BELLE FOURCHE RIVER WATERSHED MANAGEMENT AND PROJECT IMPLEMENTATION PLAN SEGMENT 6 WATERSHED PROJECT FINAL REPORT SECTION 319 NONPOINT SOURCE POLLUTION CONTROL PROGRAM

Topical Report RSI-2563

prepared for

Belle Fourche River Watershed Partnership
1837 5th Avenue South
Belle Fourche, South Dakota 57717

January 2016

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by

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RESPEC
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EXECUTIVE SUMMARY

Project Title:	Belle Fourche River Watershed Management and Project Implementation Plan Segment 6
Grant Number(s):	C9-99818513-0, C9-99818514-0
Project Start Date:	July 1, 2013
Project Completion Date:	July 31, 2015
Funding:	
Total EPA 319 Grant Budget:	$1,242,000
Total Matching Funds Budget:	$1,576,500
Total Nonmatching Funds Budget:	$2,414,400
Total Budget:	**$5,232,900**
Budget Revisions:	
June, 2013	
319 Award	$805,000
June, 2014	
319 Award	$437,000
Total Expenditures of EPA Funds:	$1,242,000
Total 319 Matching Funds Accrued:	$1,878,605.40
Total Nonmatching Funds Accrued:	$3,465,074.29
Total Expenditures:	**$6,585,679.69**

The Belle Fourche River Watershed Management and Project Implementation Plan Segment 6 was sponsored by the Belle Fourche River Watershed Partnership (BFRWP) with support from agricultural organizations, federal and state agencies, and local governments. This project continued implementing the best management practices (BMPs) identified in the Total Maximum Daily Load (TMDL) report for the Belle Fourche River. This project segment had the following objectives:

- Continue implementing BMPs in the watershed to reduce total suspended solids (TSS) to 20 milligrams per liter (mg/L) below the Belle Fourche Reservoir and 20 mg/L above the Belle Fourche Reservoir.
- Begin implementing BMPs to reduce *E. coli* in the Belle Fourche River.
- Develop a Stormwater Management Plan for the city of Belle Fourche.
- Continue providing public education and outreach to stakeholders within the Belle Fourche River Watershed.
- Continue tracking the progress made toward reaching the goals of the TMDL to ensure that BMPs are effective and that the proper BMPs are implemented.

The Belle Fourche Irrigation District (BFID) installed four automation gate units to more closely control the water level in laterals and reduce the amount of nonused water discharged into waterways. In addition to the four automated gates, the BFID installed 9,850 feet of pipe to replace open laterals. The installation of these four automated gates and 9,850 feet of pipe resulted in reduced sediment-laden irrigation waste water discharged from the BFID delivery system into the surrounding water by 744 acre-feet per year; this brings the total waste volume reduction to 13,540 acre-feet, or 77 percent of the total 10-year goal.

Several activities were completed to improve irrigation efficiencies after water was delivered to irrigated fields within the Belle Fourche River Watershed. A total of 31 center-pivot sprinkler systems on 2,400 acres were installed to replace existing surface irrigated fields. Thirteen farmers participated in an irrigation scheduling project to optimize irrigation application on an estimated 1,170 acres.

Grazing/riparian areas were improved significantly within the watershed. Eighteen producers participated in range/riparian improvement projects during this segment. These projects include ten water development projects, four water development and riparian deferment projects, and four cross-fencing projects that impacted over 5,500 riparian acres in the watershed. In addition to 319 projects, Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program- (EQIP-) funded projects in the watershed positively affected 65,000 acres that included improvement on 6,000 riparian acres. New conservation plans and follow-up visits were conducted on over 70,000 acres of grazing lands.

Approximately 21 public education and outreach events were completed during this project segment in the form of public meetings, informational booths, website maintenance, radio sound bites, rainfall simulator demonstrations, and watershed tours. Outreach and education efforts reached at least 8,000 people. A soil-quality demonstration trailer was purchased by the BFRWP in 2009 to demonstrate the effects of erosion on soils and how they relate to TSS. The trailer was used at several events sponsored by the BFRWP. The BFRWP hosted seven meetings to provide updates on project work and progress being made. The BFRWP website continues to be updated with events and project status (*www.bellefourchewatershed.org*). Outreach activities have helped to increase participation and support for the BFRWP and also gave the BFRWP several contacts for BMP installation. Several informative sound bites were broadcasted on local radio to increase public awareness of water quality issues and to promote involvement with the project.

Preliminary estimates based on BMP installation indicate that TSS was reduced by 47 mg/L or 9,910 tons per year in this segment. This brings the cumulative TSS load reduction to 168,678 tons per year toward the goal of 176,588 tons per year identified in the TMDL. Currently, the project is in the seventh year of implementation. In addition to TSS, it is estimated the installed BMPs reduced *E. coli* by 227 most probable number (mpn), nitrogen by 3,631 pounds per year, and phosphorus by 3,403 pounds per year.

ACKNOWLEDGEMENTS

The BFRWP would like to thank all those involved with this segment of the implementation of practices recommended from the Belle Fourche River Watershed TMDL. The efforts of all those involved from the following organizations are greatly appreciated and have been essential to the success of this project:

- Belle Fourche Irrigation District (BFID)
- Bureau of Land Management (BLM)
- Butte County Conservation District
- Elk Creek Conservation District
- Individual ranchers, farmers, and landowners within the watershed
- Lawrence County
- Lawrence County Conservation District
- Natural Resources Conservation Service (NRCS)
- South Dakota Association of Conservation Districts (SDACD)
- South Dakota Conservation Commission
- South Dakota Department of Agriculture (SDDA)
- South Dakota Department of Environment and Natural Resources (SD DENR)
- South Dakota Game Fish and Parks (SDGFP)
- South Dakota Grassland Coalition
- South Dakota School of Mines & Technology (SDSM&T)
- South Dakota State University (SDSU)
- U.S. Army Corp of Engineers (USACE)
- U.S. Bureau of Reclamation
- U.S. Environmental Protection Agency (EPA)
- U.S. Fish and Wildlife Service (USFWS)
- U.S. Geological Survey (USGS)
- Wyoming Department of Environmental Quality (WDEQ).

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1.0 INTRODUCTION

The Belle Fourche River is a natural stream that drains parts of Butte, Lawrence, and Meade Counties in South Dakota. The headwaters are located in Wyoming. The river flows into the Cheyenne River in southern Meade County and ultimately into the Missouri River. The watershed is shown in Figure 1-1. The Belle Fourche River Watershed encompasses approximately 2,100,000 acres (3,300 square miles) in South Dakota and includes Hydrologic Units 10120201, 10120202, and 10120203. The city of Spearfish, with a population of 10,718, is the largest municipality located in the South Dakota portion of the watershed. Other South Dakota communities in the watershed include Deadwood (population: 1,380), Lead (3,124), Sturgis (6,644), Belle Fourche (5,658), Fruitdale (64), Nisland (232), and Newell (603).

Land in the watershed is used primarily for grazing with some cropland and a few urban areas. Wheat, alfalfa, native and tame grasses, and hay are the main crops. Some corn is grown in the Belle Fourche Irrigation District (BFID). Gold mining (while reduced in scope from the past) and silviculture occur in the Black Hills portion of the watershed. Approximately 15 percent of the watershed is federally owned, with 11 percent of the watershed managed by the U.S. Forest Service (USFS) and 4 percent managed by the Bureau of Land Management (BLM) (Figure 1-1).

The Belle Fourche River from the Wyoming border to the mouth at the Cheyenne River is identified in the 1998 and 2002 *South Dakota 303(d) Waterbody Lists* and the 2004 and 2006 *Integrated Report for Surface Water Quality Assessment* as impaired because of elevated total suspended solids (TSS) concentrations. The 2008 Integrated Report (IR) shows that all segments of the Belle Fourche River, with the exception of the reach from the Wyoming border to Fruitdale, South Dakota, were delisted after water quality standards for TSS were met. With the exception of 2010 for the segment from Redwater River to Whitewood Creek, the 2010, 2012, 2014 IRs once again showed that five of the segments were impaired, including the Wyoming border to Redwater River, Redwater River to Whitewood Creek, Whitewood Creek to Willow Creek, Willow Creek to Alkali Creek, and Alkali Creek to the mouth at the Cheyenne River. A summary of the five impaired segments of the Belle Fourche River Watershed in the 2014 IR is provided in Table 1-1. The table also lists the impaired beneficial use, impairment parameter, water quality criteria, and possible source. The impaired segments are shown on Figure 1-2.

Horse Creek was listed in the 1998 impaired waterbody list for total dissolved solids (TDS), but this was later determined to be a listing error. The Horse Creek listing was corrected to conductivity during 2002. During this assessment, approximately 10 percent of the samples collected from Horse Creek exceeded the water quality standard for TSS. The 2008, 2010, and 2012 IR lists Horse Creek as nonsupporting for conductivity and delisted for TSS. Horse Creek was delisted for both conductivity and TSS in the 2014 IR.

The Belle Fourche River from the Wyoming border to the Redwater River was first listed for pathogens in the *2002 South Dakota Report to Congress 305(b) Water Quality Assessment* and continued to be listed for fecal coliform in successive IRs (2004, 2006, 2008, and 2010), failing to support its immersion recreation beneficial use because of elevated levels of *E. coli*. The South Dakota Department of Natural Resources (SD DENR) developed a Total Maximum Daily Load (TMDL) in 2012 that identified livestock, wildlife, and stormwater from the city of Belle Fourche as potential sources of *E. coli* impairments in the watershed.

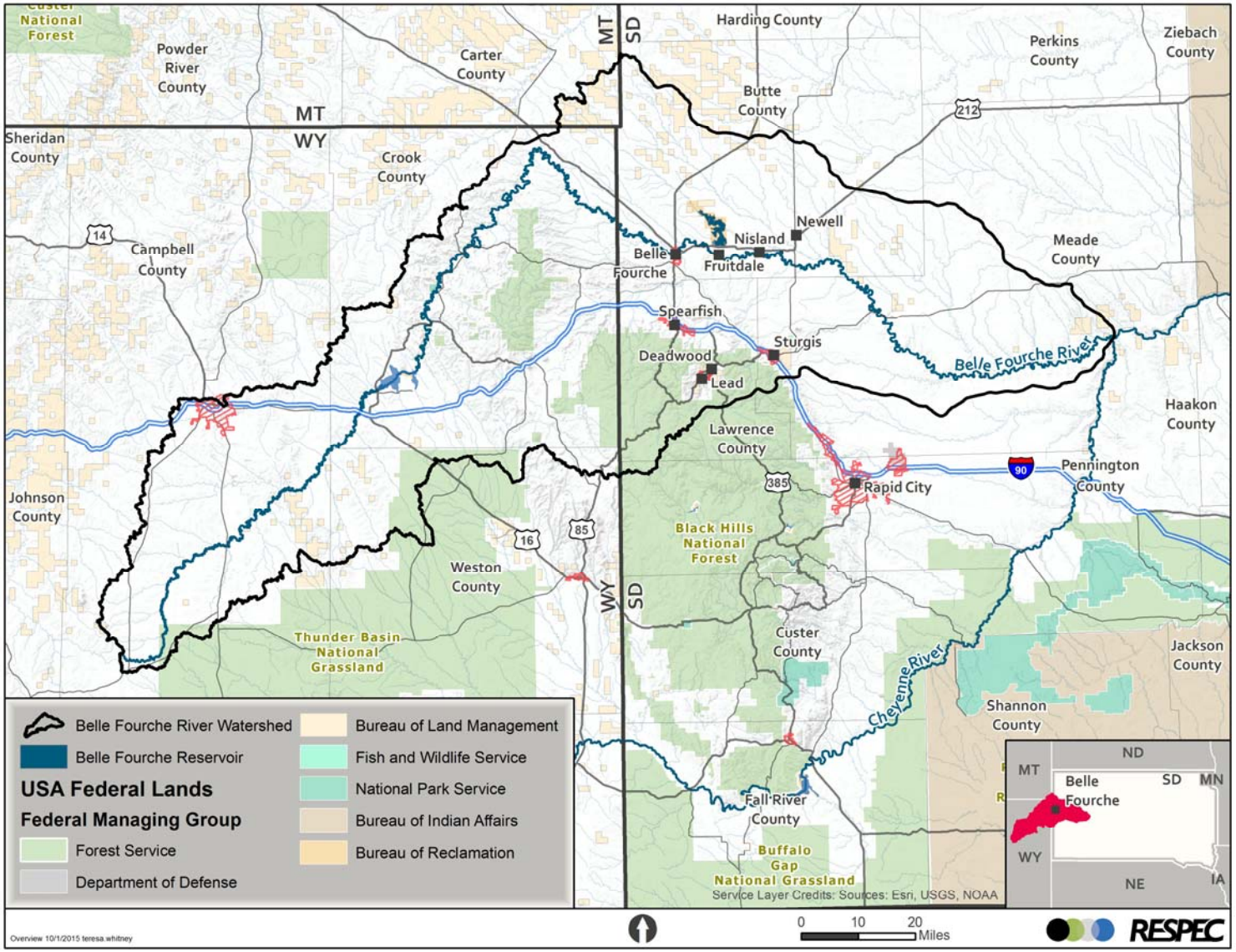

Figure 1-1. Belle Fourche River Watershed.

Table 1-1. Summary of Belle Fourche River Exceedance Water Quality Data From the 2014 Integrated Report

Stream	Stream Reach	Beneficial Use	Impairment Parameter	Water Quality Criteria	Source
Belle Fourche River	Wyoming Border to Redwater River, South Dakota	Immersion Recreation	Fecal Coliform (per/100 mL)	200[(a)]/400[(b)]	Wildlife, Livestock, Urban Runoff
		Immersion Recreation	*E. coli*	126[(a)]/235[(b)]	Wildlife, Livestock, Urban Runoff
		Warm-Water Permanent Fish Life	TSS (mg/L)	90[(a)]/158[(b)]	Irrigated Crop Production
Belle Fourche River	Redwater River to Whitewood Creek	Warm-Water Permanent Fish Life	TSS (mg/L)	90[(a)]/158[(b)]	NA[(c)]
Belle Fourche River	Whitewood Creek to Willow Creek	Warm-Water Permanent Fish Life	TSS (mg/L)	90[(a)]/158[(b)]	N/A
Belle Fourche River	Willow Creek to Alkali Creek	Warm-Water Permanent Fish Life	TSS (mg/L)	90[(a)]/158[(b)]	N/A
Belle Fourche River	Alkali Creek to Mouth	Immersion Recreation	Fecal Coliform (per/100 mL)	200[(a)]/400[(b)]	Livestock
		Immersion Recreation	*E. coli*	126[(a)]/235[(b)]	Livestock
		Limited Contact Recreation	Fecal Coliform (per/100 mL)	1,000[(a)]/2,000[(b)]	Livestock
		Limited Contact Recreation	*E. coli*	630[(a)]/1,178[(b)]	Livestock
		Warm-Water Permanent Fish Life	TSS (mg/L)	90[(a)]/158[(b)]	N/A

mL = milliliters.
mg/L = milligrams per liter.
(a) 30-day average.
(b) Daily maximum.
(c) N/A = Not available.

