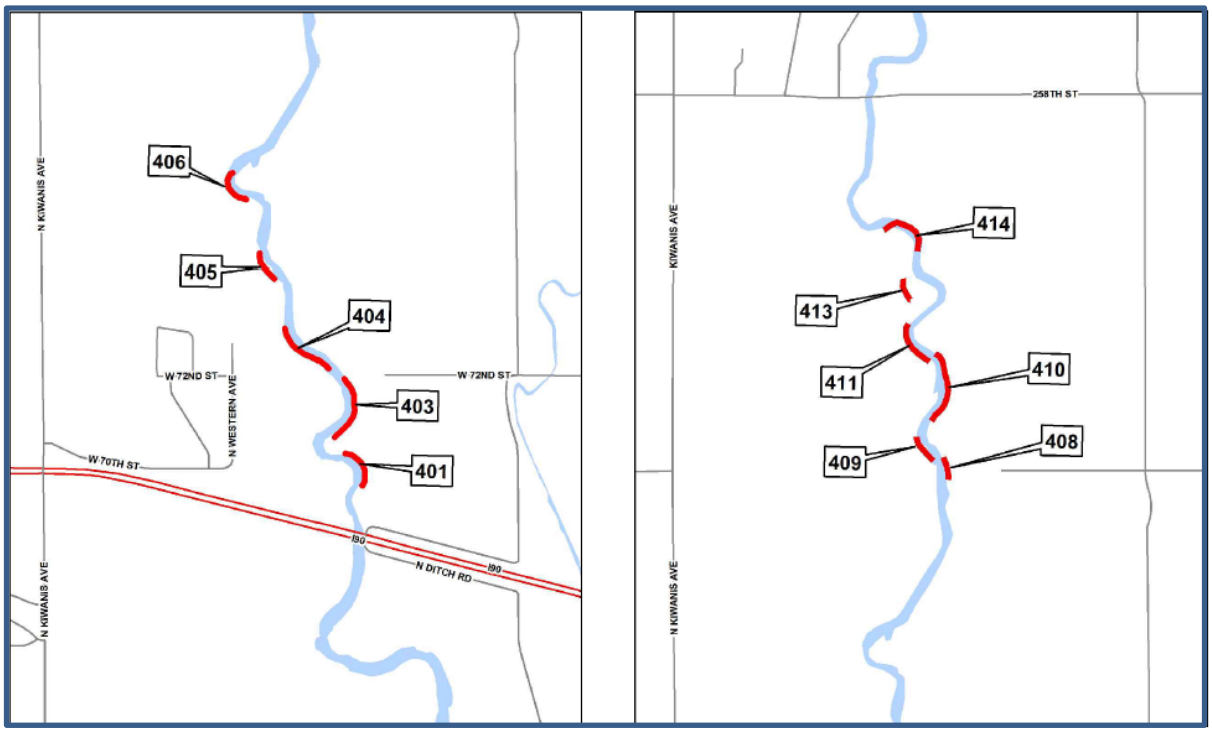


Figure 11: Phase 4 Site Locations

The Bank stabilization along the Big Sioux in this segment of the project was completed in 2012. There was 1,270 linear feet of damaged sites repaired at multiple locations on the Big Sioux River between Baltic and Sioux Falls. The sites were originally completed in 2011 and did not have enough time to revegetate when severe flooding damaged them. Two sites in Phase 4 were not completed in the winter of 2011 (sites 411 & 413) because the ground was warming and the sites were not accessible when the contractor was to start construction. Site 411 and 413 were planned for completion during Segment 2. Site 413 was completed during January 2012, but Site 411 had been selected for a log jam demonstration based on findings from ARS, and has not been completed to date.

Some sites had shown failures after the water receded in late 2011 (Figure 12). Water levels remained high until July/August and caused damage to about half of the bank stabilization sites from Phase 3 and 4. The perceived cause for the failure of these sites was not having adequate protection between the top of the rock and the top of the bank since vegetation was not given enough time to fully establish before the extended high flows. The sites that were damaged were repaired in the fall of 2011 (Figure 12-13). Since waters levels were high for so long most of the trees couldn't be planted. The trees were planned for later in this Segment but were not planted because the sites were growing with the existing seed from trees along the riparian area. Phase 1 and 2 sites from Segment 1 handled the extra water without any major failures. These sites had higher rock elevations and adequate time for vegetation to establish.

Figure 12: Damaged Site 406 (August 2011)

Figure 13: Repaired Site 406 (August 2014)

Task 3: <u>Cropland Management BMPs.</u> Provide assistance for producers with Cropland to protect priority areas of the Big Sioux River and its tributaries.

Products: Twenty acres of filter strips, 9,847 LF of terraces, and 10,000 linear feet of grassed waterways on cropland. BMPs installed will be funded by the landowner/operator, USDA conservation programs (EQIP and CCRP) and by state conservation programs.

Milestones:	**Planned**	**Completed**
Filter Strips	20 ac.	79.2 ac.
Terrace Restoration	9,847 LF.	6,647 LF.
Grass Waterways	10,000 LF.	8,202 LF.

Accomplishment: 79.2 acres of filter strips were installed throughout the watershed. Producers were assisted with planning through the Farm Service Agency and NRCS to enroll the acres into CRP. Assistance was provided to four landowners with terrace systems that had exceeded their lifespan or had filled in over time to restore capacity and functionality reducing sediment delivery. Terraces were cleaned out and graded to their original design specifications. The project also worked with landowners to repair terrace systems damaged by large rain events and wildlife to restore them back to their original state. New terrace systems were directed towards the EQIP program for funding. Over the course of the implementation project, the terrace restoration project restored 6,647 linear feet of failing and damaged terraces. Technical assistance was provided by the project coordinator and NRCS to determine eligibility of terrace restoration projects. The terrace restoration program though this project and the increased size of farm implements has increased interest in the EQIP terrace program. Several producers have either put in new terraces or rebuilt older terraces to fit larger farming equipment. Most of the terrace work has taken place in Lincoln and Union Counties primarily because of the Loess soils and more rugged landform. During this segment, 93,222 linear feet of terraces were completed through the EQIP program. The project will continue with the restoration program to reduce TSS transport to surface waters by helping with smaller projects that may not rank high enough for EQIP yet still need repairs to keep them from failing.

Task 4: <u>Alternative Water Quality Treatments</u>. Provide demonstration treatment to tile outlets to reduce nitrate levels of tile discharge entering impaired water bodies. BMPs will be implemented and monitored as demonstration projects to provide treatment for agricultural land tile discharge. Emphasis will be tile lines that discharge directly into the Big Sioux River or tributary streams.

Products: Two demonstration projects for treatment of tile outlets that discharge directly into the Big Sioux River or tributary streams. Monitoring will be completed on tile outlet treatment inflow and outflow to determine the effectiveness of the demonstration projects.

Milestones:	**Planned**	**Completed**
Tile Bioreactor	2	1
Sampling	10	10

Accomplishment: One Bioreactor was installed on the Dewey Gevik Learning Center (Hartford Site) West of Sioux Falls. It was installed in cooperation with the SDSU Water Resources Institute (Figures 14 & 15). The Water Resources Institute planned to assimilate the Bioreactor

in their already ongoing research project. Their current project collected water samples from the 4 Bioreactors that were installed in previous years. SDSU collected 10 samples above the Bioreactor and 10 samples below during Segment 2. A copy of the annual report has been included in a separate appendix to this report.

Figure 14: Bioreactor Lining

Figure 15: Bioreactor with Woodchips

Objective 2: Increase public awareness of water quality issues in general (project activities and results in particular) throughout the Big Sioux River watershed. Promote sound BMPs that best address priority impairments.

Task 5: <u>Public Information and Outreach.</u> Conduct informational meetings and provide mailings and new releases to the public for information on the project. Demonstrate the value of strategically placed watering systems for improved soil and water quality, riparian and bank protection, and cattle gains. Through the services of East Dakota Water Development District complete a survey of landowners within the project area to determine their concerns and activities that they are willing to undertake.

Products: Completion of landowner survey within the watershed. Conduct at least one public meeting within each county and major cities to discuss the project and the activities that will be undertaken. Develop web site links to existing web sites of Conservation Districts, East Dakota Water Development District and City of Sioux Falls to provide information to the public on what activities are happening within the watershed.

Milestones:	**Planned**	**Completed**
Public Meetings	4	4
News Releases	2	21
Landowner Survey	1	0

Accomplishment: An advertisement was printed in the local newspapers for informational meetings to be held at various locations throughout the watershed. The public was informed of the project goals and opportunities for participation at those meetings. Since the start of Segment 2 of the project, 21 Newspaper articles/news interviews/media events were completed. The Mayor of Sioux Falls has been very instrumental in helping bring the Big Sioux River Watershed Project and water quality issues to the public's attention (Figure 16). Other events and news releases that showcase what is being done to improve water quality are in separate appendix to this report. Questions were developed for a landowner survey, but the survey was not implemented.

Figure 16: Mayors Big Sioux River Annual Summit

Objective 3: Water Quality Credit Trading (WQCT) Pilot Program and Master Plan development.

Task 6: <u>Develop a pilot WQCT program</u> that can be used by communities such as Sioux Falls to improve water quality conditions within the Central Big Sioux watershed.

Products: A pilot program that can be used by communities to fund BMPs in the watershed that will help the meet future TMDL requirements.

Milestones:	**Planned**	**Completed**
Submit WQCT Report to USDA & US EPA	1	0

Accomplishment: A Water Quality Credit Trading Program was developed and informally tested on one AWMS and two SRAM practices in the Watershed. No actual credits were traded, but the process was evaluated and documented. The final report is set to be completed during Segment 3 of this project.

