
WATERSHED PROJECT FINAL REPORT
SECTION 319 NONPOINT SOURCE POLLUTION
CONTROL PROGRAM

Spring Creek Watershed Management and
Project Implementation Plan Segment I

Topical Report RSI-2415

prepared for

Pennington County
315 St. Joseph Street
Suite 118
Rapid City, South Dakota 57701

March 2014



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by

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March 2014

EXECUTIVE SUMMARY

Project Title: Spring Creek Watershed Management and Project Implementation Plan Segment I

Project Start Date: June 1, 2010

Project Completion Date: December 31, 2012

Funding

- Total EPA Grant Budget: \$576,000
- Total Matching Funds Budget: \$448,887
- Total Nonmatching Funds Budget: \$0

Total Budget: \$1,024,887

- Budget Revisions
- June, 2010
319 Award \$324,000
- June, 2011
319 Award \$252,000
- Funds Rollover to Segment 2 \$160,606

Total Expenditures of EPA Funds: \$415,393

Total 319 Matching Funds Accrued: \$262,275

Total Nonmatching Funds Accrued: \$6,861

Total Expenditures: \$684,529

ACKNOWLEDGEMENTS

Pennington County would like to thank all of those involved with Segment I of the Spring Creek Watershed Management and Project Implementation Plan. Without the tireless efforts of individuals involved from the following organizations, this project segment would not have been possible:

Black Hills Flyfishers

Black Hills Resource Conservation and Development

City of Hill City

City of Rapid City

Custer County

Individual ranchers, farmers, and landowners within the watershed

Pennington County Conservation District

South Dakota Association of Conservation Districts

South Dakota Conservation Commission

South Dakota Department of Agriculture

South Dakota Department of Environment and Natural Resources

South Dakota Game, Fish and Parks

South Dakota School of Mines & Technology

Spring Creek Watershed Advisory Group

United States Army Corps of Engineers

United States Environmental Protection Agency

United States Fish and Wildlife Service

United States Forest Service, Black Hills National Forest

United States Geological Survey

United States Natural Resources Conservation Service

West Dakota Water Development District.

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1.0 INTRODUCTION

Spring Creek is a perennial mountain stream located in Pennington and Custer Counties in the Black Hills of South Dakota. Spring Creek is a tributary of the Cheyenne River, which flows into the Missouri River. The drainage area of the Spring Creek Watershed is approximately 425 square miles (1,100 square kilometers) at the confluence with the Cheyenne River and includes Hydrologic Units 101201090901, 101201090902, 101201090903, 101201090904. Spring Creek flows through Sheridan Lake, which is a man-made reservoir with a surface area of approximately 380 acres. The city of Hill City (population approximately 950) is the only municipality located in the watershed. The watershed is displayed in Figure 1-1.

Land use in the watershed is primarily silviculture, recreation, residential, and grazing. Metamorphic slates and schists, along with granite rock, underlie a large portion of the basin and form the Central Crystalline Area of the Black Hills that covers the majority of the study area.

Digital Elevation Models (DEMs) of the area show that the average slope is approximately 20 percent. Much of the land is located within the Black Hills National Forest and is predominantly forested with ponderosa pine; other cover includes grasslands and hardwoods. The average annual precipitation in the watershed is 20.8 inches; 80 percent usually falls in April through September. Tornadoes and severe thunderstorms strike occasionally. These storms are local and of short duration and occasionally produce heavy rainfall events. The average seasonal snow pack is 27.3 inches per year.

Spring Creek above Sheridan Lake has been listed in the South Dakota Integrated Report for Surface Water-Quality Assessment as impaired for the beneficial use of immersion recreation caused by high levels of fecal coliform since 2006. In October 2008, a Total Maximum Daily Load (TMDL) was approved by the United States Environmental Protection Agency (EPA) with the goal of reducing fecal coliform levels in Spring Creek to meet applicable water-quality standards: (1) maximum daily concentration of 400 colony forming units per 100 milliliters (cfu/100mL) and (2) maximum geometric mean of five samples over a 30-day period of 200 cfu/100mL. These standards apply only during the recreational season of May 1 through September 30.

The fecal coliform-impaired (303(d) listed) segment of Spring Creek has a length of 31 miles, starting at the headwaters and flowing through Hill City and Mitchell Lake, which has a surface area of approximately 7 acres. This segment ends where Spring Creek drains into Sheridan Lake, approximately 4 miles downstream from Mitchell Lake. The drainage area of the 303(d) listed segment is approximately 126 square miles.