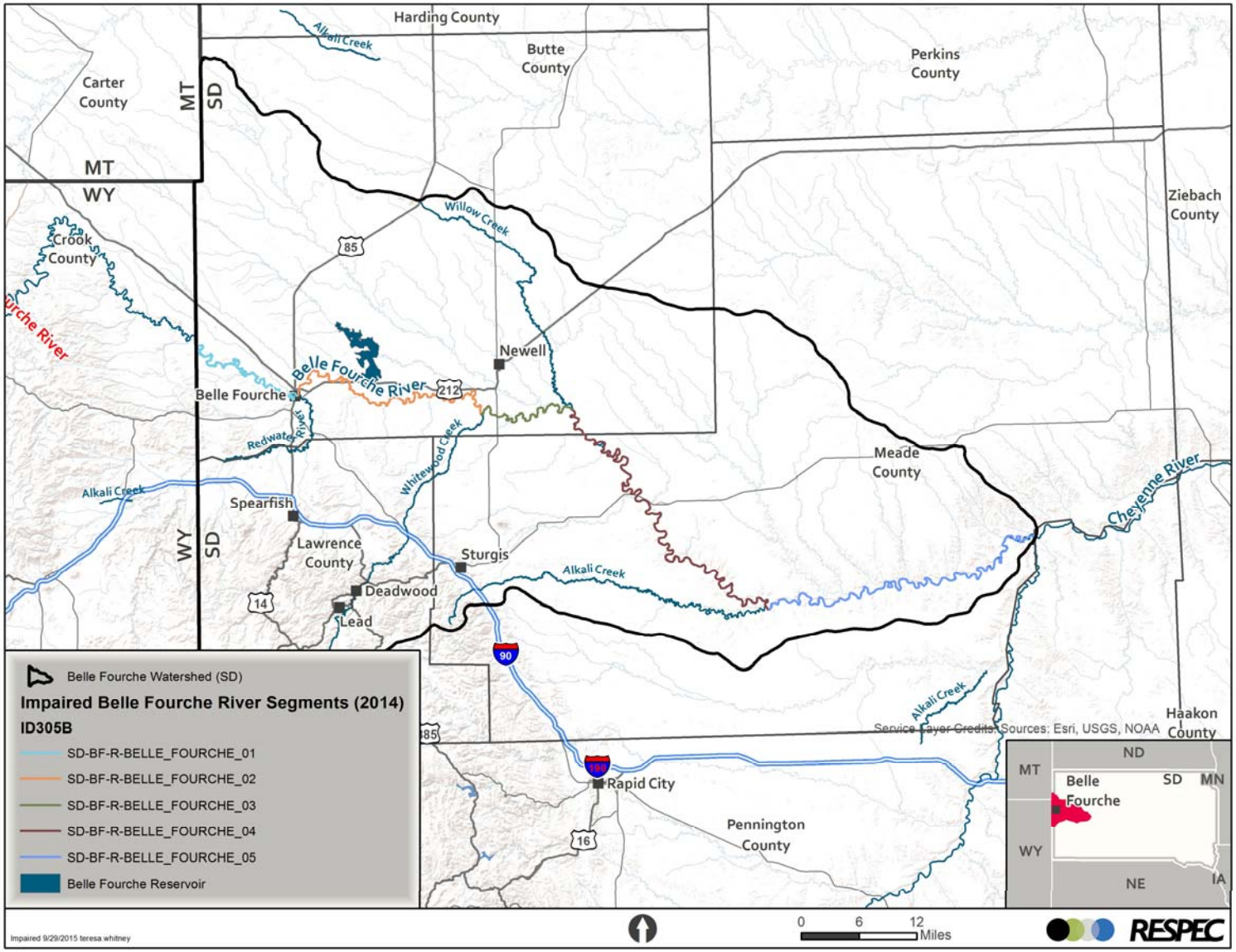

Figure 1-2. Belle Fourche River Impaired Stream Segment Locations.

The Belle Fourche River Watershed Partnership (BFRWP) completed a water quality assessment project that led to developing a TSS TMDL for the Belle Fourche River and Horse Creek. The project period extended from April 2001 through 2003. Six TMDLs were approved by the U.S. Environmental Protection Agency (EPA) for the Belle Fourche River and Horse Creek in 2005. Based on the results of the watershed study, the main sources of TSS were determined to be rangeland erosion, irrigation return flows, free cattle access to streams, riparian degradation, natural geologic processes, hydraulic alteration by irrigation, and reduced stream miles. The *Ten-Year Belle Fourche River Watershed Strategic Implementation Plan* [Hoyer, 2005] developed to implement the TMDL includes recommendations for reducing TSS concentrations by using practices that include irrigation water management, riparian rehabilitation, and grazing management. As part of the Segment 4 implementation project, the fecal coliform TMDL has been developed for Whitewood Creek.

During the winter of 2004, the BFRWP applied for and received a Clean Water Act Section 319 Grant to begin implementing the BMPs recommended in the TMDLs for the Belle Fourche River. Currently, the BFRWP is in its eleventh year of implementing BMPs in the watershed and has been funded through Fiscal Year 2017 with the Segment 7 proposal. The project is supported by agricultural organizations, federal and state agencies, local governments, South Dakota State University (SDSU), and the South Dakota School of Mines and Technology (SDSM&T).

Funding for the project included support from local ranchers and farmers, the BFRWP, SD DENR, U.S. Fish and Wildlife Service (USFWS), Lawrence County, BFID, Wyoming Department of Environmental Quality (WDEQ), Natural Resources Conservation Service (NRCS), Bureau of Reclamation, U.S. Geological Survey (USGS), and the Clean Water Act Section 319 Grant. Products of the first implementation project segment were the *Ten-Year Belle Fourche River Watershed Strategic Implementation Plan* [Hoyer, 2005] and the *Belle Fourche Irrigation District Water Conservation Plan* [Rolland and Hoyer, 2005]. These plans outline best management practice (BMP) installation activities to be completed in this project for a 10-year time frame, and associated TSS and nonused water savings are presented for each action planned. The BMPs recommended by the TMDLs and the 10-year plan installed during this project segment include replacing open irrigation ditches with pipeline, lining open irrigation ditches, installing pipelines to deliver water from the BFID system to the fields, installing irrigation sprinkler systems within the BFID, scheduling irrigation events, and grazing management.

2.0 PROJECT GOALS AND OBJECTIVES

The goal of the Belle Fourche River Watershed Management Project is to bring the Belle Fourche River and Horse Creek into compliance with water quality standards within 10 years. To accomplish this goal, a 55 and 41 percent reduction of TSS load will be required on the Belle Fourche River and Horse Creek, respectively.

In this project segment, the concentration reduction goal is 40 mg/L. To accomplish this goal, this project segment had the following three objectives:

1. Continue implementing BMPs in the watershed to reduce TSS concentration 20 mg/L below the Belle Fourche Reservoir and 20 mg/L above the Belle Fourche Reservoir.
2. Conduct public education and outreach events to stakeholders within the Belle Fourche River Watershed.
3. Track progress toward meeting TMDL goals to ensure that the BMPs are effective and that the proper BMPs are being implemented.

2.1 PLANNED AND ACTUAL MILESTONES, PRODUCTS, AND COMPLETION DATES

Objective 1. Implement BMPs Recommended to Reduce TSS. This objective was comprised of two tasks: (1) improving irrigation water management and (2) implementing riparian vegetation improvements. The products of this objective included installing four automation gate units to more closely control the water level in laterals and reduce the amount of nonused water discharged into waterways; installing 9,850 feet of pipe to replace open laterals; installing 31 sprinkler irrigation systems to replace existing flood irrigation on 2,400 acres; scheduling irrigation on 1,170 acres; implementing rangeland projects that benefit 5,500 riparian acres; and conducting range planning and follow-up on 70,000 acres. The implementation of the BMPs is discussed further in Chapter 3.0.

Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, Report Writing, Writing Future Grants, and Federal Audit. Approximately 21 outreach activities were conducted that involved approximately 8,000 participants. In addition, two Grant Tracking and Reporting System (GRTS) reports and this final report were written. These activities are further discussed in Chapter 4.0 of this report.

Objective 3. Complete Essential Water Quality Monitoring and TMDL Development. Water quality samples were collected by the USGS at real-time stream gaging sites and the SD DENR at several water quality monitoring (WQM) sites in the watershed. A detailed statistical analysis is included in Chapter 5.0 of this report.

Table 2-1 lists the project objectives along with their products, planned milestone completion date, and actual milestone completion date. All BMPs were completed by the July 2015 deadline. Final reporting was completed by August 2015.

Table 2-1. Planned Versus Actual Milestone Completion Dates

BFRWP Implementation	Planned Completion	Actual Completion
Objective 1. Implement BMPs Recommended to Reduce TSS		
Product 1. Improve Irrigation Delivery and Application	July 2015	July 2015
Product 2. Complete and Install Riparian Area BMPs	July 2015	July 2015
Product 3. City of Belle Fourche Stormwater Master Plan	July 2015	July 2015
Objective 2. Conduct Public Education and Outreach		
Product 4. Public Outreach, Report Writing, Federal Audit	July 2015	July 2015
Objective 3. Complete Essential Water Quality Monitoring		
Product 5. Water Quality Monitoring	July 2015	August 2015

2.2 EVALUATION OF GOAL ATTAINMENT

Project success was evaluated by comparing project outputs and outcomes with the planned milestones. Sediment reduction goals were met for this segment. BMP accomplishments were close to goals outlined in the project implementation plan. Some goals were not completely met and others were higher than expected, which resulted in sediment reductions higher than expected. Further explanations of these changes are shown in Section 3.1 of this report. The following milestones were obtained:

- Implementation of several BMPs recommended within the *Phase I Watershed Assessment Final Report and TMDL* [Hoyer and Larson, 2004].
- Reductions, estimated as a result of BMP installation, of 47 mg/L (9,910 tons per year) were obtained.
- Completion of approximately 21 successful education and outreach activities, which led to greater public participation in the project, completion of annual GRTS reports and this final report, and two required federal audits.

This project successfully implemented BMPs to reduce sediments. Although the type of BMP implementation may have changed from the outlined goals, overall progress toward sediment reduction was made. BMPs were implemented that are estimated to reduce TSS in the Belle Fourche River by approximately 9,910 tons per year. Table 2-2 shows pollutant reductions achieved by each implemented BMP. Reductions are recorded in both milligrams per liter (mg/L) and tons per year. Milligrams per liter were derived from the original HSPF model used for the TMDL. Sediment reductions reported in tons per year and nitrogen and phosphorous in pounds per year were derived from a combination of Spreadsheet Tool for Pollutant Load (STEPL) and literature values for load reductions when STEPL was not applicable.

Table 2-2. Pollutant Reduction Achieved by Each Best Management Practice Implemented

Best Management Practice	Modeled Sediment Reductions[(a)] (mg/L)	StepL/Book Value Sediment Reductions (tons/year)	StepL/Book Value Nitrogen (lbs/yr)	StepL/Book Value Phosphorous (lbs/yr)
4 Flow Automation Units	1	400	210	180
9,850 Feet of Pipe Replacing Open Canals and Laterals	3	1,182	NA	NA
31 Sprinkler Irrigation Systems	15	5,338	2,730	2,320
Irrigation Scheduling		260	105	90
Managed Grazing	28	2,730	586	793
Totals	**47**	**9,910**	**3,736**	**3,493**

(a) Based on the HSPF model in the TMDL.

3.0 BEST MANAGEMENT PRACTICES

The installation of the BMPs recommended in the Belle Fourche River TMDL continued during this project segment. The BMP installation included funding from local ranchers and farmers, the BFID, USFWS, and NRCS along with the EPA's 319 program. The following BMPs were installed:

- Four automation gate units
- 31 irrigation sprinkler systems to replace flood irrigation on 2,400 acres
- Thirteen producers completing irrigation scheduling on approximately 1,170 acres
- Ten water development projects, four water development and riparian deferment projects, and four pasture cross-fencing projects involving 18 producers and improving 5,500 riparian acres
- Environmental Quality Incentives Program (EQIP) projects in the watershed positively affected 65,000 acres that included improvement on 6,000 riparian acres
- Completed conservation plans or conducted follow-up on over 70,000 acres of grazing lands.

Table 3-1 provides a status of the BMP implementation planned and implemented to date.

Table 3-1. Best Management Practices Implemented

Best Management Practice	Planned This Segment	Installed This Segment	Installed to Date
Flow Automation Units	4	4	41
Line Open Canals and Laterals (Feet of Lining)	1,000	0	14,460
Replace Open Canals and Laterals With Pipeline (Feet of Pipeline)	1,000	9,850	31,349
Sprinkler Irrigation Systems	32 on 2,560 acres	31 on 2,400 acres	97
Irrigation Scheduling	20 producers on 1,000 acres	13 producers on 1,170 acres	
Managed Riparian Grazing (Acres)	6,000	5,500	32,338
Stormwater Management Plan for City of Belle Fourche	1	1	1
Complete Essential Water Quality	1	1	NA
Information and Education Events	20	21	NA

3.1 REDUCING NONUSED IRRIGATION WATER AND IMPROVING EFFICIENCY

3.1.1 Automation

To reduce return flows of nonused irrigation waters, the project installed BMPs that will improve precision in water quantity delivered to irrigators. During the Segment 6 project, four wasteway measurement units were installed in the BFID, as shown on Figure 3-1. These four units increased the total automated units installed to 59, which is also shown on Figure 3-1. The wasteway measurement

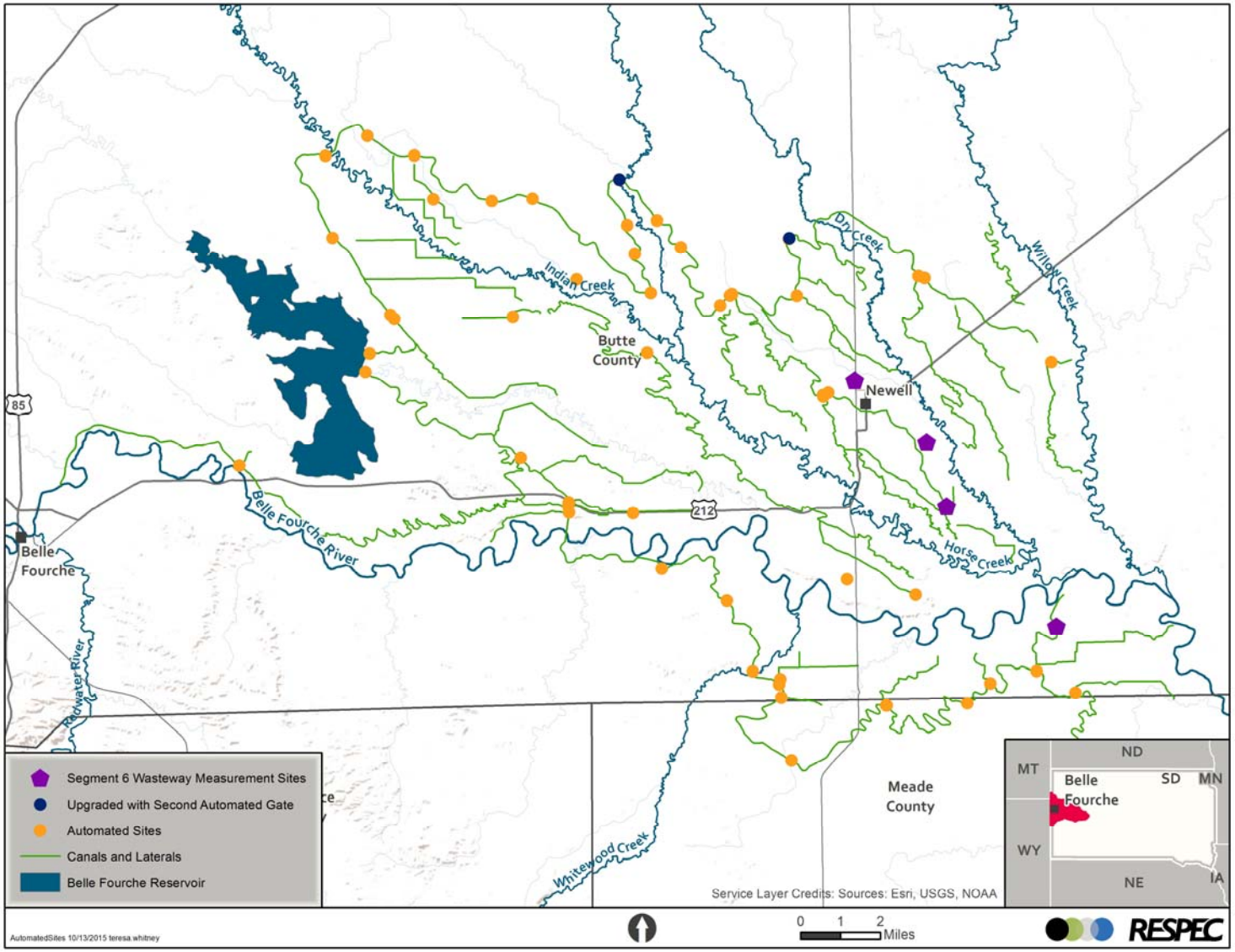

Figure 3-1. Location of the Automated Sites in the Belle Fourche Irrigation District Installed During Segment 6.

units enables water levels to be measured and monitored real-time from the BFID office in Newell, South Dakota, and provides a better understanding of water being wasted from the system and allows for more precise adjustments to water releases. Figure 3-1 shows the locations of the four new automated sites. Wasteway flow data at each site are recorded every 10 minutes and stored in a database so that the total volume of water wasted during any given time period is easily summarized and efficiencies are easily calculated.