Task 7: <u>Develop a Water Quality Master Plan</u> for the Central Big Sioux River Watershed (CBSRW). Create a plan that can be used by water quality professionals, planners, and stakeholders as a decision-support framework to guide them in the cost effective watershed scale investments to help bring stream segments into compliance with assigned beneficial uses. Following are the major components of this Water Quality Master Plan:

- Obtain and integrate all pertinent water quality studies, model results, and data into a centralized spatial GIS database.
- Establish a technical steering committee and an informal watershed stakeholders group to facilitate the development of the master plan and provide necessary public outreach and involvement.
- Expand the existing watershed model developed for the Sioux Falls TMDL study using Hydrologic Simulation Program – Fortran (HSPF) to include the entire CBSRW project area.
- Develop decision-support framework to assist in the selection, prioritization, and placement of water quality BMPs to improve water quality of impaired reaches of the CBSRW.
- Evaluate federal Water Quality Trading regulations and develop methodologies to incorporate these opportunities between point source and non-point source entities within the CBSRW.
- Develop an adaptive prioritized BMP Implementation Plan component to incorporate cost effective schedules associated with funding alternatives.

Products: Organize, public notice, and facilitate four CBSRW Steering Committee meetings.
Organize, public notice, and facilitate four CBSRW Stakeholders meetings.
Organize and facilitate one CBSRW field tour early in the project.
Develop and deliver a Water Quality Master Plan to CBSRW Steering Committee.

Milestones:	**Planned**	**Completed**
Stakeholder Meetings	4	4
Steering Committee Meetings	4	16
Watershed Tour	1	7
Draft Water Quality Master Plan	1	1
Final Water Quality Master Plan	1	1

Accomplishment: A Stakeholder Group and Steering Committee were set up for this project. Later, the two groups were merged into a Steering Committee and structured with voting members. The voting members were comprised of the 6 Conservation Districts, City of Sioux Falls, City of Brookings, City of Brandon and EDWDD. Several watershed tours were completed during as well. One tour illustrated BMPs that were implemented by producers to protect and improve water quality in the Big Sioux River and Skunk Creek (Figure 17). The individuals that participated in the tour were the Watershed Coordinator Barry Berg, South Dakota's Secretary of Agriculture Lucas Lentsch, South Dakota Senator Shantel Krebs, Moody County Conservation District Chairman Jack Majeres, Minnehaha County District Conservationist Deron Ruesch and a reporter for the Argus Leader Peter Harriman. The Group met with producers during the tour and discussed what conservation and clean water meant to their operations. After the tour, the Sioux Falls Argus Leader produced a front page article on

the work being done to improve water quality and how producers were helping achieve the project goals. Another tour was set up to show the City of Sioux Falls Environmental Division personnel the work being done in the watershed and results it had on water quality. RESEC Engineering was hired as the consultant for completion of the master plan. A draft Master Plan was delivered to the Steering Committee during 2013 for review and was finalized during September of 2013. Copies of the final Master Plan were given to members of the Steering Committee.

Figure 17: Big Sioux River & Skunk Creek Tour

Task 8: <u>ARS Design Criteria</u> and Citing on Bank-toe Protection

Products: The design criteria and sites will be identified from using the concepts model on the Big Sioux River.

Milestones:	**Planned**	**Completed**
Design Criteria/Final Report	1	0

Accomplishment: Three draft reports and an Engineered Log Jam (ELJ) design guidelines paper were produced by ARS for review. Final versions of these reports are expected to be completed during the next segment of this project.

The reports consist of

- "Physical-Scale Models of Engineered Log Jams for the Big Sioux River, SD"
    - This report was drafted without information from a movable bed model that was constructed for this report, but that information is intended to be placed in the final version of the Log Jam report.
- "Preliminary Results, Design Guidelines for ELJs"
- "Analysis of Bank Erosion Along Skunk Creek, South Dakota"
- "Bank Erosion and Stabilization of the Big Sioux River between Dell Rapids and Sioux Falls, South Dakota"
    - See Figure 18 for a map showing the erosion potential along the Big Sioux from this report.

A site that was not completed during phase 4 of the bank stabilization project is planned to implement an ELJ based on findings from the ELJ report and Design Guidelines during the next

segment of this project. Large trees with the root ball still attached are already at this site. It was suggested by ARS to complete another study to gage the effectiveness of the ELJ that will be installed, but no commitments have been made at this time. Stabilization through future segments of the Big Sioux River Watershed Implementation Project will consider findings from the other reports drafted by ARS.

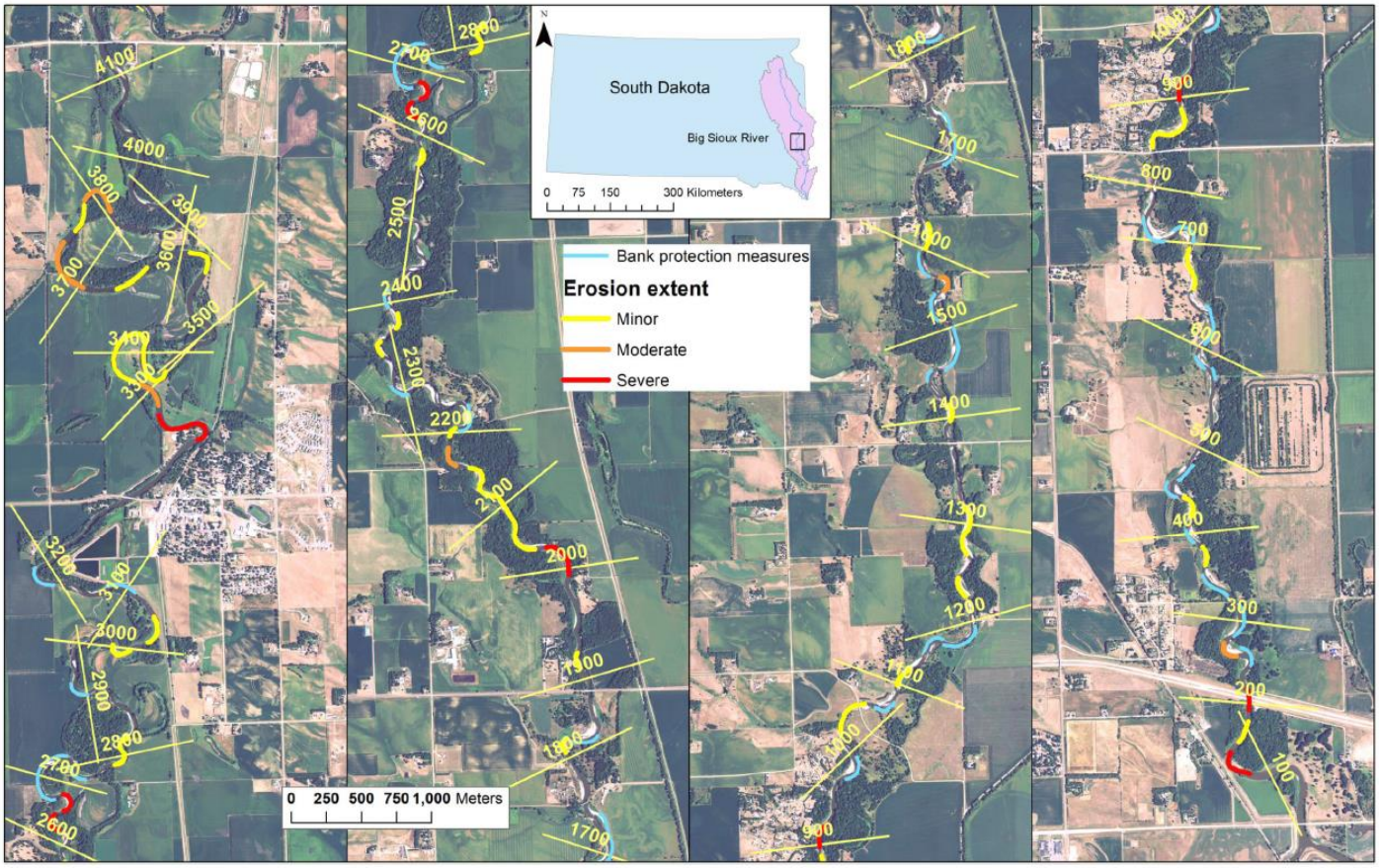


Figure 18: Erosion Potential along the Big Sioux River

Objective 4: <u>Conduct water quality monitoring</u> to assess project impacts on impaired water bodies.

Task 9: Monitor water quality at the 33 river and tributary locations.

Products: 560 water quality analyses for TSS and bacteria (fecal and E. coli), and other parameters, from 33 sites in the project area. 120 replicate or blank quality assurance/quality control samples were collected.

Milestones:	**Planned**	**Completed**
Water Samples/Testing by EDWDD	680	993

Accomplishment: EDWDD has completed all sampling during this project. Below is a list of sites and location in the watershed.

Site	Location
R19	Big Sioux River (BSR) @ Estelline
R20	BSR @ Bruce
R1	BSR @ 8th Street South
R2	BSR @ 216th St. Brookings
R3	BSR 471st Ave. Brookings
R4	BSR @ below Brookings USGS gage
R5	BSR @ Flandreau
R6	BSR @ Egan
R7	BSR @ Trent
R8	BSR @ below Dell Rapids
R9	BSR @ I-90 Sioux Falls (SF)
R10	BSR @ Western Avenue (SF)
64	BSR @ East Falls Park Drive (SF)
R11	BSR @ North Bahnson (SF)
117	BSR @ North Timberline Rd. (SF)
R12	BSR @ Brandon
R13	BSR @ SD Highway 42
65	BSR @ US Hwy 18 Canton
66	BSR @ 488th Ave. Hudson
67	BSR @ 302nd St. Hawarden
32	BSR @ SD Hwy 50 Richland
TBD	BSR @ North Sioux City
T18	Skunk Creek @ Chester
T18.5	Skunk Creek @ Grand Meadow St. Lyons
T19	Colton Creek @ Grand Meadow St. Lyons
T20	West Branch Skunk Creek @ Van Denmark Ave. Hartford
T21	Skunk Creek @ 467th Ave. Ellis
T22	Willow Creek @ 262nd St. Sioux Falls
T23	Skunk Creek @ Marion Rd. Sioux Falls
SK1	Skunk Creek @ 247th St. Colton
SK2	Skunk Creek @ 248th St. Colton
SK3	Skunk Creek @ 249th St. Colton
SK4	Skunk Creek @ 250th St. Colton

Objective 5: Reporting

Task 10: GRTS and Final Report. Prepare and submit semi-annual and annual reports to fulfill GRTS reporting requirements and a final project report summarizing the results of the project and the impact of the BMPs on the water quality within the project area.