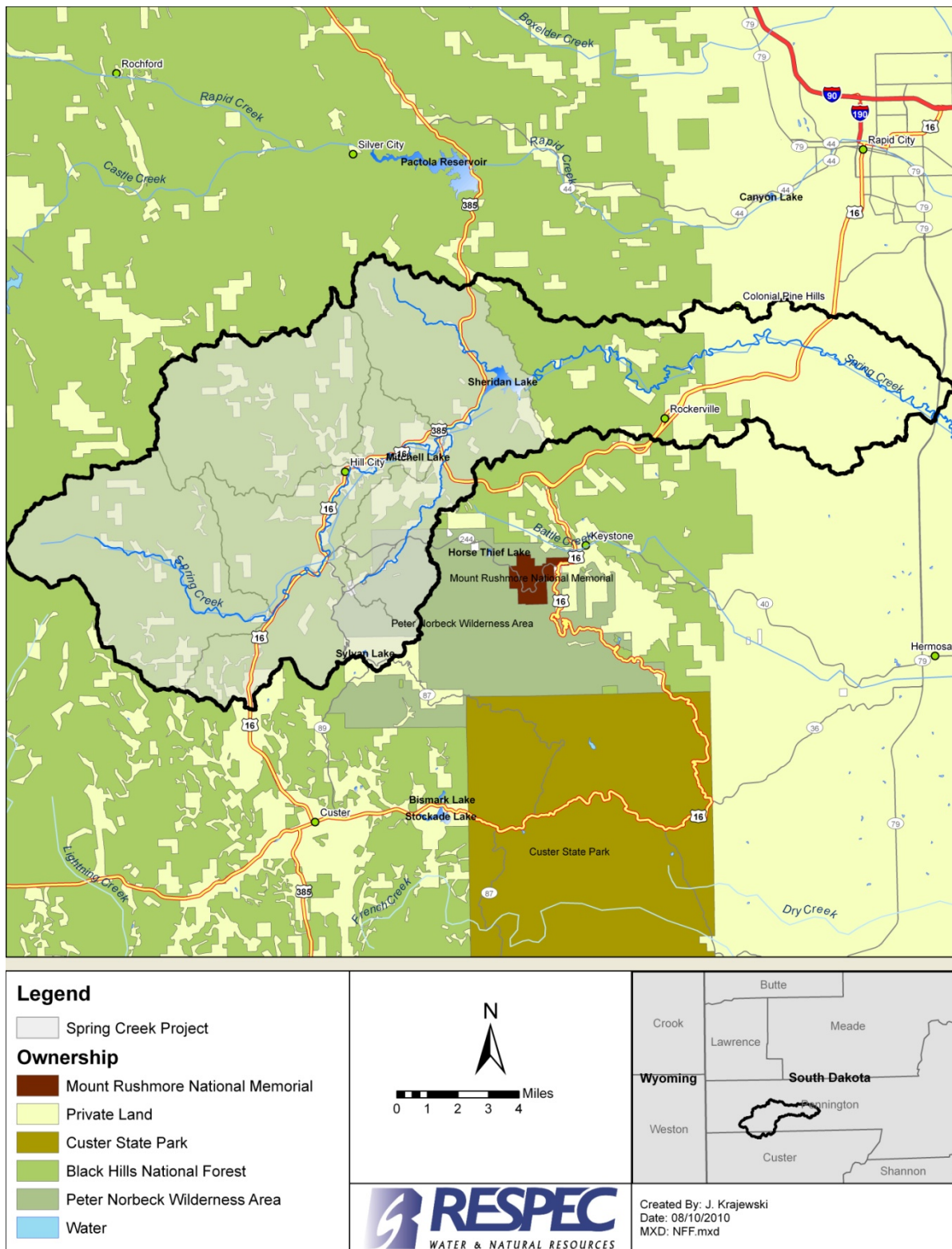


Figure 1-1. Spring Creek Watershed.

The results of the 2008 fecal coliform bacteria TMDL report [Kenner and Larson, 2008] indicate that more than one-half (63.5 percent) of the bacteria load originates from livestock and other agricultural land uses. The remaining load originates from urban runoff (13.7 percent) and other human sources (14.8 percent), including failing septic and leaking sanitary sewer systems.

2.0 PROJECT GOALS AND OBJECTIVES

The goal of the Spring Creek Watershed Management and Project Implementation Plan is to bring Spring Creek into compliance for fecal coliform bacteria by implementing recommended Best Management Practices (BMPs) by 2021. The goals of this project segment, as set forth in the Spring Creek and Sheridan Lake TMDL studies, include the following:

- Implement several BMP pilot projects that will be used to demonstrate and promote the effectiveness of BMP implementation on water quality.
- Develop a 10-year Spring Creek Watershed Strategic Implementation Plan, Stormwater Management Plan, and Septic System Management Plan that will help prioritize BMP implementation and public outreach efforts.
- Conduct significant public education and outreach to stakeholders within the Spring Creek Watershed.
- Perform water-quality monitoring to aid in developing baseline conditions that will be used to ensure that BMPs are properly implemented and effective.