In addition to the four new wasteway measurement units, two existing automated gate units were upgraded with a second automated gate each (Figure 3-1). The capacity of the automation at these sites was increased because both units are remote with minimal maintenance access. These two units were not upgraded as part of this 319 program but are an example of additional conservation efforts being made within the watershed. Figure 3-2 illustrates an automated site within the BFID.

3.1.2 Lining and Piping

Approximately 9,850 feet of pipe was installed by the BFID to replace open laterals during the Segment 6 implementation project; this was above the goal of 1,000 feet for this segment. Pipeline installation eliminated water losses from infiltration and evaporation along these sections. Canal or lateral lining projects were not a part of the Segment 6 project.

3.1.3 On-Farm Irrigation Improvements

Thirty-one center-pivot sprinkler systems were installed to replace existing surface irrigation on 2,400 acres during this segment. The goal for this segment was converting 32 sprinkler systems on 2,560 acres. Converting from surface or flood irrigation to sprinkler irrigation reduces waste water which, in turn, reduces sediments reaching waterways that act as a drain for the BFID. An example of a flood-irrigated field demonstrating inefficient use of water that leads to an increased sediment load in the Belle Fourche River is illustrated in Figure 3-3. Figure 3-4 shows an improved center-pivot irrigation system that greatly reduces runoff of excess water, which was partially funded by the project. The general locations of producer irrigation BMPs are shown in Figure 3-5.

3.1.4 Irrigation Scheduling

Sprinkler irrigation greatly reduces excess runoff and improves water efficiencies and reduces sediments in waterways. Proper timing of irrigation events is imperative to maximize these benefits. The BFRWP has recognized this and has received funding in the past from a NRCS Conservation Innovation Grant (CIG) to work with producers in scheduling timely irrigation events. This CIG expired in 2010, and although local participating producers had gained knowledge from the project, technical assistance was still needed to continue adopting this technology. During this funding segment, technical service was provided to 13 irrigators on approximately 1,170 acres. The participating farmers were provided sensors and a datalogger to record soil moisture and technical assistance from project staff to schedule timely irrigation events. Figure 3-6 shows an example of a soil-moisture graph provided to the producer. The two lines represent the two soil-moisture sensors at different rooting depths. The number on the left represents moisture with 0 being saturated and 200 being dry. As the moisture of the sensors reach different zones of soil saturation (represented by the colored bars), recommendations can be made for irrigation application. This practice greatly increased water efficiencies and reduced excess runoff.

Figure 3-2. Gate Automation Unit Installed in the Belle Fourche Irrigation District.

Figure 3-3. Flood-Irrigated Field Demonstrating Inefficient Water Use That Leads to Sediment Runoff.

Figure 3-4. Center-Pivot Irrigation System Installed in the Belle Fourche Watershed.

3.2 MANAGED GRAZING

Improved grazing distribution maintains or improves the integrity of the riparian corridor of the watershed. Healthy riparian areas are integral to trapping sediment from rangeland runoff and reducing TSS entering the Belle Fourche River. With the installation of riparian/grazing BMPs, riparian areas were improved significantly within the watershed. Eighteen producers participated in range/riparian improvement projects during this segment. These projects include ten water development projects, four water development and riparian deferment projects, and four cross-fencing projects that impacted over 5,500 riparian acres in the watershed. The location of the riparian vegetation improvement projects funded with Segment 6 funds is illustrated in Figure 3-7.

In addition to installed practices shown in Figure 3-7, conservation plans and follow-up visits to those plans were conducted on over 70,000 acres of grazing lands in the watershed. These were done in cooperation with the South Dakota Grassland Coalition (SDGLC) and their 319 project titled *Grassland Management and Planning Project Implementation Plan*. The continued success of this partnership between the SDGLC and the BFRWP has provided a solution to reducing TSS coming from range riparian sites as well as adjacent uplands. The photograph in Figure 3-8 depicts a site on a ranch where grazing plans and riparian exclusion and water development were implemented to improve range/riparian health and reduce sediments reaching the waterway.

Outside of grazing projects, the BFRWP teamed with the Belle Fourche Weed Management group to provide funds for native plant rehabilitation along the Belle Fourche River after the control of the locally

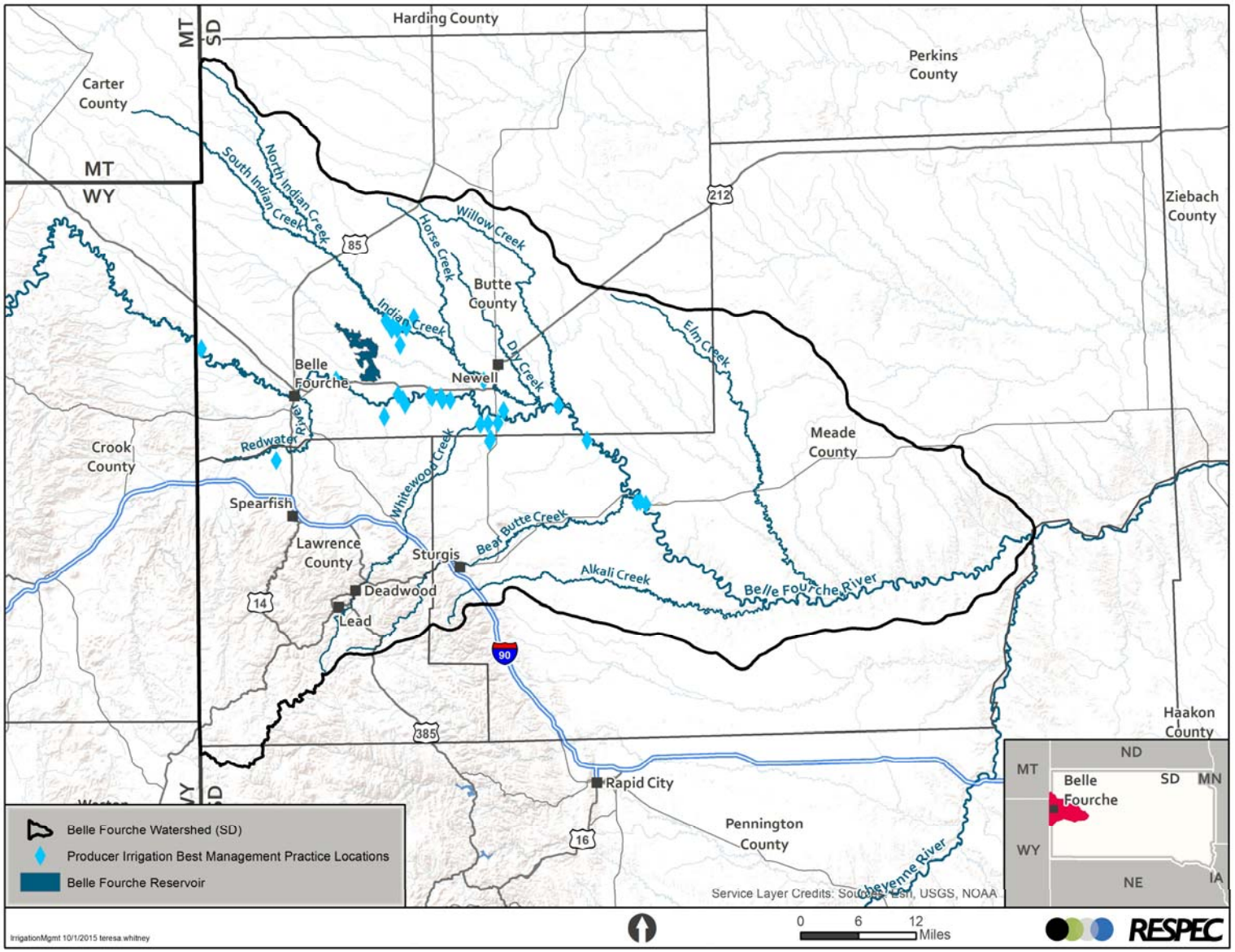

Figure 3-5. General Location of Producer Irrigation Best Management Systems.

noxious plant phragmites. This streambank stabilization project is an ongoing effort that has received funds from the Wild Turkey Federation, the South Dakota Conservation Commission, local county governments, and other private entities. Watershed staff assisted in this effort by helping the group obtain alternative funding sources to fund the rehabilitation efforts.

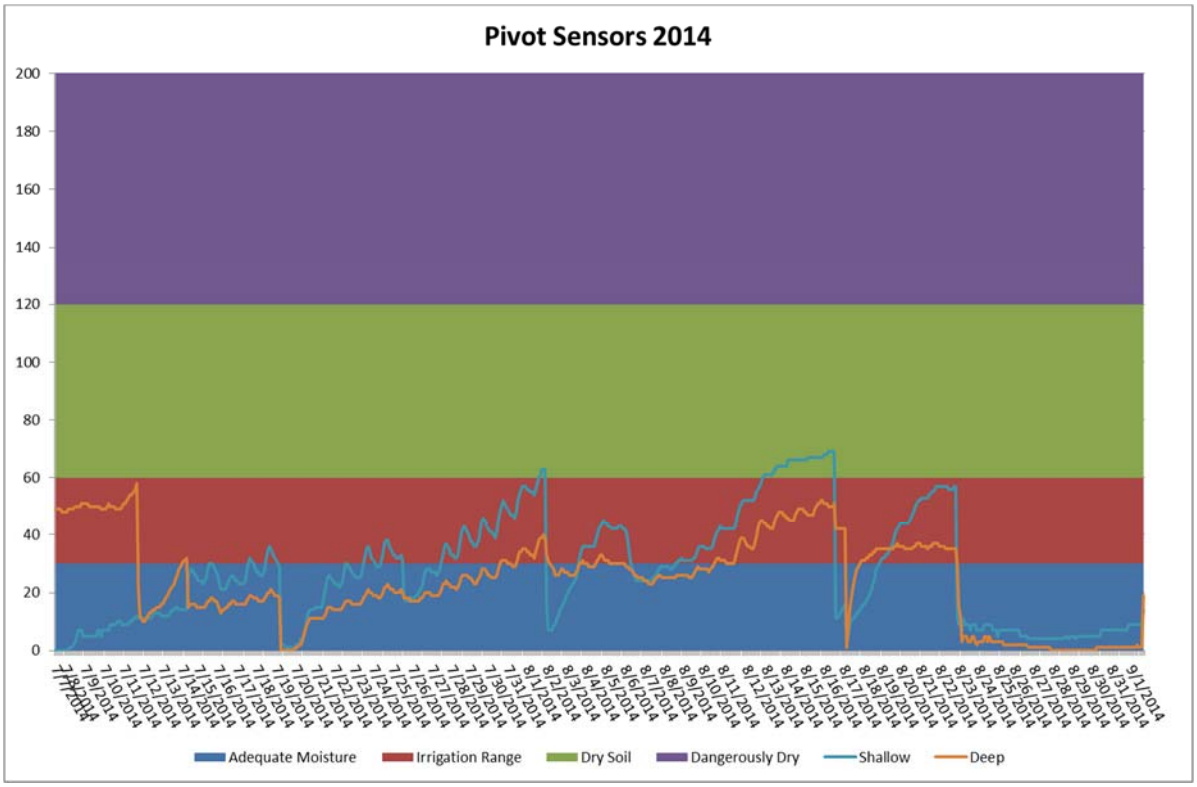

Figure 3-6. Center-Pivot Irrigation System Installed in the Belle Fourche Watershed.

In addition to 319 projects, the NRCS EQIP-funded projects in the watershed positively affected 65,000 acres that included improvement on 6,000 riparian acres. Many of the producers that participated in EQIP received technical assistance from watershed staff to help with their grazing plans.

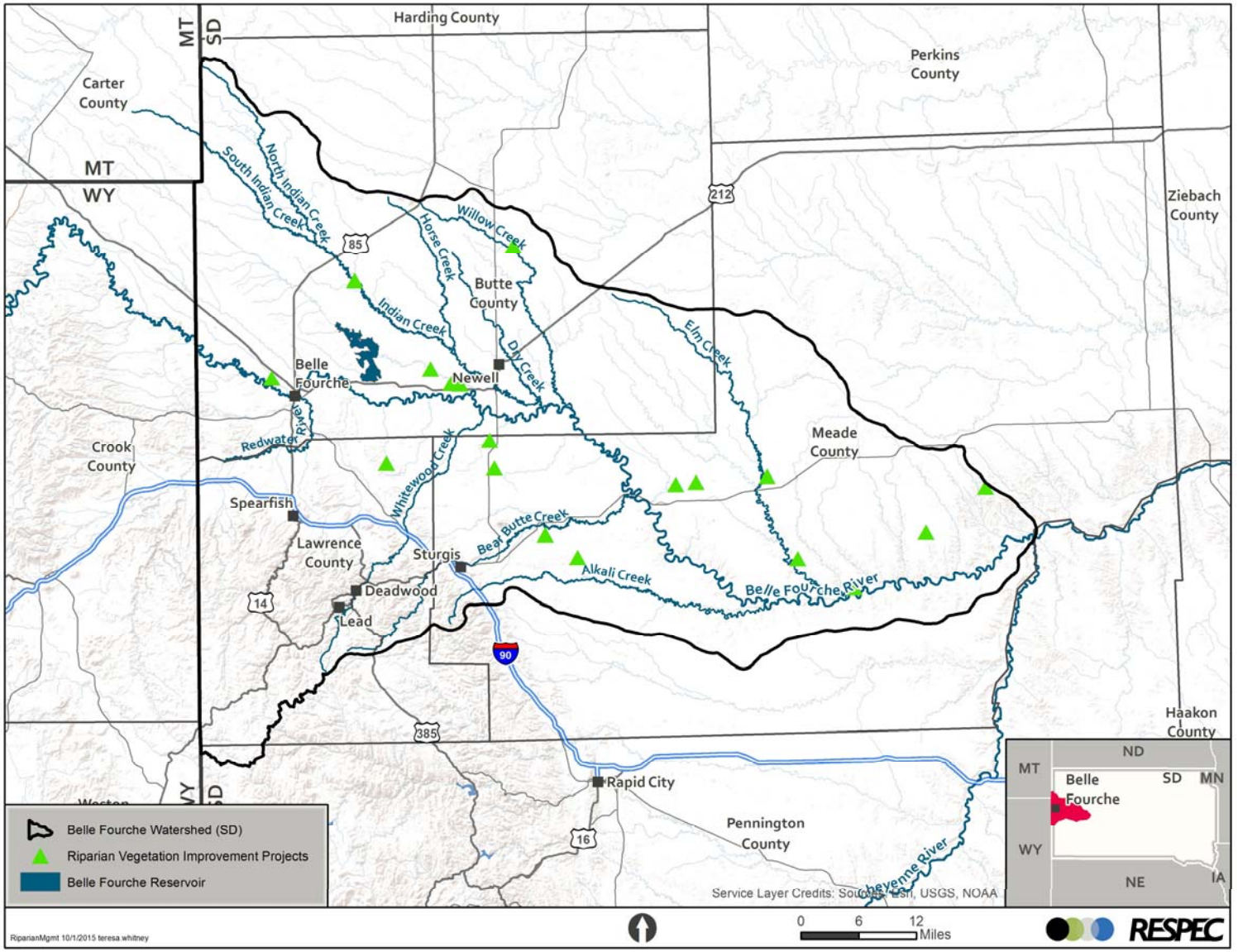

Figure 3-7. Location of Riparian Vegetation Improvement Projects in Segment 6.