Products: Annual GRTS reports and Project (Second Segment) Final Report.

Milestones:	**Planned**	**Completed**
Annual GRTS reports	4	4
Segment 2 Final Report	1	1

Accomplishment: All required reports have been completed for Segment 2 of the project.

Summary of Project Goals and Objectives

Table 5: Planned Versus Completed Project Milestones.

Objectives/Tasks/Products	Milestones	
	Planned	**Completed**
Objective 1: BMP Installation		
Task 1: Livestock Nutrient Management		
Feasibility Studies	13	10
Engineering Designs	13	14
Nutrient Management Plans	12	8
System Installation	12	7
Clean Water Diversions	6	2
Task 2: Riparian Area Protection		
CRP/RAM ac.	150	138.1
Grazing Mgt. System Planned	2	6
Easements Developed ac.	201	16.8
Water Developments pipelines, fences, wells, pumps	8	6
Bank Stabilization/Rehabilitation ft.	1270	1270
SRAM	0	585
Task 3: Cropland BMPs		
Terrace Restoration ft.	9,847	6,647
Grassed Waterways ft.	10,000	11,043
Filter Strips ac.	20	79.2
Task 4: Alternative Water Quality Treatments		
Engineering Services	2	1
Bioreactor Installation	2	1
Monitoring Inflow & Outflow	20	10
Objective 2: Information & Education		
Task 5: Public Outreach		
Landowner Survey	1	0
Informational Meetings	6	66
News Releases	6	21
Objective 3: Master Plan Development		
Tasks 6 & 7 Master Plan & Pilot WQ Trading Program		
Consultant Hires	1	1
Pilot Trading Plan Implemented	1	1
Final WQ Trading Plan	1	0
Task 8: ARS Design Criteria & Citing Bank Toe Protection		
Gather Data	1	1
Model and Experiment	1	0
Develop Report on Design Criteria	1	0
Objective 4: Monitoring and Evaluation		
Task 9: Water Quality Monitoring		
Water Samples/Testing	420	793
QA/QC for Samples	84	200
Objecting 5: Reporting		
Task 10: GRTS & Final Reports		
Annual GRTS Reports	4	4
Final Report	1	1

New BMPs Developed

The Seasonal Riparian Area Management (SRAM) was a new program developed in 2012 by the Watershed Coordinator, DENR, City of Sioux Falls and EDWDD. The program was finalized and piloted in 2013 on the main stem of Skunk Creek. Enrollment of land immediately adjacent to Skunk Creek and within the 100 year flood plain was eligible for the program. Livestock producers enrolling pasture into the program were paid $60 per acre to defer grazing from April through September but would be allowed to dormant graze from October through March as long as a minimum vegetative stand of 4 to 6 inches remained. An alternative water source was required if the grazing was to take place during the dormant grazing period to minimize impacts on the riparian area. Haying was allowed from June through September for the acres enrolled to utilize the forage and maintain the vigor of the vegetative stand. Fencing, pipelines, and tanks were eligible for cost share not to exceed 75 percent project incentives with 25 percent producer match. The program was piloted and evaluated on Skunk Creek for two years during this Segment and has shown a considerable amount of success in reduction of E-coli. Due to the success and acceptance of the SRAM program, it has been continued and expanded to the rest of the project watershed with emphasis still on the major tributaries in the Skunk Creek basin. It has been one of the most aggressive and accepted programs that has been implemented in the Big Sioux River Watershed to date.

Preliminary statistics from the additional monitoring sites along Skunk Creek (Figure 19) have shown that the SRAM program has a definite impact on the direct loading of E-coli concentrations. The graph below is a comparison of the E-coli colonies/100ml in 2014 and 2015 as Skunk Creek flows downstream from heavily pastured riparian areas (NWQI SK1) through pastures that have been enrolled into the SRAM program (NWQI SK2 - NWQI SK4). Results show a trending decline in the E-coli concentrations based on direct stream loading during normal to low flow levels. Outliers and extremes were thrown out due to the influence of overland runoff during high precipitation events. Since there is an elevated loading during high flow periods, emphasis should still remain on containment of manure for animal feeding operations near drainages and mitigation of potential runoff from fields receiving manure from these facilities through nutrient management plans.

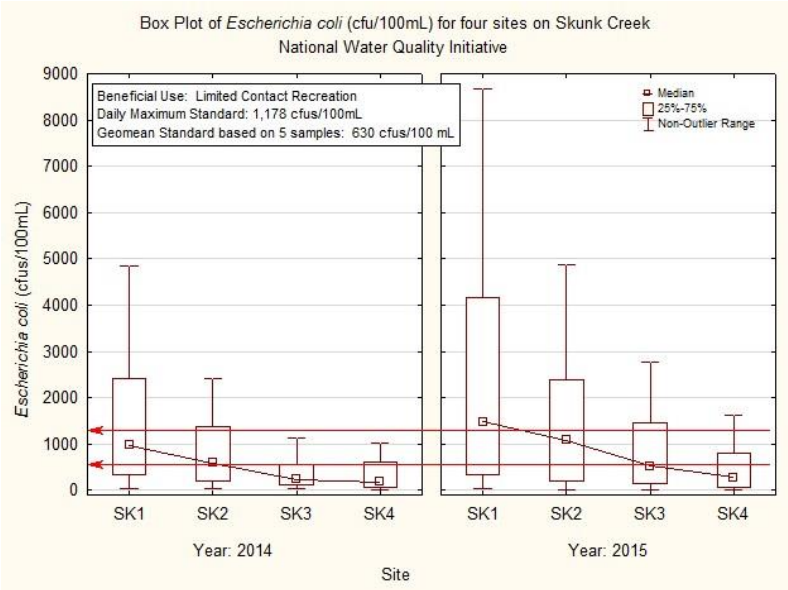


Figure 19: Preliminary E-coli Stream Monitoring

Evaluation

Locations were gathered for all BMPs installed in the project area through the DENR Tracker system. These locations were also uploaded to the EPA GRTS website with load reductions for each point. A map of these locations is shown in Figure 20 and BMPs installed through previous projects are shown in Figure 21. Along with the type of BMP that was installed, these maps show that several BMPs were installed throughout the watershed. With the frequency and location of the BMPs, the project was able to assist in improving condition of the stream reaches within the project area.