2.1 PLANNED AND ACTUAL MILESTONES, PRODUCTS, AND COMPLETION DATES

Objective 1. Implement BMPs Recommended in the Fecal Coliform Bacteria TMDL for Spring Creek.

This objective consisted of two tasks: (1) improving riparian vegetation and manure management techniques, and (2) implementing on-site wastewater treatment system (OWTS) improvement projects. The products of this objective include completing six riparian projects and six OWTS projects. Implementation of these BMPs is discussed in further detail in Chapter 3.0.

Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, and Report and Future Grant Writing.

This objective consisted of a single task and the following products were planned:

- Administering nine public meetings and two watershed tours
- Creating one public web page
- Writing additional grants
- Completing the Grant Reporting and Tracking System (GRTS) final report
- Completing one final report.

The completed products of Objective 2 include the following:

- Administering three public meetings and two watershed tours
- Conducting individual meetings with over 200 landowners
- Evaluating and ranking 87 cost-share applications for funding to implement BMPs within the watershed
- Creating the Spring Creek Watershed Advisory Group (SCWAG)
- Creating the Spring Creek Watershed 319 Project website
- Initiating three direct mailings to over 1,000 residents within the watershed
- Submitting grant proposals to the National Forest Foundation, National Wild Turkey Federation, South Dakota Discovery Center, and U.S. Forest Service
- Completing the GRTS Final Report and this Segment I final report.

These activities are discussed in further detail in Chapter 4.0 of this report.

Objective 3. Develop Project Planning Documents.

This objective comprised three tasks: (1) a study of the existing septic systems within the watershed and developing a corresponding Septic System Management Plan, (2) a study of the current stormwater management controls within the watershed and developing a Stormwater Management Plan, and (3) completing a 10-Year Strategic Implementation Plan. These documents are currently in draft form and have not yet been officially adopted.

Objective 4. Complete Essential Water-Quality Monitoring.

Monitoring was initially planned to occur at 19 sites monthly during the 2010 recreation season and twice outside the recreation season. Stormwater runoff sampling was planned for four sites, and stage recording was planned for six sites. In addition, four lake profiles were planned for the 2010 season.

The products for Objective 4 include collecting ambient and storm event water-quality and water-quantity monitoring data. Specifically, 259 grab and 49 storm event samples were collected at 17 ambient monitoring sites and five stormwater monitoring sites throughout the 2010 and 2011 monitoring seasons. This monitoring resulted in 1,710 analyses being performed for fecal coliform bacteria, *E. coli* bacteria, Total Suspended Solids (TSS), Total Phosphorus (TP), and nitrate+nitrite as Nitrogen (nitrates).

Table 2-1 lists the project objectives, their products, the planned milestone completion dates, and the actual milestone completion dates.

Table 2-1. Planned Versus Actual Milestone Completion Dates

Spring Creek Watershed Implementation	Planned Completion	Actual Completion
<i>Objective 1. Implement BMPs Recommended in the Fecal Coliform Bacteria TMDL for Spring Creek.</i>		
Product 1. Riparian Vegetation and Manure Management Improvement Projects	Jun-12	Sep-12
Product 2. Septic System Improvement Projects	Jun-12	Apr-12
<i>Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, and Report and Future Grant Writing.</i>		
Product 3. Public Outreach and Education, Record Keeping, and Report and Future Grant Writing	Jun-12	Jun-12
<i>Objective 3. Develop Project Planning Documents.</i>		
Product 4. Septic System Management Plan	Jun-12	Draft
Product 5. Stormwater Management Plan	Jun-12	Draft
Product 6. Spring Creek Watershed 10-Year Strategic Implementation Plan	Jun-12	Draft
<i>Objective 4. Complete Essential Water-Quality Monitoring Data.</i>		
Product 7. Compile Water-Quality Monitoring Data	Sep-11	Sep-11

2.2 EVALUATION OF GOAL ATTAINMENT

The project success was evaluated by comparing project outputs and outcomes with the planned milestones. All objectives established for this project were reached and included the following:

- Implemented several BMPs recommended by Kenner and Larson [2008] and Krajewski and Rausch [2014].
- Implemented BMPs that resulted in estimated fecal coliform load reductions of 2.18×10^{11} cfu/day for this project segment.
- Created the SCWAG; administered three public meetings, two watershed tours, and individual meetings with over 200 land-owners; created the Spring Creek Watershed 319 Project website; initiated three direct mailings to over 1,000 residents within the watershed; and completed the annual GRTS reports and this Segment I final report.