Figure 3-8. Riparian Exclusion Site on a Ranch Where Grazing Plans and Water Development Were Used to Improve the Range and Riparian Health.

4.0 SUMMARY OF PUBLIC PARTICIPATION AND OUTREACH

Approximately 21 public education and outreach events were completed during this project segment in the form of public meetings, informational booths, website maintenance, radio sound bites, rainfall simulator demonstrations, and watershed tours. A summary of the events are listed in Table 4-1. Outreach and education efforts reached an estimated 8,000 people. A soil-quality demonstration trailer was purchased by the BFRWP in 2009 to demonstrate the effects of erosion on soils and how they relate to TSS. The trailer was used at several events sponsored by the BFRWP. The BFRWP hosted seven meetings to provide updates on project work and progress. The BFRWP website continues to be updated with events and project status (*www.bellefourchewatershed.org*). Outreach activities have helped to increase participation and support for the BFRWP and also gave the BFRWP several contacts for BMP installation. Several informative sound bites were broadcasted on local radio to increase public awareness of water quality issues and to promote project involvement.

Table 4-1. Summary of Public Outreach and Education During Segment 6

Type of Education and Outreach	Date	Number of Participants
BFRWP Meetings (7 Meetings)	July 1, 2013–July 31, 2015	105
Range Beef Cow Symposium Presentation	2014	200
Soil Moisture Management Presentation Vale	2014	30
Society for Range Management (SRM) Range Tour and Rainfall Simulator Demonstration	2014	60
Spearfish Youth Rainfall Simulator Demonstration	2014	30
Vale Ag Show, Booth	2014, 2015	500
South Dakota Grasslands Coalition Bird Tour, Rainfall Simulator Demo	2014	60
No-Till/Cover Crop Tour/Soil-Quality Demonstration	2015	50
Ranchers Roundup, Union Center, Booth	2013, 2014	400
South Dakota High School Range Camp	2014, 2015	150
Informational Radio Sound Bites	2014	5,000
Website	2013–2015	1,500

The BFRWP sponsored/cosponsored three tours in the watershed during Segment 6. These tours included local producers; state and federal agency staff; local, state, and federal government officials; and the interested public. Partners in these tours included Butte, Lawrence, and Elk Creek Conservation Districts, the South Dakota Association of Conservation Districts, SDSU Cooperative Extension, South Dakota Society for Range Management, NRCS, and Bureau of Reclamation. These tours showcased projects sponsored by the BFRWP that included irrigation demonstrations in the BFID and rangeland demonstrations on ranches in the watershed. These outreach activities helped increase participation and support for the BFRWP and also gave the BFRWP several contacts for BMP installation.

A water infiltration demonstration conducted at a grazing management tour in the watershed is illustrated in Figure 4-1. Figure 4-2 shows one of the tours that demonstrate no-till/covercrop practices being adopted in the watershed.

Figure 4-1. Grazing Management Tour in the Watershed, Water Infiltration Demonstration.

Figure 4-2. Soil Health Tour Demonstrating the Benefits of No-Till and Cover Crops in Improving Soil Health and Water Quality Grazing Management Tour in the Watershed.

5.0 MONITORING RESULTS

The following sections outline and summarize all applicable, pertinent, and relevant water quantity and water quality data within the Belle Fourche River Watershed in South Dakota.

5.1 303(D) IMPAIRED WATERBODIES AND U.S. ENVIROMENTAL PROTECTION AGENCY APPROVED TOTAL MAXIMUM DAILY LOADS

Sixteen impaired stream reaches are within the Belle Fourche River Watershed (BFRW) in South Dakota, as shown on Figure 5-1. These waterbodies are listed as nonsupportive of their assigned beneficial uses as specified in South Dakota's 2014 303(d) list of impaired waterbodies [SD DENR, 2014]. Five of the listed impairments are located on the Belle Fourche River, while the remaining eleven impaired stream reaches are located on tributaries to the Belle Fourche River.

Table 5-1 provides a summary of current 303(d)-listed waterbodies within the project area, the number of years on the 303(d) list, the impairments, TMDL status, and their respective water quality criteria threshold values.

5.2 DISCHARGE ANALYSES

Flow in the Belle Fourche River can be significantly impacted by meteorological events and periods of wet and dry climatic conditions as observed through seasonality within the watershed. Discharge rates observed within the Belle Fourche River are influenced not only by seasonal climatic conditions and storm events, but they are also heavily dependent upon irrigation activities within the BFID.

The typical irrigation season in the BFID begins in June and lasts until the end of September. Historical observations have shown that the region receives very little precipitation during the irrigation season; therefore, increases in observed discharge within the Belle Fourche River during seasonally dry periods can be attributed to losses or waste within the irrigation system's transport and delivery infrastructure. Water quantity was evaluated in further detail through two analyses by first using data available from gage stations on the Belle Fourche River, and then the analysis was completed for a station on Horse Creek, which is an irrigation-dominated tributary to the Belle Fourche River.

5.2.1 Belle Fourche River Discharge Analysis

Discharge data collected by the USGS at gaging locations on the Belle Fourche River within the South Dakota portion of the watershed were obtained for analysis. The gaging station locations are shown in Figure 5-2, and Table 5-2 provides a basic summary of the discharge data from these four USGS streamflow gaging stations.

Historical monthly mean discharge rates were computed for the four USGS gaging stations on the Belle Fourche River and are displayed in Figure 5-3. As illustrated in this plot, elevated monthly average discharge rates occur within the months of March through June with flows tapering off during the fall and winter months. Elevated flows from March to June are a product of seasonal precipitation patterns and corresponding runoff events. From July through September, flow rates decrease because of decreased precipitation, but they are influenced by activities performed by the BFID throughout the irrigation season.

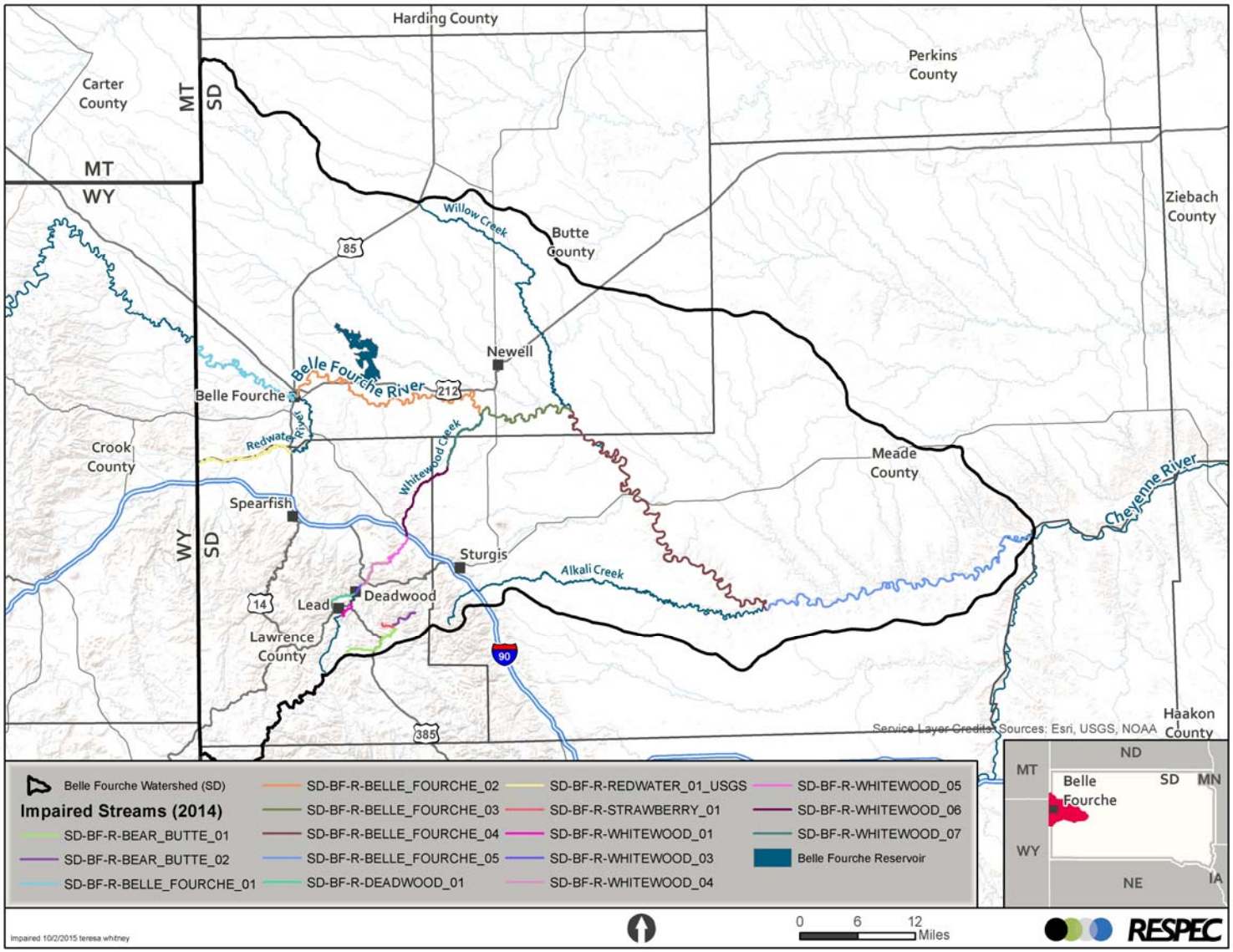

Figure 5-1. 303(d)-Listed Impaired Waterbodes in the Belle Fourche River Watershed in South Dakota.

Table 5-1. 303(d) Listed Impaired Waterbodies in the Belle Fourche River Watershed in South Dakota (Page 1 of 2)

Waterbody Name/ Description	Assessment Unit I.D.	Years Listed	Impaired Beneficial Use(s)	303(d) Listing Parameter	EPA Category	Water Quality Criteria Threshold Values (Bacteria Criteria Apply From May 1 Through September 30)
Bear Butte Creek (Headwaters to Strawberry Creek)	SD-BF-R-BEAR_BUTTE_01	2014 2012 2010 2008 2006	Cold-Water Permanent Fish Life	Water Temperature	5	Maximum temperature of < 65 degrees Fahrenheit (°F).
Bear Butte Creek (Strawberry Creek to S2, T4N, R4E)	SD-BF-R-BEAR_BUTTE_02	2014 2012 2010 2008	Cold-Water Permanent Fish Life	Water Temperature	5*	Maximum temperature of < 65°F.
Belle Fourche River (Wyoming Border to Redwater River, South Dakota)	SD-BF-R-BELLE_FOURCHE_01	2014 2012 2010 2008 2006 2004	Immersion Recreation	*E. coli* Bacteria Fecal Coliform Bacteria	5*	*E. coli*: Daily maximum of ≤ 235 most probable number per 100 milliliters (mpn/100 mL) and a geometric mean of at least five samples over a 30-day period ≤ 126 mpn/100 mL. Fecal Coliform: Daily maximum of ≤ 400 mpn/100 mL and a geometric mean of at least five samples over a 30-day period ≤ 200 mpn/100 mL.
		2014 2012 2010 2008 2006 2004	Warm-Water Permanent Fish Life	Total Suspended Solids	5*	Maximum daily concentration of ≤ 158 mg/L and a 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period of ≤ 90 mg/L.
Belle Fourche River (Redwater River to Whitewood Creek)	SD-BF-R-BELLE_FOURCHE_02	2014 2012 2006 2004	Warm-Water Permanent Fish Life	Total Suspended Solids	4A*	Maximum daily concentration of ≤ 158 mg/L and a 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period of ≤ 90 mg/L.
Belle Fourche River (Whitewood Creek to Willow Creek)	SD-BF-R-BELLE_FOURCHE_03	2014 2012 2010 2006 2004	Warm-Water Permanent Fish Life	Total Suspended Solids	4A*	Maximum daily concentration of ≤ 158 mg/L and a 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period of ≤ 90 mg/L.
Belle Fourche River (Willow Creek to Alkali Creek)	SD-BF-R-BELLE_FOURCHE_04	2014 2012 2010 2006 2004	Warm-Water Permanent Fish Life	Total Suspended Solids	4A*	Maximum daily concentration of ≤ 158 mg/L and a 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period of ≤ 90 mg/L.
Belle Fourche River (Alkali Creek to Mouth)	SD-BF-R-BELLE_FOURCHE_05	2014 2012 2010	Immersion Recreation Limited Contact Recreation	*E. coli* Bacteria Fecal Coliform Bacteria	4A*	**Immersion Recreation:** *E. coli*: Daily maximum of ≤ 235 mpn/100 mL and a geometric mean of at least five samples over a 30-day period ≤ 126 mpn/100 mL. Fecal Coliform: Daily maximum of ≤ 400 mpn/100 mL and a geometric mean of at least five samples over a 30-day period ≤ 200 mpn/100 mL. **Limited Contact Recreation:** *E coli*: Maximum daily concentration of ≤ 1,178 mpn/100 mL and a geometric mean of at least five samples over a 30-day period of ≤ 630 mpn/100 mL. Fecal Coliform: Maximum daily concentration of ≤ 2,000 mpn/100 mL and a geometric mean of at least five samples over a 30-day period ≤ 1,000 mpn/100 mL.
		2014 2012 2010 2006 2004	Warm-Water Permanent Fish Life	Total Suspended Solids	4A*	Maximum daily concentration of ≤ 158 mg/L and a 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period of ≤ 90 mg/L.