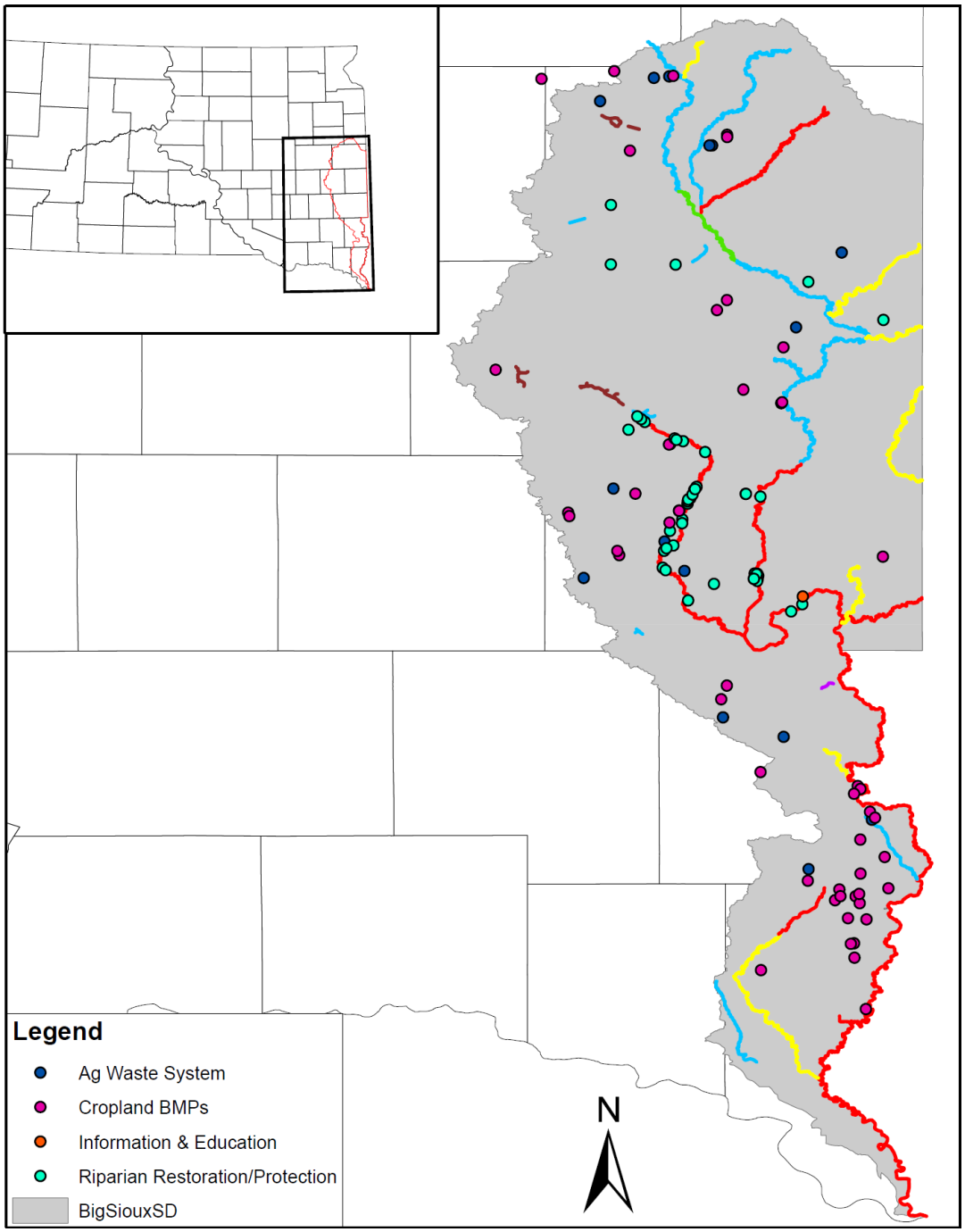


Figure 20: Central Big Sioux River Implementation BMP locations

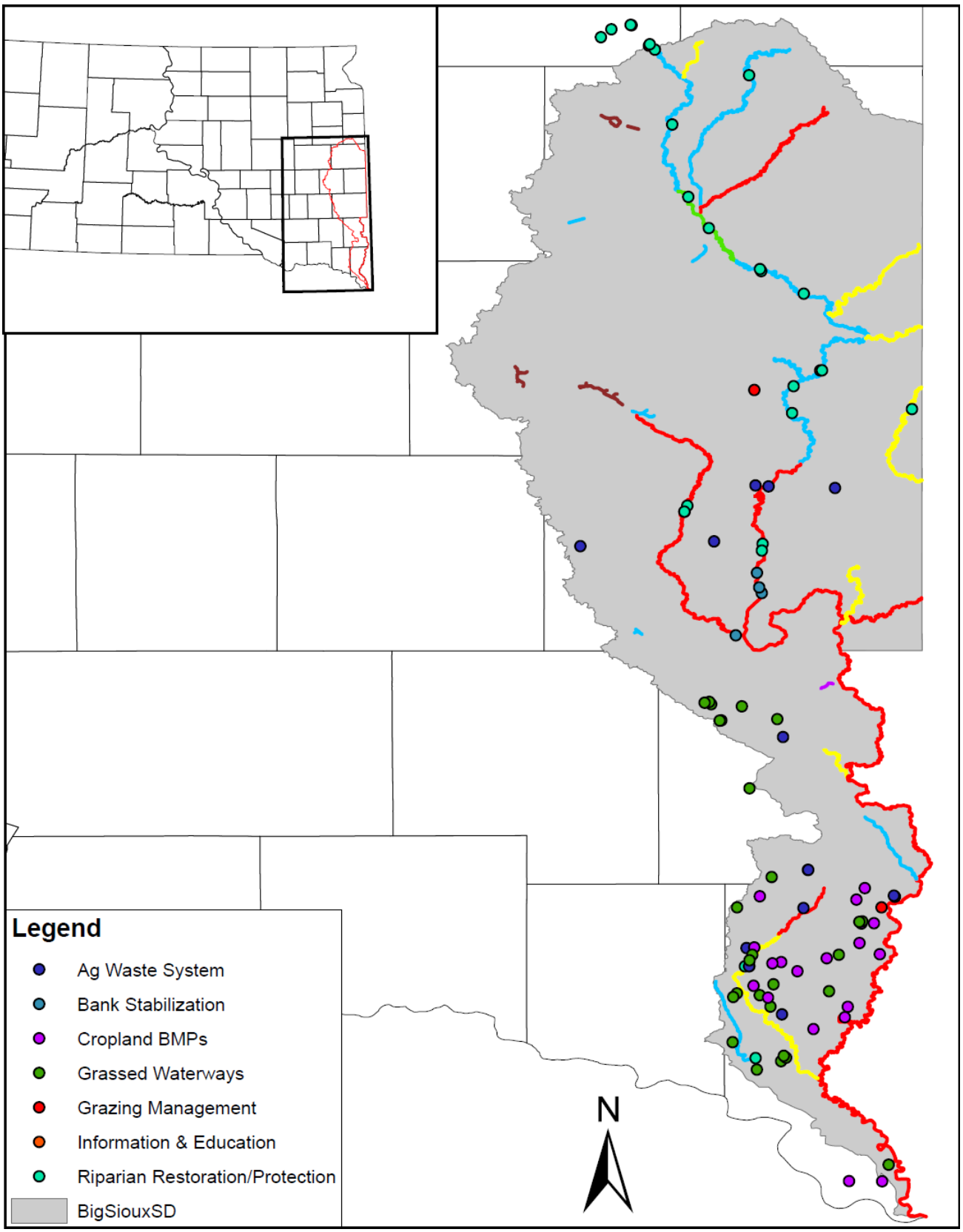


Figure 21: BMP locations from Previous Implementation Projects

STEPL was used to evaluate the reduction of TSS and other nutrients from implementation of BMPs throughout the project area. Load reductions realized by lake/stream segment can be found in Table 6.

Table 6: Big Sioux Implementation Load Reductions by River Segment.

Streem Reach or Lake Affected	Sediment (Tons)	N (Pounds)	P (Pounds)
SD-BS-L-ALVIN_01	10	45	15
SD-BS-L-MADISON_01	166	794	246
SD-BS-R-BEAVER_01	290	1,261	413
SD-BS-R-BIG_SIOUX_04	1,078	8,149	2,246
SD-BS-R-BIG_SIOUX_06	7	133	33
SD-BS-R-BIG_SIOUX_07	70	8,751	1,992
SD-BS-R-BIG_SIOUX_08	120	2,695	754
SD-BS-R-BIG_SIOUX_11	148	599	202
SD-BS-R-BIG_SIOUX_14	419	1,701	607
SD-BS-R-BIG_SIOUX_15	234	809	322
SD-BS-R-BIG_SIOUX_16	927	3,099	1,206
SD-BS-R-BRULE_01	672	2,447	882
SD-BS-R-EAST_BRULE_01	728	2,476	977
SD-BS-R-JACK_MOORE_01	16	3,467	784
SD-BS-R-NORTH_DEER_01	401	5,256	1,323
SD-BS-R-PATTEE_01	591	2,139	865
SD-BS-R-PEG_MUNKY_RUN_01	22	8,334	1,875
SD-BS-R-SKUNK_01	2,496	16,878	5,143
SD-BS-R-SPLIT_ROCK_01_USGS	274	944	374
SD-BS-R-UNION_01	231	777	306
Other	23	929	155
Total	**8,923**	**71,683**	**20,720**

Load reductions from past projects and the current project broken out by BMP type are listed in Table 7. The total number of projects that were completed to make up the load reductions is also listed in this table. The previous projects are made up of the Central Big Sioux River Implementation Segment 1, Central Big Sioux River Interim Project and Lower Big Sioux River Implementation Segments 1& 2.

Table 7: Load Reductions by BMP.

Best Management Practices	# of Projects	Sediment (tons)			Nitrogen (pounds)			Phosphorus (pounds)		
		Previous	Current	Total	Previous	Current	Total	Previous	Current	Total
Ag Waste System	**23**	**222**	**76**	**298**	**138,287**	**30,734**	**169,021**	**28,865**	**6,864**	**35,729**
Cropland BMPs	**99**	**8,882**	**8,347**	**17,229**	**33,762**	**32,007**	**65,769**	**12,109**	**11,615**	**23,724**
Riparian Restoration/Protection	**67**	**23,739**	**500**	**24,239**	**68,006**	**8,942**	**76,948**	**22,985**	**2,241**	**25,226**
Total	**189**	**32,843**	**8,923**	**41,766**	**240,055**	**71,683**	**311,738**	**63,959**	**20,720**	**84,679**

Monitoring Results

Stream water quality monitoring for the Big Sioux River main stem and tributaries was completed by EDWDD. They will continue the monitoring of the Big Sioux River and tributaries and provide their results to SDDENR and the project in future segments. The results will be compared with past sampling data to determine trends and what effect BMPs are having on the water quality. See Appendix A for sampling results of selected stream segments.

Coordination Efforts

The Moody Conservation District was the lead sponsor of the Central Big Sioux River Watershed Segment 2 Project. The district chairman and board of directors provided input and voted on recommendations from the steering committee for the project during monthly meetings. Federal, state, local agencies and organizations contributed funds, technical services, cash and in kind match to accomplish goals of the project (Table 8). The agencies and their roles are summarized below.

South Dakota Association of Conservation Districts

The SDACD provided budgetary administration of salary funding for the watershed coordinator. One half of the coordinator salary administered for the project was generated from the statewide 303d watershed project and Farm Bill Implementation Technical Assistance fund. These funds were specifically used for projects either outside of the watershed or projects not listed in the Project Implementation Proposal in order to expand the suite of BMPs offered. In an effort to increase the suite of BMPs and project funding, the watershed coordination team developed a preliminary application for a new USDA grant program that was developed during this segment of the project. The Regional Conservation Partnership Program (RCPP) was developed by USDA and interested partners of USDA were given the opportunity to submit preliminary proposals with new and innovative ways to put conservation on the ground. The preliminary proposal was accepted and a final proposal was completed and submitted to Washington D.C. in September of 2014. The full proposal was accepted and the project was granted $1,980,920 in February of 2015. Since the program was new it took several months to get it off the ground. The official start date for the RCPP was May 1, 2015. It took several months to develop the tools needed to start working with the funding. The RCPP is now in full swing and plans to start implementing in Segment 3 of the project.

Conservation Districts

The Moody Conservation District agreed to be the lead project sponsor and entered into a joint powers agreement with the other Conservation Districts involved with the project. All counties that support the project have appointed members to serve on the steering committee. The Moody Conservation District receives a project update during each board meeting and approves project funds being spent. The office manager assists with cost-share reimbursement, file maintenance and other financial transactions during the board meetings.

City of Sioux Falls

The City of Sioux Falls has finalized the joint powers agreement with Moody Conservation District. They appointed members to serve on the steering committee and have held several meetings and summits to discuss the future of the watershed project and its goals. The city has provided technical and financial assistance through SRF NPS funds for bank stabilization.

RESPEC Engineering
RESPEC has completed the Master Plan and submitted copies to the City of Sioux Falls and the Steering Committee. They are currently in the process of completing the Water Quality Credit Trading Program final report and plan to submit their results to the U.S. EPA and USDA.

South Dakota Department of Environment and Natural Resources
The South Dakota Department of Environment and Natural Resources (SDDENR) administered the U.S. EPA Section 319 grant and provided oversight of all project activities. Project administration included on-site office visits, watershed tours, review of reports, approval of payment requests, and attendance of steering committee meetings. Training workshops and meetings were sponsored by the SDDENR to keep the watershed coordinator current with implementation activities and funding procedures. A project officer was appointed to the project to assist in managing funds, setting up and maintaining the Tracker system and reviewing all implementation activities and reporting.

United States Department of Agriculture/Natural Resources Conservation Service
The Natural Resources Conservation Service (NRCS) provided technical assistance for the planning, design and installation of conservation practices. Personnel included: District Conservationists from Lincoln and Union County field offices; a Soil Conservation Technician from the Union County office; a Civil Engineering Technician from the Minnehaha County office; a Resource Conservation Development Coordinator from the Mitchell South Dakota Service Center. A workspace was supplied from the NRCS and software licenses were granted from NRCS. Access to the NRCS system enabled the watershed coordinator to generate conservation plans, contracts and maps for BMP implementation activities. Programs utilized, but not limited to, included the USDA's Environmental Quality Incentives Program (EQIP), Regional Conservation Partnership Program (RCPP) and Conservation Reserve Program (CRP) administered through the Farm Service Agency (FSA).

United Stated Environmental Protection Agency
The United States Environmental Protection Agency provided the Clean Water Act Section 319 Grant which was the primary funding source of the project. EPA officials from the Region 8 office in Denver, Colorado participated in one on-site tour and review of the project.

Public Participation

The public was notified of opportunities to participate in the project through news releases, meetings and other public events to inform and educate them about the project. Audiences were given a presentation of the project, its goals, and funding opportunities for implementation activities in the watershed. The mayor of Sioux Falls has been an integral part in putting together the Annual Mayors Big Sioux River Summit. The First Annual Mayors Big Sioux River Summit was started in the fall of 2013 to include public participation in all aspects of the Big Sioux River Watershed and to showcase what is being done to improve water quality. The first two summits during this project segment were held in Sioux Falls. Future plans are to conduct summits in other cities that are also part of the watershed.

Aspects of the Project that did not Work Well

Several bank stabilization sites failed due to prolonged high waters from spring into summer of 2011 and 2012 and required restoration in the fall. The lack of standing vegetation along with the a lower top of rock elevation compared to phase 1 and 2 made phase 3 and 4 more susceptible to erosion. Some of the erosion that occurred at these locations caused complaints from local land owners. The City of Sioux Falls cooperated with these landowners and the contractors to create solutions that worked for those involved.

Grass waterways and CRP have not been very attractive during this Segment of the project. Cropland prices and commodities have been on an upward trend through most of the segment and made it difficult to implement them. Also with the movement of tiling, many existing waterways were taken out and replaced with drainage tile.

Project Budget

Table 8: Big Sioux River Segment 2 Implementation Project Original Budget.

Big Sioux River Watershed Implementation Project Segment 2	Seg. 2 Combined Project Expenses			Project Funding							
Project Personnel and Administration	**Year 1**	**Year 2**	**Year 3**	***Total***	**319-EPA Grant**	**CWSRF**	**USDA**	**Local Cash**	**City of Sioux Falls**	**City of Sioux Falls (SRF-NPS)**	**East Dakota WDD**
Project Coordinators	**$55,647.00**	**$88,916.00**	**$88,915.00**	**$233,478.00**	**$233,478.00**						
Travel/Lodging/Meals/Expenses	**$9,531.00**	**$14,642.00**	**$14,641.56**	**$38,814.56**	**$10,173.56**					**$28,641.00**	
Administration	**$66,279.33**	**$74,263.33**	**$74,263.34**	**$214,806.00**	**$83,674.00**			**$32,050.00**		**$99,082.00**	
Objective 1 - Best Management Practices											
Task 1. Livestock Nutrient Management											
13 feasibility studies 12 designs	**$84,615.38**	**$95,115.38**	**$75,269.24**	**$255,000.00**	**$58,648.00**	**$13,800.00**	**$42,752.00**	**$63,750.00**		**$76,050.00**	
Implementation of 12 Animal Waste Management Systems	**$815,949.00**	**$832,225.00**	**$832,226.00**	**$2,480,400.00**	**$74,553.00**	**$72,200.00**	**$1,005,247.00**	**$620,100.00**		**$708,300.00**	
Task 2. Riparian Area Protection											
Riparian Area Management Program, 150 acres @ $1,460/acre	**$73,000.00**	**$73,000.00**	**$73,000.00**	**$219,000.00**	**$20,000.00**		**$99,000.00**	**$30,000.00**		**$70,000.00**	
Easements, 201 acres @ $2000/ac	**$129,333.00**	**$135,833.00**	**$135,834.00**	**$401,000.00**	**$13,000.00**					**$375,000.00**	**$13,000.00**
Grazing management system (2 @ $20,000) & Water developments	**$14,500.00**	**$72,750.00**	**$72,750.00**	**$160,000.00**	**$5,000.00**		**$72,500.00**	**$30,000.00**		**$52,500.00**	
*Bank Stabilization, 1270 linear feet @ $100/ft		**$202,925.00**	**$202,925.00**	**$405,850.00**						**$405,850.00**	
Task 3. Cropland Best Management Practices											
Terrace Restoration - Critical Area Planting, 9,847 feet		**$5,169.00**	**$5,170.00**	**$10,339.00**	**$7,754.00**			**$2,585.00**			
Grassed Waterways, 10,000 feet at $1.70/ft	**$5,666.00**	**$5,667.00**	**$5,667.00**	**$17,000.00**			**$15,300.00**	**$1,700.00**			
Filter Strips, 20 acres @ $100/ac	**$666.00**	**$667.00**	**$667.00**	**$2,000.00**			**$1,800.00**	**$200.00**			
Task 4. Alternative Water Quality Treatments											
Tile outlet treatment demo 2 systems/20 samples	**$8,000.00**	**$10,000.00**		**$18,000.00**	**$12,000.00**			**$4,000.00**			**$2,000.00**
Objective 2 - Information & Education/Public Participation											
Task 5. Public Outreach											
News releases, meetings, mailings, landowner survey, website	**$8,125.00**	**$18,125.00**	**$6,250.00**	**$32,500.00**	**$16,250.00**					**$6,250.00**	**$10,000.00**
Objective 3 - Master Plan Development											
Task 6. Develop Pilot WQ Trading Program *											
Consultant costs	**$35,500.00**	**$35,500.00**		**$71,000.00**	**$25,000.00**				**$46,000.00**		
Task 7. Develop Master Plan for Watershed Restoration *											
Consultant Costs	**$100,000.00**	**$100,000.00**	**$100,000.00**	**$300,000.00**	**$50,000.00**				**$50,000.00**	**$200,000.00**	
Task 8. ARS Design Criteria and Citing of Bank-Toe Protection*											
Consultant Costs	**$100,000.00**	**$150,000.00**		**$250,000.00**						**$250,000.00**	
Objective 4 - Monitoring and Evaluation (Section 5.0)											
Task 9. Water Quality Monitoring											
River WQ Monitoring QA/QC - 420 @$35 each (10 sites * 14/yr * 3 yr)	**$5,880.00**	**$6,510.00**	**$6,510.00**	**$18,900.00**							**$18,900.00**
Totals	**$1,512,691.71**	**$1,921,307.71**	**$1,694,088.14**	**$5,128,087.56**	**$609,530.56**	**$86,000.00**	**$1,236,599.00**	**$784,385.00**	**$96,000.00**	**$2,271,673.00**	**$43,900.00**

Table 9: Big Sioux River Segment 2 Implementation Project Actual Budget.

Big Sioux River Watershed Implementation Project Segment 2								
Project Personnel and Administration	319-EPA Grant	CWSRF WQ	USDA	Local Cash	City of Sioux Falls	City of Sioux Falls (SRF-NPS)	East Dakota WDD	Totals
Project Coordinators	**$177,486.74**							**$177,486.74**
Travel/Lodging/Meals/Expenses	**$48,937.06**			**$250.00**				**$49,187.06**
Administration	**$31,853.43**		**$21,072.00**			**$577.90**		**$53,503.33**
Objective 1 - Best Management Practices								
Task 1. Livestock Nutrient Management								
AWMS	**$106,166.68**	**$86,000.00**	**$1,230,983.53**	**$1,918,978.37**		**$288,657.35**		**$3,630,785.93**
Task 2. Riparian Area Protection								
Riparian Area Management						**$27,379.95**		**$27,379.95**
Easements, 201 acres @ $2000/ac						**$35,399.11**		**$35,399.11**
SRAM	**$81,513.65**					**$434,565.00**		**$516,078.65**
Grazing management system (2 @ $20,000) & Water developments			**$171,115.18**	**$12,813.26**		**$14,205.88**		**$198,134.32**
*Bank Stabilization, 1270 linear feet @ $100/ft						**$261,563.15**		**$261,563.15**
Task 3. Cropland Best Management Practices								
Terrace Restoration - Critical Area Planting, 9,847 feet	**$5,437.49**			**$4,117.55**				**$9,555.04**
EQIP Terraces			**$76,465.91**	**$20,719.31**				**$97,185.22**
Grassed Waterways, 10,000 feet at $1.70/ft								**$0.00**
Filter Strips, 20 acres @ $100/ac			**$78,045.00**					**$78,045.00**
Task 4. Alternative Water Quality Treatments								
Tile outlet treatment demo 2 systems/20 samples	**$1,341.83**							**$1,341.83**
Objective 2 - Information & Education/Public Participation								
Task 5. Public Outreach								
News releases, meetings, mailings, landowner survey, website	**$463.80**			**$4,559.98**				**$5,023.78**
Objective 3 - Master Plan Development								
***Task 6. Develop Pilot WQ Trading Program** *								
Consultant costs								
***Task 7. Develop Master Plan for Watershed Restoration** *								
Consultant Costs					**$93,392.20**	**$204,561.56**		**$297,953.76**
***Task 8. ARS Design Criteria and Citing of Bank-Toe Protection** *								
Consultant Costs						**$145,941.45**		**$145,941.45**
Objective 4 - Monitoring and Evaluation (Section 5.0)								
Task 9. Water Quality Monitoring								
River WQ Monitoring QA/QC - 420 @$35 each (10 sites * 14/yr * 3 yr)	**$3,135.96**						**$1,497.12**	**$4,633.08**
Totals	**$456,336.64**	**$86,000.00**	**$1,577,681.62**	**$1,961,438.47**	**$93,392.20**	**$1,412,851.35**	**$1,497.12**	**$5,589,197.40**

Future Activity Recommendations

Future segments of the Big Sioux River Implementation Project should continue to work closely with the project partners to address the resource concerns in high priority areas of the watershed. Personal contacts and public meetings should continue in order to inform and educate landowners of opportunities available as the project evolves. Project personnel should invest as much time as possible working with landowners to develop a shared interest in restoring the beneficial uses of the watershed. Existing programs such as CRP and EQIP should continue to be used along with 319 and SRF NPS funds to accomplish the overall goals of the project.