Table 5-1. 303(d) Listed Impaired Waterbodies in the BFRW in South Dakota (Page 2 of 2)

Waterbody Name/ Description	Assessment Unit I.D.	Years Listed	Impaired Beneficial Use(s)	303(d) Listing Parameter	EPA Category	Water Quality Criteria Threshold Values (Bacteria Criteria Apply From May 1 Through September 30)
Deadwood Creek (Rutabaga Gulch to Whitewood Creek)	SD-BF-R-DEADWOOD_01	2014	Immersion Recreation	*E. coli* Bacteria	5	Immersion Recreation: *E. coli*: Daily maximum of ≤ 235 mpn/100 mL and a geometric mean of at least five samples over a 30-day period ≤ 126 mpn/100 mL. Fecal Coliform: Daily maximum of ≤ 400 mpn/100 mL and a geometric mean of at least five samples over a 30-day period ≤ 200 mpn/100 mL.
Redwater River (WY Border to US HWY 85)	SD-BF-R-REDWATER_01_USGS	2014 2012 2010 2008	Cold-Water Permanent Fish Life	Water Temperature	5	Maximum temperature of < 65°F.
Strawberry Creek (Bear Butte Creek to S5, T4N, R4E)	SD-BF-R-STRAWBERRY_01	2014 2012 2010 2008 2006 2004	Fish/Wildlife Prop. Rec. Stock Waters	Cadmium	4A*	Cadmium: Maximum concentration of < (1.136672 – [(ln(hardness) × 0.041838] × exp[1.128 × (ln(hardness)] – 3.828) in mg/L.
Whitewood Creek (Whitetail Summit to Gold Run Creek)	SD-BF-R-WHITEWOOD_01	2014 2012 2010 2008 2006	Cold-Water Permanent Fish Life	Water Temperature	5	Maximum temperature of < 65°F.
Whitewood Creek (Deadwood Creek to Spruce Gulch)	SD-BF-R-WHITEWOOD_03	2014 2012 2010 2008 2006 2004	Immersion Recreation	*E. coli* Bacteria Fecal Coliform Bacteria	4A*	**Immersion Recreation:** *E. coli*: Daily maximum of ≤ 235 mpn/100 mL and a geometric mean of at least five samples over a 30-day period ≤ 126 mpn/100 mL. Fecal Coliform: Daily maximum of ≤ 400 mpn/100 mL and a geometric mean of at least five samples over a 30-day period ≤ 200 mpn/100 mL.
Whitewood Creek (Spruce Gulch to Sandy Creek)	SD-BF-R-WHITEWOOD_04	2014 2012 2006	Immersion Recreation	*E. coli* Fecal Coliform Bacteria	5	**Immersion Recreation:** *E. coli*: Daily maximum of ≤ 235 mpn/100 mL and a geometric mean of at least five samples over a 30-day period ≤ 126 mpn/100 mL. Fecal Coliform: Daily maximum of ≤ 400 mpn/100 mL and a geometric mean of at least five samples over a 30-day period ≤ 200 mpn/100 mL.
		2014				
Whitewood Creek (Sandy Creek to I-90)	SD-BF-R-WHITEWOOD_05	2014 2012 2010 2008 2006	Cold-Water Marginal Fish Life	pH	5	6.5–9.0 Standard Unit (S.U.)
Whitewood Creek (I-90 to Crow Creek)	SD-BF-R-WHITEWOOD_06	2014	Limited Contact Recreation Life	*E. coli* Bacteria	5	6.5–9.0 S.U.
		2014 2012 2010 2008	Warm-Water Permanent Fish	pH		**Limited Contact Recreation:** *E coli*: Maximum daily concentration of ≤ 1,178 mpn/100 mL and a geometric mean of at least five samples over a 30-day period of ≤ 630 mpn/100 mL.
Whitewood Creek (Crow Creek to Mouth)	SD-BF-R-WHITEWOOD_07	2014 2012 2010	Warm-Water Permanent Fish Life	Total Suspended Solids	5	Maximum daily concentration of ≤ 158 mg/L and a 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period of ≤ 90 mg/L.

(a) EPA Category: (1) All uses met, (2) Some uses met but insufficient data to determine support of other uses, (3) Insufficient data, (4A) Water impaired but has an approved TMDL, (5) Water impaired/requires a TMDL.
* = Waterbody has an EPA-approved TMDL, refer to Appendix A. D**= TMDL development in discussions with the EPA. The EPA category data are shown as reported in the *2014 South Dakota Integrated Report for Surface Water Quality Assessment*.

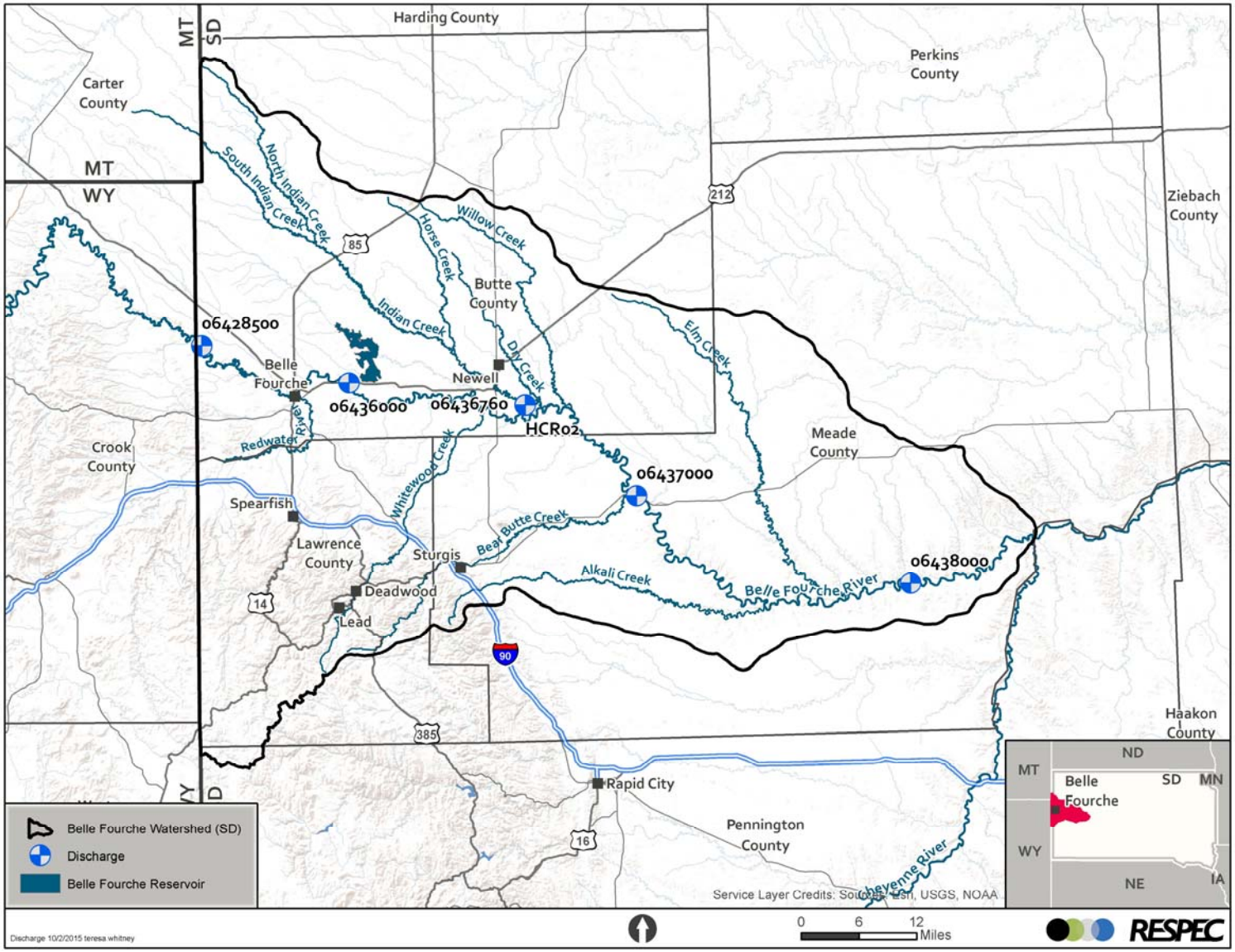

Figure 5-2. Discharge Monitoring Sites on the Belle Fourche River.

Table 5-2. U.S. Geological Survey Gaging Stations on the Belle Fourche River in South Dakota

USGS Gaging Station	Period of Record	Period of Record Average Discharge (cfs)	Range of Discharge (cfs)
Belle Fourche River at WY-SD State Line (06428500)	12/01/1946–12/31/2014	93.3	0.0–5,510
Belle Fourche River Near Fruitdale, SD (06436000)	11/01/1945–9/30/2014	103.2	0.0–11,100
Belle Fourche River Near Sturgis, SD (06437000)	11/07/1945–11/03/2014	302.8	0.0–29,700
Belle Fourche River Near Elm Springs, SD (06438000)	08/19/1928–10/27/2014	398.0	0.0–40,800

cfs = cubic feet per second

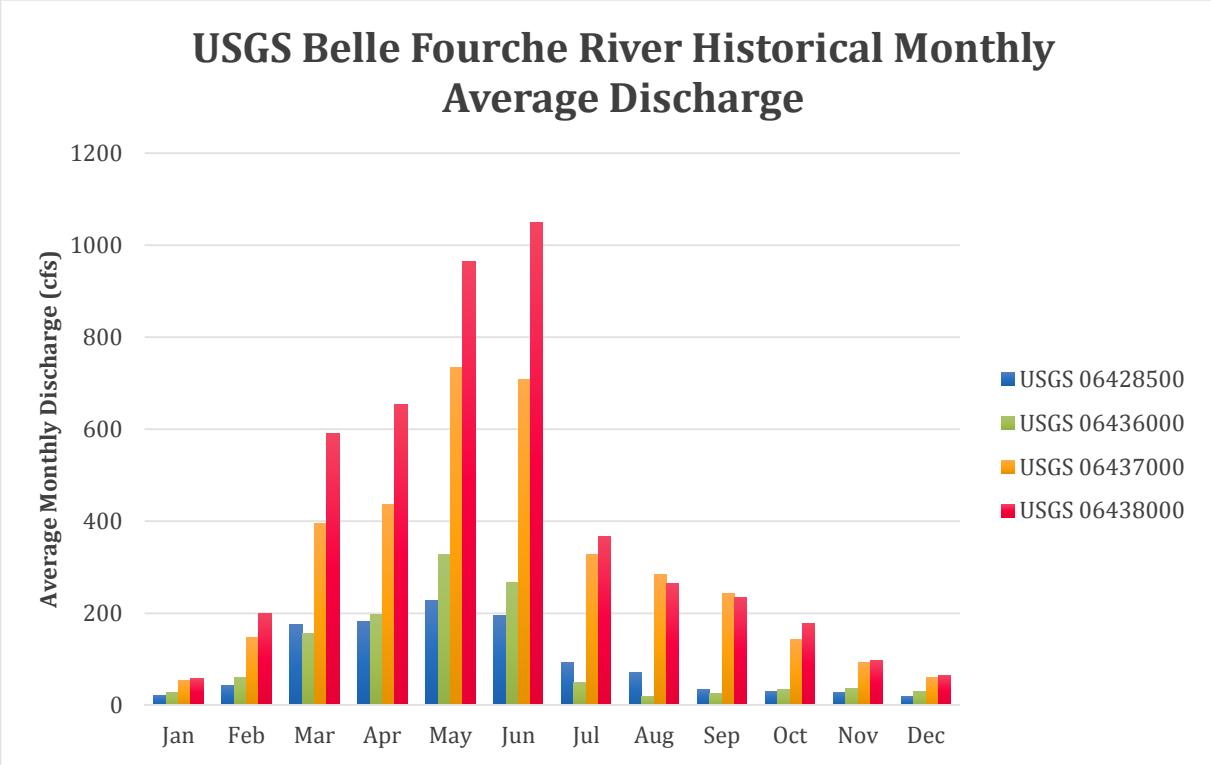

Figure 5-3. Average Historical Monthly Flows on the Belle Fourche River at U.S. Geological Survey Gaging Locations Within the Belle Fourche River Watershed in South Dakota.

Historical daily average flow in the Belle Fourche River at the state line (USGS 06428500) was compiled as a time series to understand historical flow cycles. Figure 5-4 illustrates this information for a 42-year period. The figure indicates that the watershed has experienced 7-year cycles of wet and dry periods over the last 35 years.

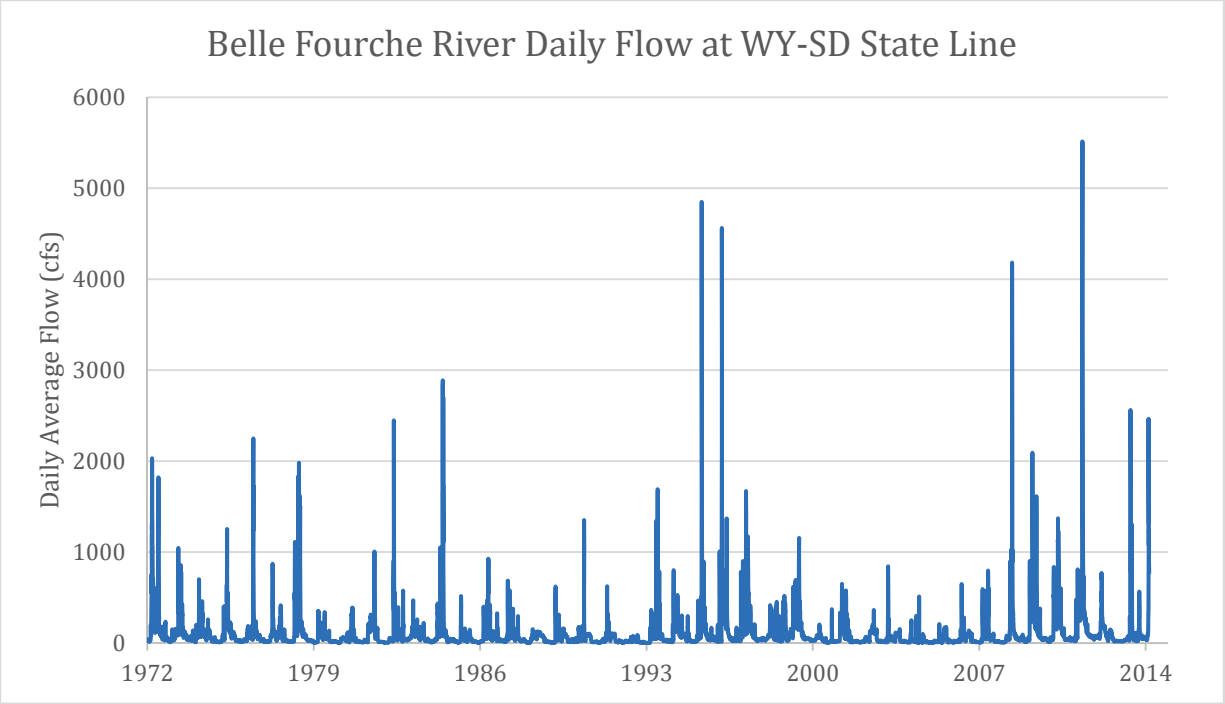

Figure 5-4. Daily Average Flow for the Belle Fourche River at the State Line (USGS 06428500).

5.2.2 Horse Creek Discharge Analysis

Real-time discharge data on Horse Creek above Vale, South Dakota (06436760), was collected by the USGS over the period from October 1980 through September 2012, when the USGS discontinued its operation. Since that time, RESPEC has collected discharge data on the creek at HCR02, which is at the same location. Horse Creek is dominated by irrigation return flows during dry summer periods, because it delivers excess runoff from fields within the BFID delivery system back to the Belle Fourche River. Since about 2006, BMPs have been implemented within the BFID delivery system, along with on-farm improvements, with the purpose of reducing the volume of sediment-laden return flows that impact Horse Creek and ultimately, the Belle Fourche River. To understand the effectiveness of these improvements, this section compares the period of BMP implementation (2006–2014) with a time period before implementation (1995–2005). The relation of Horse Creek to the delivery system and fields located within the BFID and the location of the discharge monitoring station is illustrated in Figure 5-5.

The influence on flows in Horse Creek from waste in the BFID delivery system and field applications is evident when observing monthly median discharge rates for Horse Creek and monthly precipitation averages for the 20-year period of 1995–2014, as illustrated in Figure 5-6. Median flow rates were analyzed because they best represent base flows within the creek rather than flow rates influenced by stormwater runoff. Precipitation values for Newell, South Dakota, were used because this is the only continuous meteorological station within the Horse Creek Watershed. Median discharge rates in the months of June through September are elevated, while the monthly precipitation totals for the period trend downward from 3.48 inches in May to 0.93 inch in September. This relationship clearly illustrates the impact of the BFID's delivery system on Horse Creek.