Additional efforts to create awareness and interest for riparian grassland buffers and rotational grazing should be made. Creation of a database with producers that own land adjacent to streams in the watershed would be a valuable tool for contacting and mailing information about project opportunities. Mailings could serve as a way to measure producer interest on a large scale towards changing management of the riparian areas from traditional methods to newer systems with less impact. Levels of riparian program activity should be continually monitored throughout the project in order to aid in the development of new and fresh ideas to enhance riparian health.

BMPs that reduce sediment transport should be considered for this portion of the watershed. Additional monitoring of stream bank and gully erosion should be investigated in order to refine future segment implementation projects to target critical areas on and along the river. Pilot projects to inventory effects of tiling and riparian degradation due to pasturing should be taken into consideration as well.

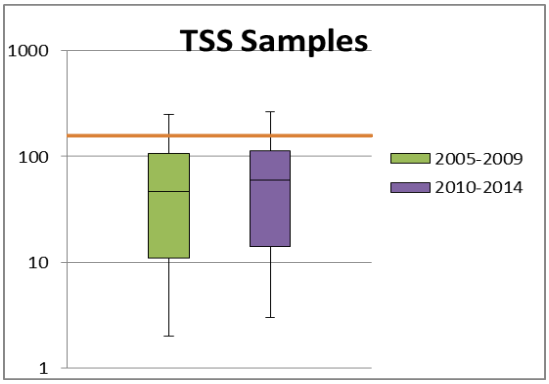
Animal feeding operations should remain a high priority in regard to waste storage, handling and utilization. Nonpoint sources of runoff should be targeted for implementation activities along and near tributaries and the Central Big Sioux River itself. Installation of BMPs in these sensitive areas will provide the largest benefit to enhancing and protecting water quality in the watershed. A cost analysis based on BMP reductions should be considered through the progression into future segments and used to extend water quality impacts of shrinking federal program funds.

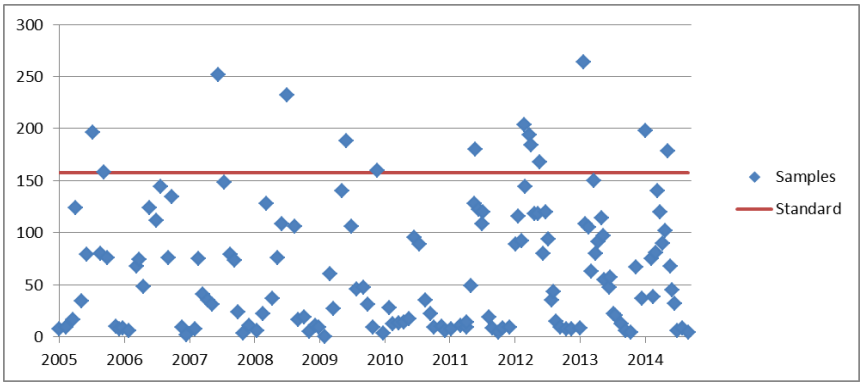
Appendix A

Monitoring Results

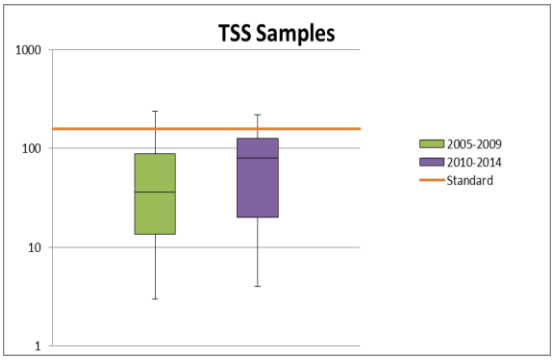
The following figures show the daily standard for each stream segment in comparison to stream samples. Each of these segments are listed in the SD DENR 2014 Integrated Report (IR). To be listed in the IR, 10% of the samples must exceed the Standard. In some causes the chronic standard (not displayed in these figures) is applied to the reach. These samples and exceedance given here are not those used for the 2014 IR.

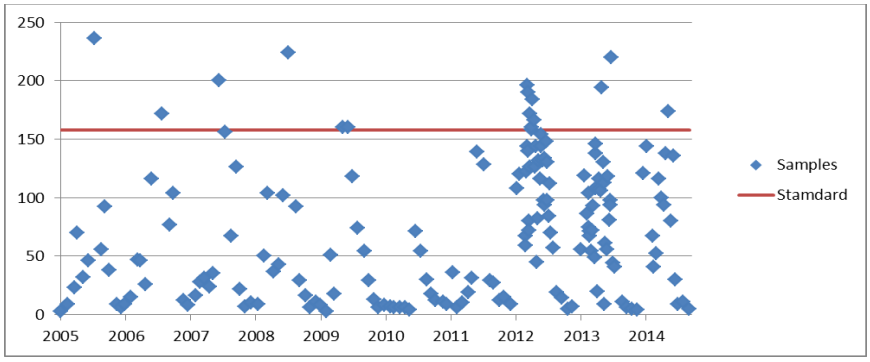
Big Sioux_05-9.88% Exceedance-Newly Listed in 2014



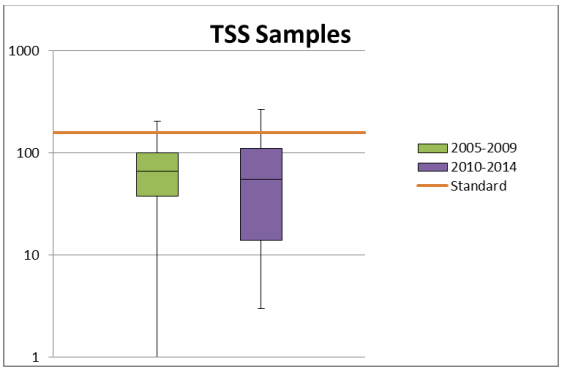


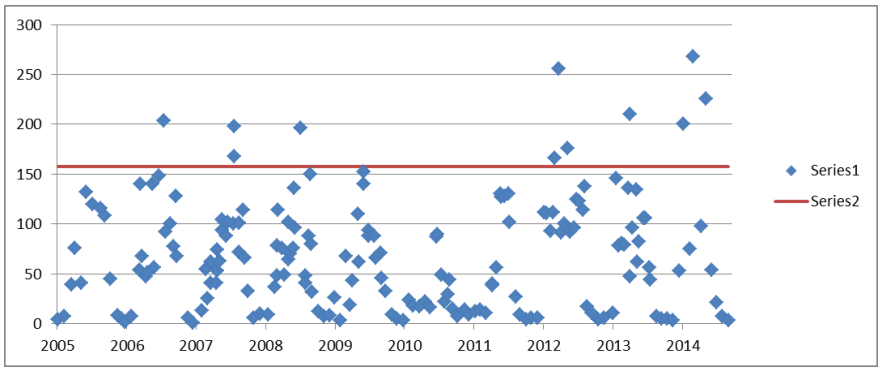
BS_06 -7.7% Exceedance-listed for the chronic standard.



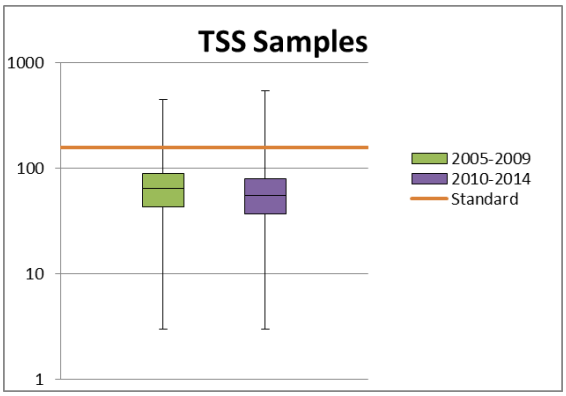


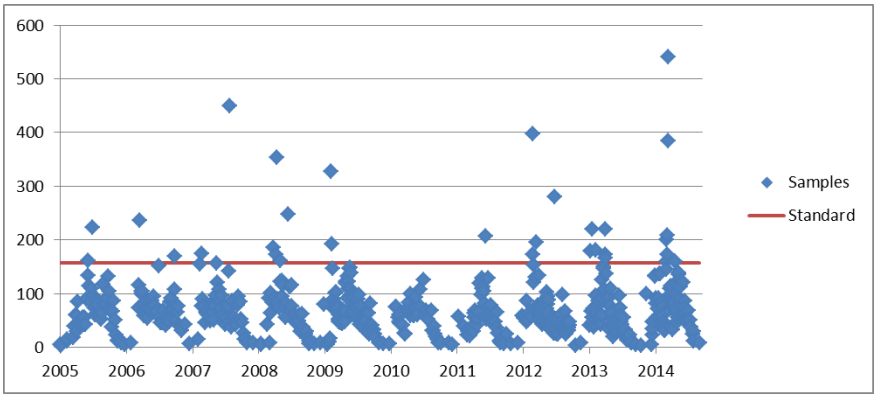
BS_07- 8.5% exceedance.



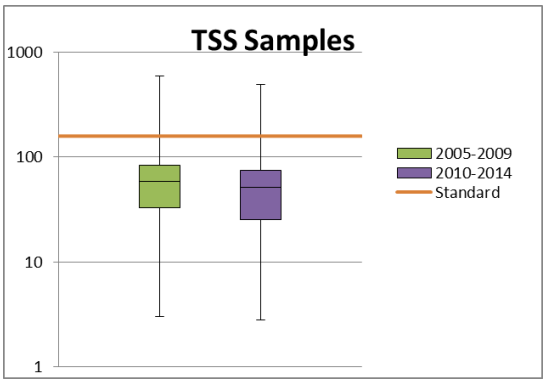


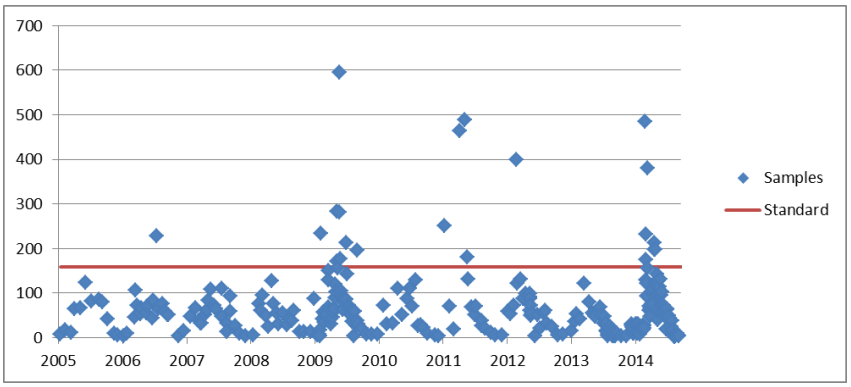
BS_08- 5.6% exceedance, listed for the chronic standard with a 22% exceedance.



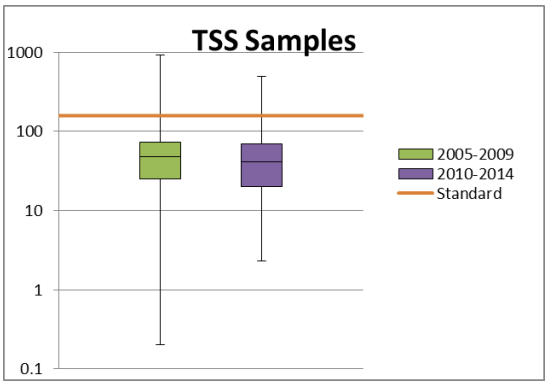


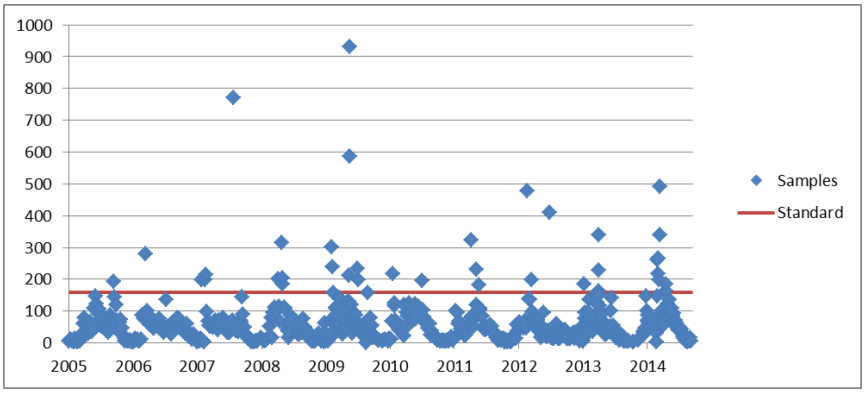
BS_10- 6.8% exceedance, listed for the chronic standard with a 19% exceedance.



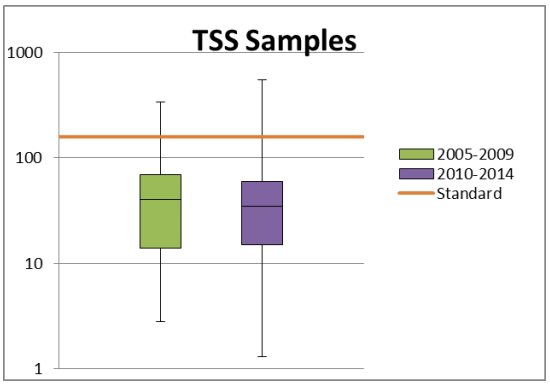


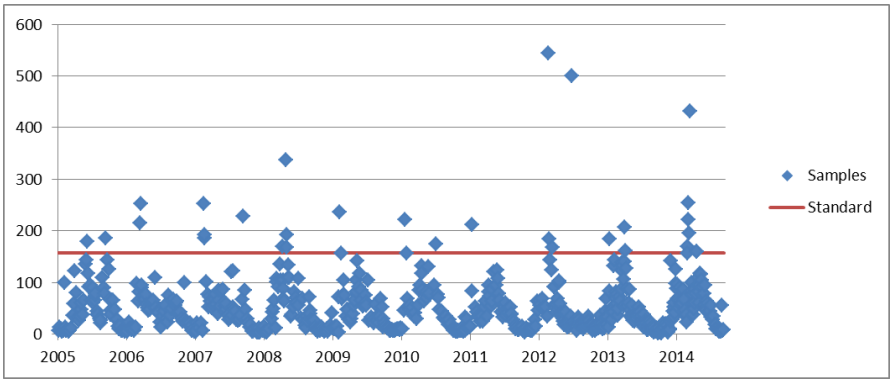
BS_11-5.4% exceedance, listed for the chronic standard with a 16.7% exceedance.



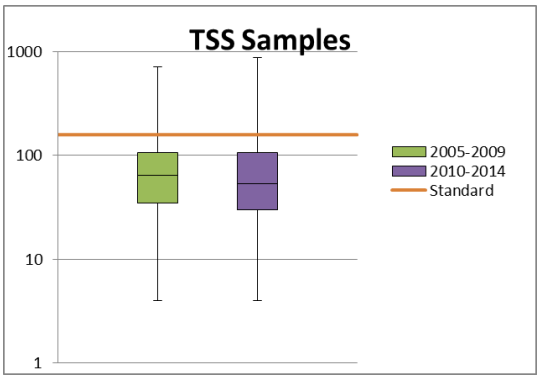


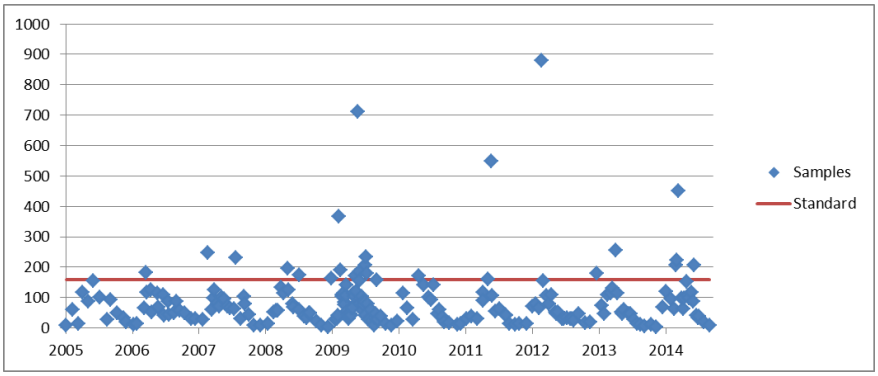
BS_12-4.2% exceedance, listed for the chronic standard with a 13.7% exceedance.



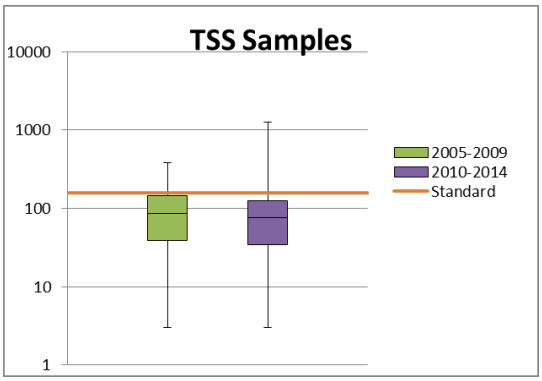


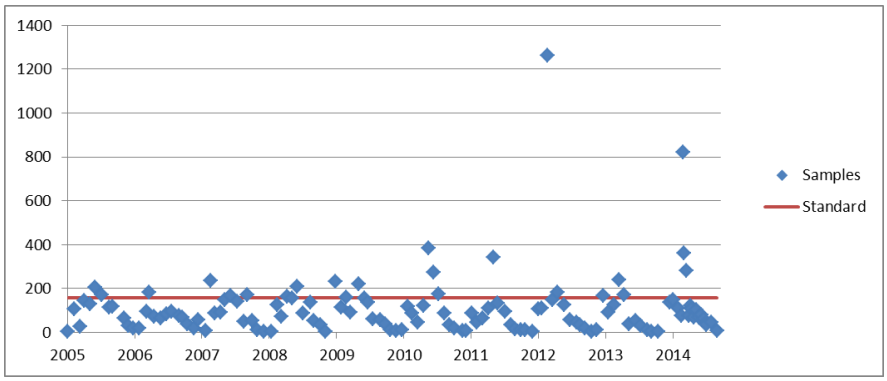
BS_13-11.4% exceedance, listed for the chronic standard with a 32.9% exceedance.



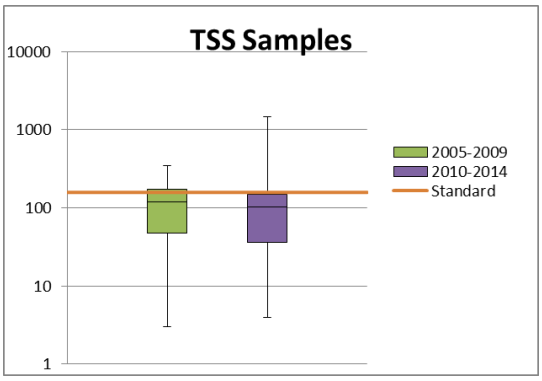


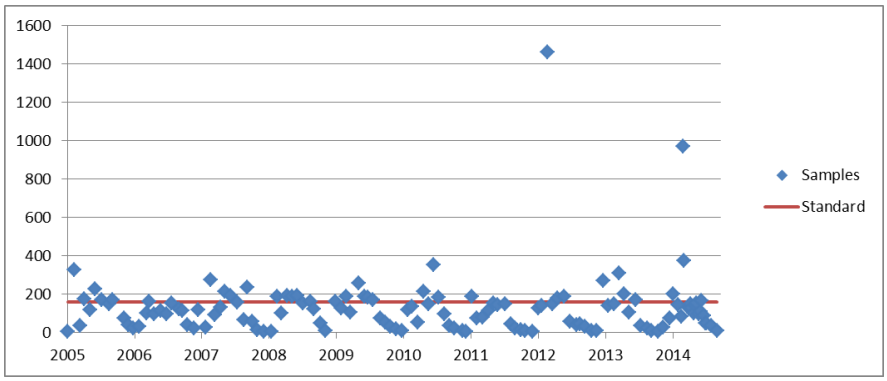
BS_14-15.3% exceedance, listed for the chronic standard with a 42.4% exceedance.