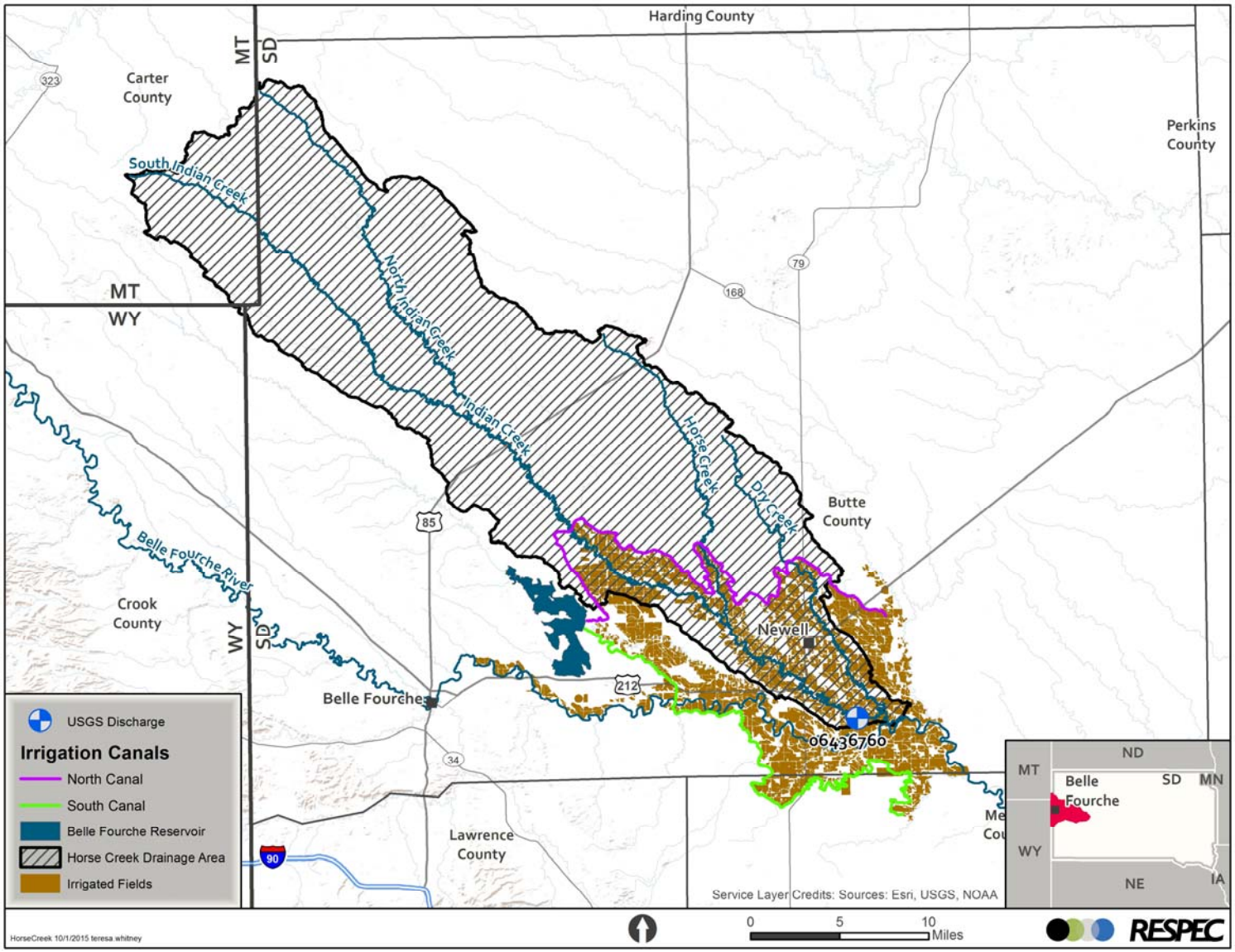

Figure 5-5. Location of Horse Creek in Relation to the Fields and Main Delivery System Within the Belle Fourche Irrigation District.

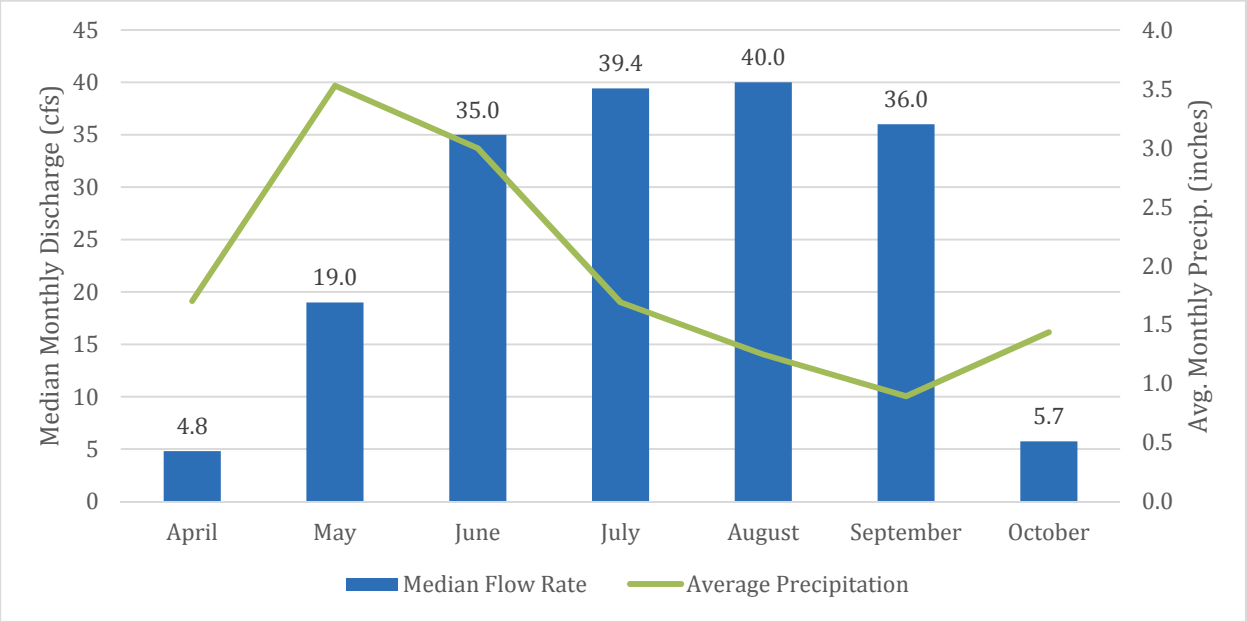

Figure 5-6. Historical Median Discharge on Horse Creek and Average Precipitation at Newell, South Dakota.

The typical irrigation season in the BFID begins in June and lasts until the end of September. As depicted in Figure 5-6, the median flow jumps from 4.8 cfs in April to 35.0 cfs in June. The median flow increases to a maximum of 40 cfs in August and drops to less than 6 cfs by October. Because the area typically receives little precipitation during the irrigation season, much of the elevated discharge rates observed in Horse Creek over the irrigation season can be attributed to inefficiencies or waste within the irrigation system's transport and delivery on individual fields.

Although median flow rates adequately present a means of understanding seasonal impacts from irrigation returns on flows in Horse Creek, they are not adequate on their own for comparing the pre- and post-BMP implementation periods because of precipitation influences. To reduce bias in the comparison, monthly median flow rates specific to each period were normalized by their respective monthly average precipitation values. This normalization results in arbitrary units of cfs/inch, and the higher the value, the more likely it is that median flow rates are influenced by irrigation return flows. Table 5-3 compares these values for the typical irrigation season of June through September between the pre-BMP (1995–2005) and post-BMP (2006–2014) periods. The values are also graphed in Figure 5-7.

Table 5-3 and Figure 5-7 show that monthly median flow rates normalized by monthly average precipitation actually increased from pre-BMP to post-BMP implementation in the months of June and July. This may be explained in typical management of the delivery system during those months of the irrigation season.

During June and into early July, demand for irrigation water is often low because of either adequate or over-adequate soil moisture throughout the irrigation district. Even with low demand, the delivery system must be flowing to carry even the smallest water orders to their respective fields and to be prepared for increases in irrigation water demand. When this is the case, not all water in the delivery system is

delivered to fields, but instead must be released through wasteways leading to natural drainages, such as Horse Creek.

Table 5-3. Comparison of Monthly Median Flows, Average Precipitation, and Flow per Precipitation for the Pre- and Post-BMP Implementation Periods

	Period	June	July	August	September
Median Flow (cfs)	Pre-BMP	29.5	40.0	39.0	40.0
	Post-BMP	41.0	39.1	41.4	33.0
Average Precipitation (in)	Pre-BMP	3.27	1.82	1.05	0.83
	Post-BMP	2.67	1.53	1.48	0.97
Flow per Precipitation (cfs/in)	Pre-BMP	9.0	22.0	37.0	48.0
	Post-BMP	15.4	25.6	27.9	34.2
Reduction (%)		**–41**	**–14**	**33**	**41**

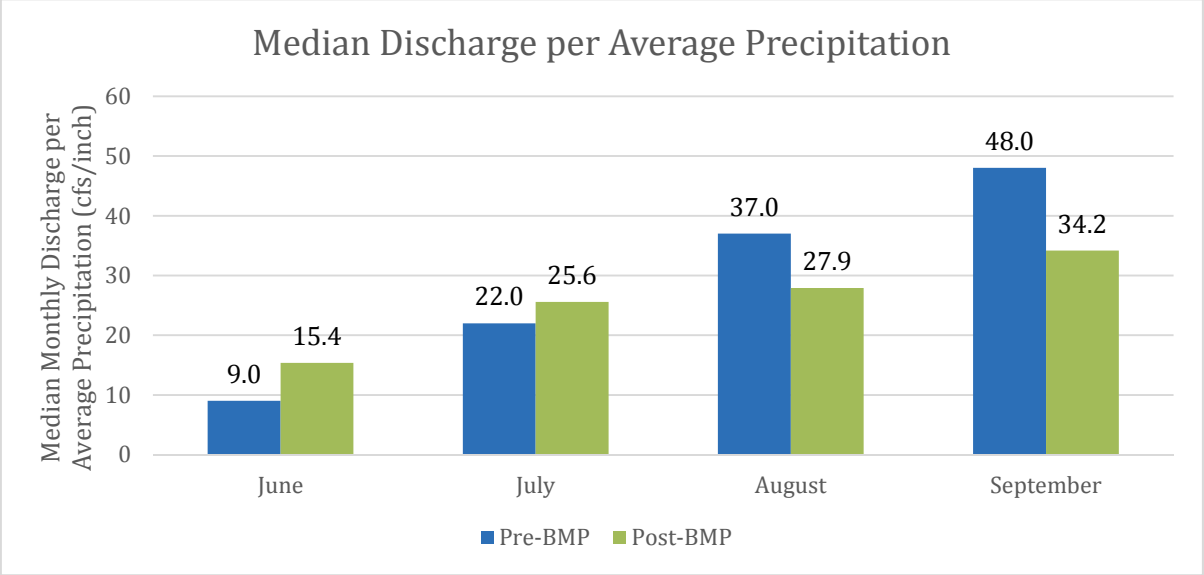

Figure 5-7. Comparison of the Median Flow Rate per Average Precipitation by Month for the Pre-BMP and Post-BMP Implementation Periods.

Excess water in the delivery system during early summer can also be the result of water-level management within the Belle Fourche Reservoir. When inflows to the reservoir exceed what is needed to maintain preferred water levels, water must be released through the irrigation delivery system because it is the only controlled outlet for the reservoir. The result is in excess water within the delivery system which, in turn, must be wasted to natural drainages.

Because of the variable requirements for managing the delivery system and reservoir in June and July, the months of August and September are much more indicative of irrigation efficiency. Irrigation deliveries in August and September are seldom impacted by reservoir management needs and are regularly the most

demanding for irrigation application to fields. The comparison of pre-BMP to post-BMP implementation periods for August and September indicates improvements to the flow/precipitation metric of 33 percent and 41 percent, respectively. This fact indicates that BMP implementation within the BFID delivery system and on-farm applications over the last 10 years has made significant progress toward the goal of reducing return flows impacting Horse Creek.

The BMPs used within the BFID to date include automated gate controls and flow monitoring, replacing open ditches with pipeline, lining open canals and laterals, replacing flood irrigation techniques with sprinkler irrigation, and irrigation scheduling for BFID operators. Along with implementing physical BMPs, public meetings and project tours have helped extend public outreach and awareness within the watershed.

5.3 WATER QUALITY ANALYSES

To evaluate the effectiveness of the current implementation plan, statistical analyses were performed on multiple aspects of data collected at five sites located on the Belle Fourche River in South Dakota. Monitoring was also conducted on the Horse Creek site (HCR02), which is a key tributary to the Belle Fourche River. Figure 5-8 depicts the location of the five monitoring sites on the Belle Fourche River and the monitoring site on Horse Creek.

Using the water quality data collected at sites on the Belle Fourche River, an analysis was performed to evaluate concentrations of *E. coli*, fecal coliform, and TSS. Water quality data collected from the Horse Creek site consists of specific conductivity and *E. coli* concentration data, with the oldest of these records dating back to 2004. The USGS initiated monitoring for specific conductivity on Horse Creek in May 2004 and continued through October 2011 to collect daily mean values. RESPEC began monitoring on Horse Creek in May 2012 and continued through October 2012 to collect continuous specific conductivity measurements as well as biweekly grab samples for specific conductivity at Horse Creek above Vale, South Dakota (HCR02). Grab samples collected were analyzed for *E. coli* concentration by Energy Laboratories in Rapid City, South Dakota.

The data were grouped into two categories for analysis: pre-BMP and post-BMP implementation. Pre-BMP implementation data refer to data collected from 1995 to 2005, before rigorous BMP implementation began, while post-BMP implementation data refer to data collected from 2006 to 2014. Data pertaining to Horse Creek date back to 2004, and inclusion of a pre-BMP condition to the analysis for this monitoring location includes only 2 years of record for which the analysis is based on. Therefore, pre- and post-BMP water quality implementation conditions were not analyzed for Horse Creek.

5.3.1 Belle Fourche River

5.3.1.1 *E. coli Water Quality Data*

Statistics generated for *E. coli* bacteria sampling data collected from the five SD DENR water quality monitoring sites on the Belle Fourche River during the recreation season (May 1 through September 30) are provided in Table 5-4. The sites are listed from upstream to downstream in the table and at locations shown in Figure 5-8. *E. coli* data collection was not initiated at these sites until 2009; therefore, no pre-BMP data are available for comparing for *E. coli* reduction. Note that BMP implementation to date focused on TSS reductions rather than bacteria, although many of the practices will have a positive impact on the loadings for both constituents.

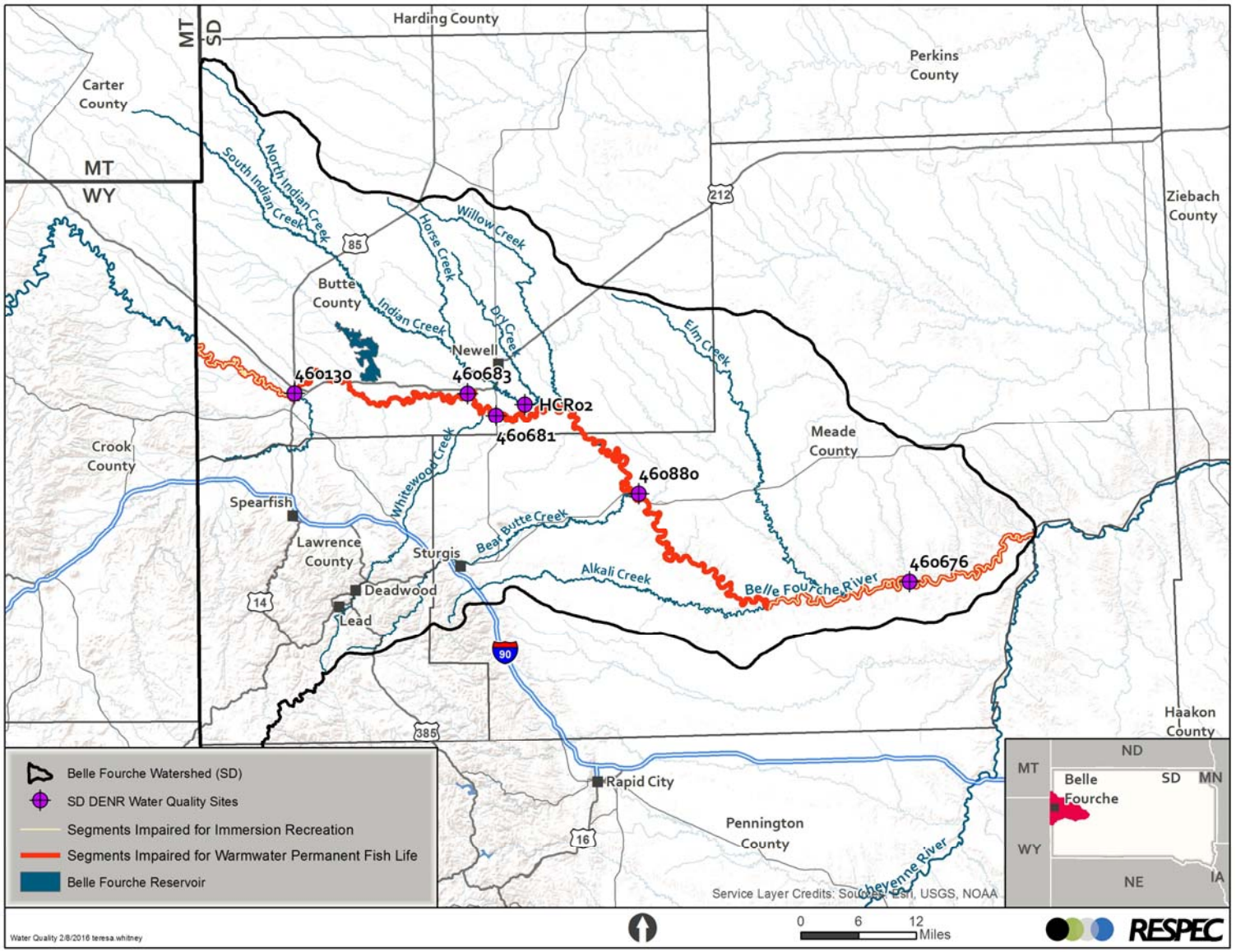

Figure 5-8. Location of the Five South Dakota Department of Environmental Quality Water Quality Monitoring Sites and the Horse Creek Monitoring Sites Within the South Dakota Portion of the Belle Fourche River Watershed.

Table 5-4. *E. coli* Statistics for Post-BMP South Dakota Department of Environment and Natural Resources Water Quality Monitoring Sites on the Belle Fourche River

Site	Period of Record	Mean (mpn/ 100 mL)	Median (mpn/ 100 mL)	Total Samples	Number of Samples Exceeding Criterion	Percent Exceedance (%)
Belle Fourche River in Belle Fourche (460130)	05/05/2009–09/02/2014	384	64	30	5	17
Belle Fourche River Near Vale (460683)	05/05/2009–08/21/2014	50	37	14	0	0
Belle Fourche River Near Vale (460681)	05/05/2009–08/21/2014	116	53	12	1	8
Belle Fourche River Near Volunteer (460880)	05/05/2009–08/21/2014	63	24	13	1	8
Belle Fourche River Northwest of Elm Springs (460676)	05/05/2009–09/02/2014	908	50	31	6	19

Data collected during the recreation season (May 1 through September 30) from each monitoring site from 2009 to 2014 were used to calculate the percent exceedance of the single sample *E. coli* bacteria criterion of 235 mpn/100 mL. The Immersion Recreation criterion for *E. coli* of 235 mpn/100 mL applies at all five sites. Sites 460130 (upstream) and 460676 (downstream) exceeded the *E. coli* standard at rates of 17 and 19 percent, respectively.

5.3.1.2 *Fecal Coliform Water Quality Data*

Fecal coliform bacteria sampling data collected from the five SD DENR water quality sites on the Belle Fourche River during the recreation season (May 1 through September 30) was statistically analyzed for pre-BMP (1995–2005) and post-BMP (2006–2014) conditions and are provided in Table 5-5. Data collected were used to calculate the percent exceedance of the single sample fecal coliform bacteria criterion of 400 mpn/100 mL for Immersion Recreation, which is applicable at all five locations. Sites 460130 and 460676 exceeded the fecal coliform standard at rates of 20 and 13 percent, respectively.

Median fecal coliform concentrations were reduced at Sites 460130, 460681, and 460880 after BMP implementation began in 2005 (post-BMP). The largest reduction in median concentration from the pre-BMP to post-BMP condition was observed at Site 460681.

Site 460676 has a large increase in mean fecal coliform concentration. This large increase is primarily because of a single elevated result in July 2009 of 130,000 mpn/100mL. The next-highest value was 5,400 mpn/100mL. Ignoring the one outlier would result in post-BMP fecal coliform mean and median concentrations at Site 460676 of 460 mpn/100mL and 115 mpn/100mL, respectively. In the remaining four sites, the percent exceedance of the standard has been reduced.

5.3.1.3 *Total Suspended Solids Water Quality Data*

Total suspended solids sampling data collected from the five SD DENR water quality sites on the Belle Fourche River were statistically analyzed for pre-BMP (1995–2005) and post-BMP (2006–2014) conditions, as shown in Table 5-6. Data collected were used to calculate the percent of samples exceeding the daily maximum value of 158 mg/L, which is applicable to those waters with an assigned Warm-Water Permanent Fish Life beneficial use. All five sites are subject to this standard.

Table 5-5. Fecal Coliform Statistics for South Dakota Department of Environment and Natural Resources Water Quality Monitoring Sites on the Belle Fourche River

Site	BMP Status	Period of Record	Mean (mpn/ 100 mL)	Median (mpn/ 100 mL)	Total Samples	Number of Samples Exceeding Criterion	Percent Exceedance (%)
Belle Fourche River in Belle Fourche (460130)	Pre-BMP	07/21/1999–09/21/2005	478	160	19	5	26
	Post-BMP	05/17/2006–09/02/2014	513	150	46	9	20
Belle Fourche River Near Vale (460683)	Pre-BMP	01/04/1995–07/13/2005	121	56	14	1	7
	Post-BMP	07/26/2006–08/21/2014	76	58	16	0	0
Belle Fourche River Near Vale (460681)	Pre-BMP	01/04/1995–07/13/2005	385	225	12	2	17
	Post-BMP	01/09/2006–08/21/2014	155	82	15	1	7
Belle Fourche River Near Volunteer (460880)	Pre-BMP	02/22/1995–07/13/2005	1,038	49	16	2	13
	Post-BMP	07/26/2006–08/21/2014	78	38	16	0	0
Belle Fourche River Northwest of Elm Springs (460676)	Pre-BMP	02/09/1999–12/14/2005	201	92	34	3	9
	Post-BMP	05/23/2006–12/02/2014	3,216 (460)[a]	120 (115)[a]	47 (46)[a]	6 (5)[a]	13 (11)[a]

(a) Numbers for Site 460676, Post-BMP when ignoring the July 2009 outlier.

Table 5-6. Total Suspended Solids Statistics for South Dakota Department of Environment and Natural Resources Water Quality Monitoring Sites on the Belle Fourche River

Site	BMP Status	Period of Record	Mean (mg/L)	Median (mg/L)	Total Samples	Number of Samples Exceeding Criterion	Percent Exceedance (%)
Belle Fourche River in Belle Fourche (460130)	Pre-BMP	04/29/1999–11/17/2005	198	7	47	6	13
	Post-BMP	01/09/2006–12/10/2014	273	24	107	31	29
Belle Fourche River Near Vale (460683)	Pre-BMP	01/04/1995–10/27/2005	83	33	46	4	9
	Post-BMP	01/09/2006–11/04/2014	62	15	39	5	13
Belle Fourche River Near Vale (460681)	Pre-BMP	01/04/1995–10/27/2005	73	18	46	4	9
	Post-BMP	01/09/2006–11/04/2014	89	22	37	6	16
Belle Fourche River Near Volunteer (460880)	Pre-BMP	02/22/1995–10/27/2005	259	19	44	7	16
	Post-BMP	01/09/2006–11/04/2014	78	24	38	5	13
Belle Fourche River Northwest of Elm Springs (460676)	Pre-BMP	02/09/1999–12/14/2005	224	29	82	10	12
	Post-BMP	01/17/2006–12/10/2014	543	32	110	28	25

The median TSS concentrations were reduced only at Site 460683 when comparing median values pre- and post-BMP. When assessing these changes in median TSS concentrations, the spatial location of the WQM sites in relation to the location of TSS BMP implementation projects within the watershed must be considered. For instance, Site 460130 is upstream of most sediment-reducing BMPs that have been implemented within the watershed and downstream from activities outside the state. Exceedance of the TSS concentration standard at this site has increased from 13 percent to 29 percent. However, the only reduction in exceedance of the TSS concentration standard has been observed at Site 460880, which is downstream from the majority of the BMPs.

5.3.2 Horse Creek

Horse Creek is a key tributary within the watershed and contributes significant volumes of irrigation return flows to the Belle Fourche River during the BFID irrigation season. Water-quantity aspects pertinent to Horse Creek were previously identified; therefore, the following discussion will outline water quality parameters that have historically and, more recently, prompted monitoring efforts on Horse Creek. The location of Horse Creek in relation to the irrigation features was illustrated in Figure 5-5.

5.3.2.1 *E. coli Water Quality Data*

Horse Creek has been assigned a Limited Contact Recreation beneficial use; however, the South Dakota 2012 and 2014 303(d) lists of impaired waterbodies states that support of this designation is inconclusive because of insufficient data available for determination. *E. coli* grab samples were collected from May 2014 through September 2014 and were analyzed by Energy Laboratories in Rapid City, South Dakota. A total of 11 grab samples were collected over this period, and *E. coli* concentrations were reported as ranging from 12 mpn/100 mL to 2,420 mpn/100 mL. Collected *E. coli* concentration data have been compared to the single sample *E. coli* bacteria criterion of 1,178 mpn/100 mL as designated for waterbodies with an assigned Limited Contact Recreation beneficial use.

Figure 5-9 displays the results of *E. coli* bacteria sampling performed on Horse Creek during the 2014 monitoring season. This plot shows that two of the eleven *E. coli* grab samples obtained were in excess of the single sample *E. coli* bacteria criterion of 1,178 mpn/100 mL. This results in an 18 percent exceedance of the *E. coli* bacteria criterion for Limited Contact Recreation waters for the 2014 monitoring season. The two samples that were in exceedance occurred on June 11, 2014, and June 17, 2014, and measured 1,300 mpn/100 mL and 2,420 mpn/100 mL, respectively. Horse Creek was under flood conditions at the time of those samples, and the high concentrations were likely a result of this event. These observations indicate that overland runoff and washoff associated with precipitation potentially had the capacity to transport accumulated bacteria near or within the riparian area to Horse Creek.

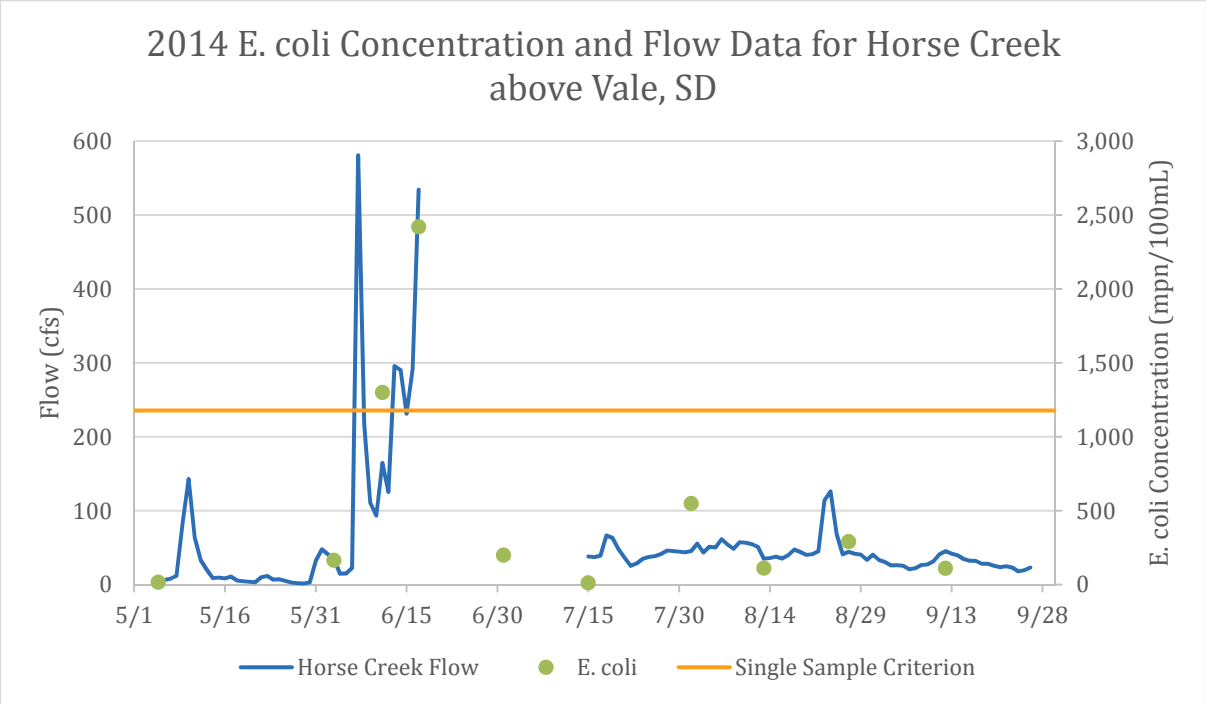

Figure 5-9. 2014 *E. Coli* Concentrations and Flow for Horse Creek Within the Belle Fourche River Watershed in South Dakota.

6.0 SUCCESSES OF THE PROJECT AND ASPECTS OF THE PROJECT THAT DID NOT WORK WELL

Continued public awareness of this ongoing project greatly enhances the effort put forth to improving water quality in the watershed. Combined efforts of radio advertisements, brochures, outreach booths, tours, the BFRWP website, and the soil-quality demonstration trailer were measured as being successful. Many comments and questions were received from the public who heard about the BFRWP from radio advertisements and sound bites. These activities increased interest and awareness from the general public in addition to the producers directly involved in an implementation project. Acceptance from the general public is a huge asset when making watershed-wide improvements in water quality.

General interest from producers was received watershed wide. BMPs often benefit producers by making their land more productive and profitable while obtaining improved water quality and overall improving soil health and land conservation. The BFRWP believes that the financial incentive offered as cost share is at a good balance to enhance the partnership between the BFRWP and the individual agriculture producer. The partnership created in each individual project is good insurance that the practice will be maintained for its usable life and continue to promote water quality and other benefits. Applications for projects always exceed allowable funds and generally a backlog of projects exist from year to year. This allows projects to be ranked in a manner that selects projects having the most direct benefit to water quality. The downside to this is that some participants with excellent projects are overlooked because the location or distance from the impaired waterbody. Some of these individuals may become disinterested after several years of unsuccessful applications.

Recent interest in no-till farming and cover crop practices to improve overall soil health has been observed in the watershed. These practices have a direct effect on water quality in the Belle Fourche River. Continued support of this practice through outreach and education would be beneficial to the BFRWP's goals of reducing sediment in the Belle Fourche River.