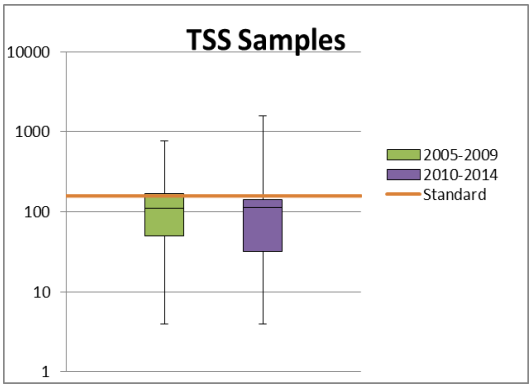


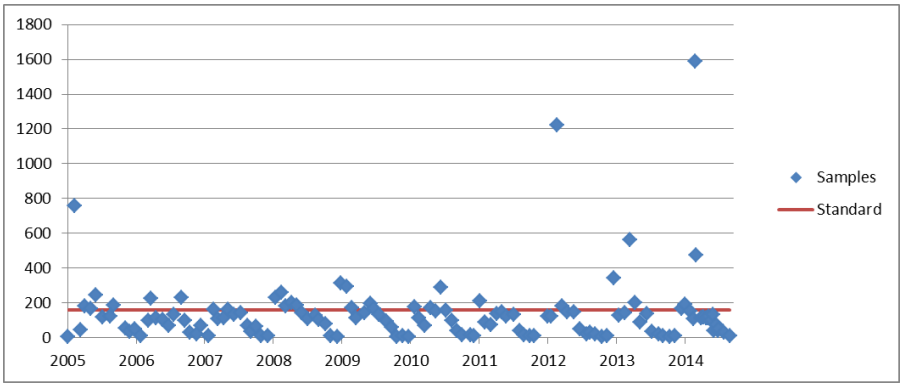
BS_15-20.7% exceedance.



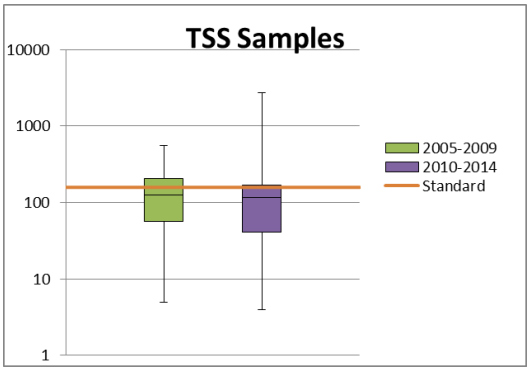


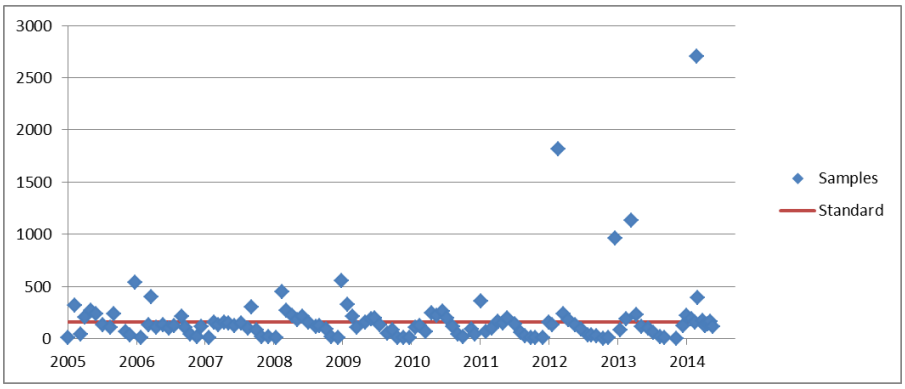
BS_16-17.5% exceedance.



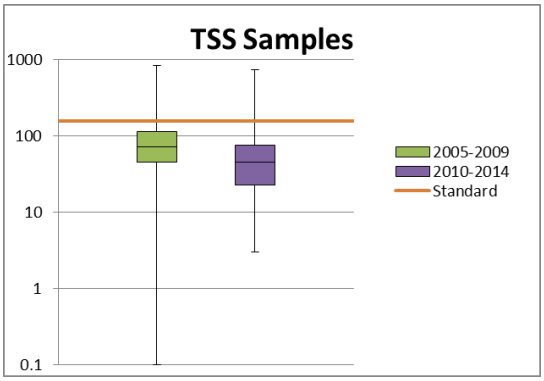


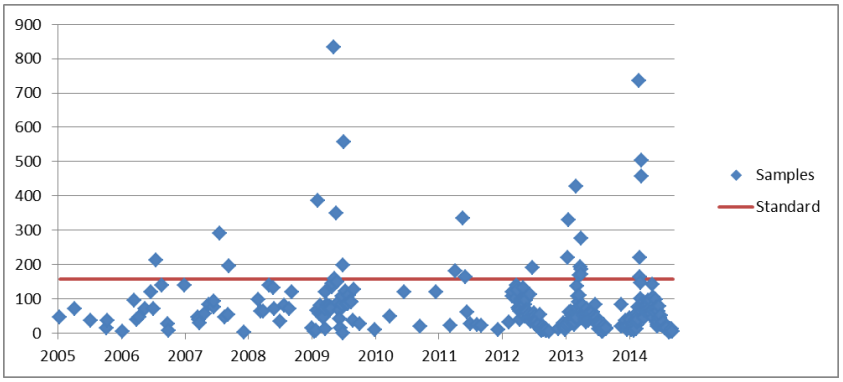
BS_17-27.6% exceedance.



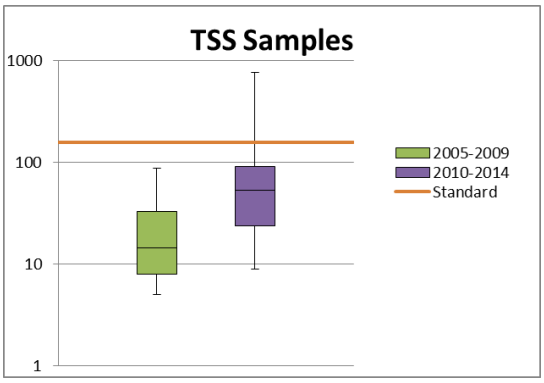


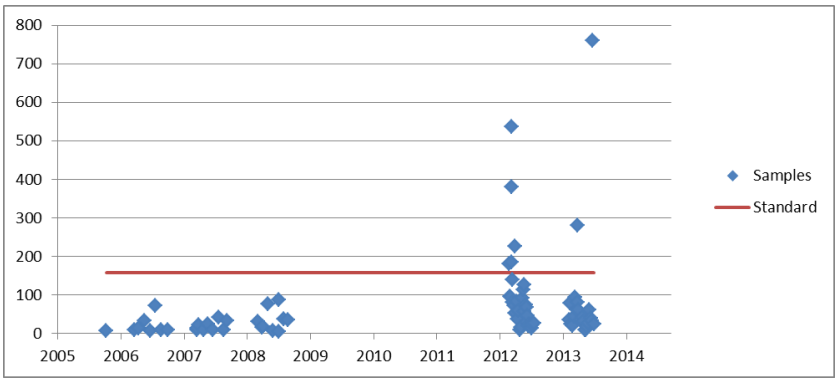
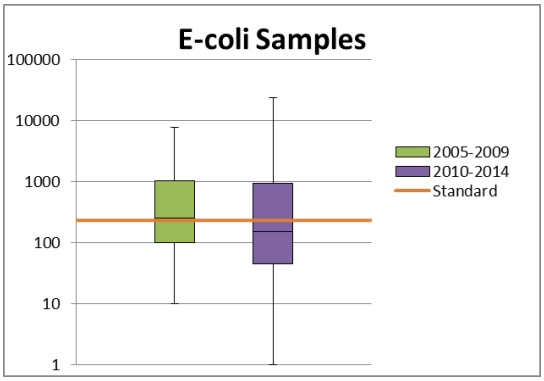
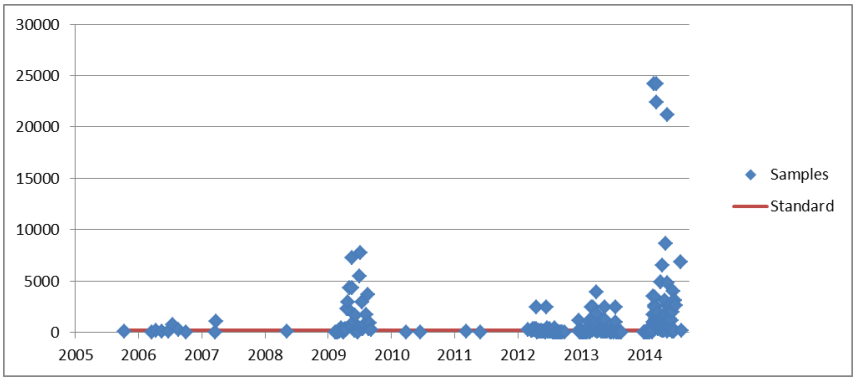
Skunk Creek-7.0% exceedance, listed for the chronic standard with a 19% exceedance.





Sixmile- 13.2% exceedance, listed for the chronic standard with a 26% exceedance.





Skunk Creek-41% exceedance.