7.0 PROJECT BUDGET/EXPENDITURES

The BFRWP received a $1,242,000 EPA Section 319 Grant through the SD DENR to continue installing the BMPs recommended in the *Phase I Watershed Assessment Final Report and TMDL* [Hoyer and Larson, 2004]. In addition to the EPA 319 project, $163,000 in state-revolving funds were provided to fund BMPs. Tables 7-1a, 7-2a, 7-3a, and 7-4a show the budgets of 319, 319/matching funds, nonmatching funds, and combined funds, respectively. These budgets were the final budgets after the Segment 6 amendment was approved. Tables 7-1b, 7-2b, 7-3b, and 7-4b are the final expenditure budgets for 319, 319/matching funds, nonmatching funds, and combined funds, respectively. Changes in these budgets were documented as exhibit amendments to the budget as they were made.

7.1 319 BUDGET

The total 319 budget remained the same with some changes between tasks. From Task 2 Product 2–Implement Riparian/Rangeland BMPs, $8,574 was transferred to Task 4 Product 4–Outreach and Education to cover the cost of the 2014 financial audit. From Task 2 Product 2– Implement Riparian/Rangeland BMPs, $31,826 was transferred to Task 1 Product 1c–Install Sprinkler Systems to cover the expense of an additional center-pivot project. No other changes were made to the 319 budget.

7.2 MATCHING FUNDS BUDGET

All federal-match requirements were met in this project. Final match dollars were higher than originally estimated. The rising cost of constructing BMPs created a situation where producer cash match was higher than expected. Also, $163,000 of state-revolving funds were received and used as a match for the project.

7.3 NONMATCHING FEDERAL FUNDS BUDGET

Overall nonmatching funds were underestimated for the project by approximately $1,050,674. Federal dollars, including NRCS EQIP, can be variable from year to year depending on the demand, so estimating actual numbers is challenging. Changes occurred in all areas of the nonmatching budget to reflect actual dollars spent.

Table 7-1a. Planned Budget of 319 Funds

Project Description	Consultants ($)	Producer ($)	BFID ($)	BFRWP ($)	Butte Conservation District ($)	Totals ($)
Objective 1. Implement BMPs Recommended in the Belle Fourche River TMDL to Reduce TSS and *E. coli*						
Task 1. Reduce Nonused Water						
Product 1. Improved Irrigation Water Delivery and Application						
1a. Line and Pipe Open Canals and Laterals						
1b. Install 4 Stage-Control Automation Units			25,000			25,000
1c. Install 30 Sprinkler Systems		557,000				557,000
1d. Irrigation Scheduling	35,000					35,000
Task 2. Range and Riparian Area BMP Implementation						
Product 2. Implement Riparian/Rangeland BMPs		225,000				225,000
Task 3. Stormwater Management						
Product 3. City of Belle Fourche Stormwater Master Plan	60,000					60,000
Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, Cultural Resources, Engineering Projects, Report Writing, Writing Future Grants						
Task 4. Project Management and Administration						
Product 4. Public Outreach, and Education Implementation Record Keeping, Cultural Resources, Engineering, Audits, Report writing, and Future Grant Writing	250,000			20,000	40,000	310,000
Objective 3. Complete Essential Water Quality Monitoring						
Task 5. Water Quality Monitoring to Assess BMPs						
Product 5. Water Quality Monitoring	30,000					30,000
Total	**375,000**	**782,000**	**25,000**	**20,000**	**40,000**	**1,242,000**

Table 7-1b. Actual Budget of 319 Funds

Project Description	Consultants ($)	Producer ($)	BFID ($)	BFRWP ($)	Butte Conservation District ($)	Totals ($)
Objective 1. Implement BMPs Recommended in the Belle Fourche River TMDL to Reduce TSS and *E. coli*						
Task 1. Reduce Nonused Water						
Product 1. Improved Irrigation Water Delivery and Application						
1a. Line and Pipe Open Canals and Laterals						
1b. Install 4 Stage-Control Automation Units			25,000			25,000
1c. Install 30 Sprinkler Systems		588,826				588,825
1d. Irrigation Scheduling	35,000					35,000
Task 2. Range and Riparian Area BMP Implementation						
Product 2. Implement Riparian/Rangeland BMPs		184,600				184,600
Task 3. Stormwater Management						
Product 3. City of Belle Fourche Stormwater Master Plan	60,000					60,000
Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, Cultural Resources, Engineering Projects, Report Writing, Writing Future Grants						
Task 4. Project Management and Administration						
Product 4. Public Outreach, and Education Implementation Record Keeping, Cultural Resources, Engineering, Audits, Report writing, and Future Grant Writing	250,000			28,574	40,000	318,574
Objective 3. Complete Essential Water Quality Monitoring						
Task 5. Water Quality Monitoring to Assess BMPs						
Product 5. Water Quality Monitoring	30,000					30,000
Total	**375,000**	**773,426**	**25,000**	**28,574**	**40,000**	**1,242,000**

Table 7-2a. Planned EPA 319 and Matching Funds Budget

EPA 319 and Matching Funds Budget	EPA 319 ($)	Matching Funds ($)					Sum of Matching Funds ($)
		CWSRF Water Quality (Cash) ($)	Producer (Cash and In-kind) ($)	Lawrence County (Cash) ($)	BFID (Cash and In-kind) ($)	WY DEQ (Cash)	
Objective 1. Implement BMPs Recommended in the Belle Fourche River TMDL to Reduce TSS and *E. coli*							
Task 1. Reduce Nonused Water							
Product 1. Improved Irrigation Water Delivery and Application							
1a. Line and Pipe Open Canals and Laterals					75,000		75,000
1b. Install 4 Stage-Control Automation Units	25,000				75,000		75,000
1c. Install 30 Sprinkler Systems	557,000	163,000	1,313,000				1,476,000
1d. Irrigation Scheduling	35,000						
Task 2. Range and Riparian Area BMP Implementation							
Product 2. Implement Riparian/Rangeland BMPs	225,000		75,000				75,000
Task 3. Stormwater Management							
Product 3. City of Belle Fourche Stormwater Master Plan	60,000						
Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, Cultural Resources, Engineering Projects, Report Writing, Writing Future Grants							
Task 4. Project Management and Administration							
Product 4. Public Outreach, and Education Implementation Record Keeping, Cultural Resources, Engineering, Audits, Report writing, and Future Grant Writing	310,000						
Objective 3. Complete Essential Water Quality Monitoring							
Task 5. Water Quality Monitoring to Assess BMPs							
Product 5. Water Quality Monitoring	30,000			14,000	10,500	14,000	38,500
Total	**1,242,000**	**163,000**	**1,388,000**	**14,000**	**160,500**	**14,000**	**1,739,500**

Table 7-2b. Actual EPA 319 and Matching Funds Budget

EPA 319 and Matching Funds Budget	EPA 319 ($)	Matching Funds ($)					Sum of Matching Funds ($)
		CWSRF Water Quality (Cash) ($)	Producer (Cash and In-kind) ($)	Lawrence County (Cash) ($)	BFID (Cash and In-kind) ($)	WY DEQ (Cash)	
Objective 1. Implement BMPs Recommended in the Belle Fourche River TMDL to Reduce TSS and *E. coli*							
Task 1. Reduce Nonused Water							
Product 1. Improved Irrigation Water Delivery and Application							
1a. Line and Pipe Open Canals and Laterals					0		0
1b. Install 4 Stage-Control Automation Units	25,000				0		0
1c. Install 30 Sprinkler Systems	588,826	163,000	1,487,122				1,650,122
1d. Irrigation Scheduling	35,000						
Task 2. Range and Riparian Area BMP Implementation							
Product 2. Implement Riparian/Rangeland BMPs	184,600		186,488.40				186,488.40
Task 3. Stormwater Management							
Product 3. City of Belle Fourche Stormwater Master Plan	60,000						
Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, Cultural Resources, Engineering Projects, Report Writing, Writing Future Grants							
Task 4. Project Management and Administration							
Product 4. Public Outreach, and Education Implementation Record Keeping, Cultural Resources, Engineering, Audits, Report writing, and Future Grant Writing	318,574						
Objective 3. Complete Essential Water Quality Monitoring							
Task 5. Water Quality Monitoring to Assess BMPs							
Product 5. Water Quality Monitoring	30,000			15,275	11,445	15,275	41,995
Total	**1,242,000**	**163,000**	**1,673,610.40**	**15,275**	**11,445**	**15,275**	**1,878,605.40**

Table 7-3a. Planned Nonmatching Funds Budget

EPA 319 and Nonmatching Funds Budget	Nonmatching Funds					Sum of Nonmatching Funds ($)
	SD DENR (Federal) ($)	NRCS EQIP (Federal) ($)	COE (Federal) ($)	BOR (Federal) ($)	USGS (Federal) ($)	
Objective 1. Implement BMPs Recommended in the Belle Fourche River Watershed TMDL to Reduce TSS and *E. coli*						
Task 1. Reduce Nonused Water						
Product 1. Improved Irrigation Water Delivery and Application						
1a. Line and Pipe Open Canals and Laterals				150,000		150,000
1b. Install 4 Stage-Control Automation Units						
1c. Install 30 Sprinkler Systems		500,000				500,000
1d. Irrigation Scheduling						
Task 2. Range and Riparian Area BMP Implementation						
Product 2. Implement Riparian/Rangeland BMPs		1,500,000				1,500,000
Task 3. Stormwater Management						
Product 3. City of Belle Fourche Stormwater Master Plan						
Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, Cultural Resources, Engineering Projects, Report Writing, Writing Future Grants						
Task 4. Project Management and Administration						
Product 4. Public Outreach, and Education Implementation Record Keeping, Cultural Resources, Engineering, Audits, Report writing, and Future Grant Writing						
Objective 3. Complete Essential Water Quality Monitoring						
Task 5. Water Quality Monitoring to Assess BMPs						
Product 5. Water Quality Monitoring	70,000		14,000	7,000	173,400	264,400
Total	**70,000**	**2,300,000**	**14,000**	**157,000**	**173,400**	**2,414,400**

Table 7-3b. Actual Nonmatching Funds Budget

EPA 319 and Nonmatching Funds Budget	Nonmatching Funds					Sum of Nonmatching Funds ($)
	SD DENR (Federal) ($)	NRCS EQIP (Federal) ($)	COE (Federal) ($)	BOR (Federal) ($)	USGS (Federal) ($)	
Objective 1. Implement BMPs Recommended in the Belle Fourche River Watershed TMDL to Reduce TSS and *E. coli*						
Task 1. Reduce Nonused Water						
Product 1. Improved Irrigation Water Delivery and Application						
1a. Line and Pipe Open Canals and Laterals				0		0
1b. Install 4 Stage-Control Automation Units						
1c. Install 30 Sprinkler Systems		106,791				106,791
1d. Irrigation Scheduling						
Task 2. Range and Riparian Area BMP Implementation						
Product 2. Implement Riparian/Rangeland BMPs		1,500,000				1,500,000
Task 3. Stormwater Management						
Product 3. City of Belle Fourche Stormwater Master Plan						
Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, Cultural Resources, Engineering Projects, Report Writing, Writing Future Grants						
Task 4. Project Management and Administration						
Product 4. Public Outreach, and Education Implementation Record Keeping, Cultural Resources, Engineering, Audits, Report writing, and Future Grant Writing						
Objective 3. Complete Essential Water Quality Monitoring						
Task 5. Water Quality Monitoring to Assess BMPs						
Product 5. Water Quality Monitoring	70,000		14,000	7,000	173,400	264,400
Total	**70,000**	**2,300,000**	**14,000**	**157,000**	**173,400**	**2,414,400**

Table 7-4a. Planned Total Budget

Total Budget	EPA 319 ($)	Matching Funds ($)	Nonmatching Funds ($)	Line Item Total ($)
Objective 1. Implement BMPs Recommended in the Belle Fourche River TMDL to Reduce TSS and *E. coli*				
Task 1. Reduce Nonused Water				
Product 1. Improved Irrigation Water Delivery and Application				
1a. Line and Pipe Open Canals and Laterals		75,000	150,000	225,000
1b. Install 4 Stage-Control Automation Units	25,000	75,000		100,000
1c. Install 30 Sprinkler Systems	557,000	1,313,000	500,000	2,370,000
1d. Irrigation Scheduling	35,000			35,000
Task 2. Range and Riparian Area BMP Implementation				
Product 2. Implement Range/Rangeland BMPs	225,000	75,000	1,500,000	1,800,000
Task 3. Stormwater Management				
Product 3. City of Belle Fourche Stormwater Master Plan	60,000			60,000
Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, Cultural Resources, Engineering Projects, Report Writing, Writing Future Grants				
Task 3. Project Management and Administration				
Product 4. Public Outreach, and Education Implementation Record Keeping, Cultural Resources, Engineering, Audits, Report writing, and Future Grant Writing	310,000			310,000
Objective 3. Complete Essential Water Quality Monitoring				
Task 4. Water Quality Monitoring to Assess BMPs				
Product 5. Water Quality Monitoring	30,000	38,500	264,400	332,900
Total	**1,242,000**	**1,576,500**	**2,414,400**	**5,232,900**

Table 7-4b. Actual Total Budget

Total Budget	EPA 319 ($)	Matching Funds ($)	Nonmatching Funds ($)	Line Item Total ($)
Objective 1. Implement BMPs Recommended in the Belle Fourche River TMDL to Reduce TSS and *E. coli*				
Task 1. Reduce Nonused Water				
Product 1. Improved Irrigation Water Delivery and Application				
1a. Line and Pipe Open Canals and Laterals		0	0	0
1b. Install 4 Stage-Control Automation Units	25,000	0		25,000
1c. Install 30 Sprinkler Systems	588,826	1,650,122	106,791	2,345,739
1d. Irrigation Scheduling	35,000			35,000
Task 2. Range and Riparian Area BMP Implementation				
Product 2. Implement Range/Rangeland BMPs	184,600	186,488.40	3,122,278.29	3,493,366.69
Task 3. Stormwater Management				
Product 3. City of Belle Fourche Stormwater Master Plan	60,000			60,000
Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, Cultural Resources, Engineering Projects, Report Writing, Writing Future Grants				
Task 3. Project Management and Administration				
Product 4. Public Outreach, and Education Implementation Record Keeping, Cultural Resources, Engineering, Audits, Report writing, and Future Grant Writing	318,574			318,574
Objective 3. Complete Essential Water Quality Monitoring				
Task 4. Water Quality Monitoring to Assess BMPs				
Product 5. Water Quality Monitoring	30,000	41,995	236,005	308,000
Total	**1,242,000**	**1,878,605.40**	**3,465,074.29**	**6,585,679.69**

8.0 FUTURE ACTIVITY RECOMMENDATIONS

Segment 7 will continue over the next 2 years and will install the BMPs outlined in the *Phase I Watershed Assessment Final Report and TMDL* [Hoyer and Larson, 2004] and the *Ten-Year Belle Fourche River Watershed Strategic Implementation Plan* [Hoyer, 2005]. Details for Segment 7 can be found in the BFRWP's project implementation plan. Currently, a new 10-year plan is being written to guide future implementation for this project. Additional segments will ensure that the overall goal for the watershed is met, which is to bring the Belle Fourche River and other impaired waterbodies within the watershed into compliance with state TSS standards. As additional TMDLs are completed for other lakes and tributaries in the watershed, the implementation of TMDLs developed will be added to the Belle Fourche River Watershed Project.

9.0 REFERENCES

Hoyer, D. P., 2005. *Ten-Year Belle Fourche River Watershed Strategic Implementation Plan*, RSI-1821, prepared by RESPEC, Rapid City, SD, for the Belle Fourche Irrigation District, Newell, SD.

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