3.0 BEST MANAGEMENT PRACTICES

Implementation of the BMPs recommended in Kenner and Larson [2008] was initiated during this project segment. BMP installations were funded by local residential, commercial, and agricultural property owners; Pennington County; the city of Hill City; West Dakota Water Development District; South Dakota Game, Fish, and Parks (SDGFP); the South Dakota School of Mines & Technology (SDSM&T); the city of Rapid City; Black Hills FlyFishers; Pennington Conservation District; Black Hills RC&D Association; U.S. Forest Service–Black Hills National Forest; Custer County; National Resource Conservation Service (NRCS); and the U.S. Geological Survey. Table 3-1 provides the BMP projects installed within Segment I.

Table 3-1. Best Management Practices Planned and Implemented in Segment I

Best Management Practice	BMP Units	Installed Segment I
OWTS – Single Family Residence	Each	6
Access Control	Acre	20.3
Channel Vegetation	Feet	415
Fence, 4-Wire	Feet	2,735
Irrigation System, Microirrigation	Each	310
Pest Management	Acre	23.3
Pipeline, PVC, HDPE, PE Pipe 1.25" - 8"	Feet	320
Riparian Forest Buffer	Acre	1
Stream Bank and Shoreline Protection	Feet	50
Watering Facility	Each	1

4.0 PUBLIC PARTICIPATION AND OUTREACH

Multiple outreach activities were completed within Segment I and are shown in Figures 4-1 through 4-4. The Spring Creek 319 Watershed Project website was launched (www.springcreekblackhills.com) and received over 1,300 unique visitors throughout Segment I. Three direct mailings about the implementation project, water-quality monitoring, and BMP cost-share signups were sent to over 1,000 watershed residents. Along with these efforts, Pennington County, the NRCS, SDSM&T, the South Dakota Department of Energy and Natural Resources (SDDENR), and the watershed consultant staff met with over 200 watershed residents and property owners. Three public meetings and two field tours were also held in the watershed.

In addition to these outreach activities, presentations were made to the following entities:

- Pennington County Board of Commissioners
- Black Hills Mayors' Conference
- National Forest Advisory Board
- South Dakota Lakes and Streams Association
- Western Dakota Water Development District
- Western South Dakota Hydrology Conference
- South Dakota Association of Conservation District's National Association of Conservation District Northern Plains Region Leaders Meeting.

Also during this segment, over 14 SCWAG meetings were held to review the project's progress and provide technical recommendations to the Pennington County Board of Commissioners.



Figure 4-1. The Boys and Girls Club of the Black Hills Monitoring Water Quality at Tracy Park in Hill City, South Dakota.



Figure 4-2. Watershed Tour Displaying Stormwater Impacts Along Spring Creek in Hill City, South Dakota.



Figure 4-3. Riparian Buffer and Streambank Protection Best Management Practice Installation Along Spring Creek Near Hill City, South Dakota.



Figure 4-4. Watershed Tour Displaying Cost-Sharing Project Opportunities Along Spring Creek Near Hill City, South Dakota.

5.0 WATER-QUALITY MONITORING RESULTS

Water quality at the watershed level was analyzed by using data collected from the 2010 and 2011 monitoring seasons. Throughout these years, monitoring included ambient and storm event sampling on Spring Creek and its tributaries (Palmer Creek, Newton Fork, Sunday Gulch, Blue Wing [Calumet Creek]) and Horse Creek. Monitoring commenced from work that Pennington County began in 2010 as described in Oswald [2010] and the SDDENR [2005]. The monitoring sites used within Segment I, and general locations, years sampled, and types of sampling that occurred are provided in Table 5-1, and the results are graphed in Appendix A.

5.1 TOTAL MAXIMUM DAILY LOAD IMPLEMENTATION EFFECTIVENESS

BMPs implemented within Segment I contributed to obtaining the goals as set forth in the Spring Creek and Sheridan Lake TMDL studies. BMP installations focused on reducing fecal coliform/*E. coli* bacteria loads to begin attaining the load reductions identified in Kenner and Larson [2008] and ultimately reducing concentrations to levels that meet the state of South Dakota's water-quality standards. The BMPs that were implemented resulted in an estimated fecal coliform reduction of 2.18×10^{11} cfu/day in Spring Creek for this project segment, based on values from the Bacteria Source Load Calculator (BSLC).

5.2 WATER-QUALITY ANALYSES

Segment I water-quality monitoring results are discussed in the following sections.

5.2.1 2010 Monitoring Results Summary

Pennington County and their partners conducted baseline multiparty monitoring in 2010 for fecal coliform bacteria, *E. coli*, TSS, TP, and nitrates. From April through October, approximately 145 grab samples were collected at 17 sites, and ISCO automatic samplers at four mainstem sites collected 24 storm event samples. Monitoring sites used throughout the 2010 monitoring season are presented in Table 5-1. During 2010, 845 analyses were completed for fecal coliform, *E. coli*, TSS, TP, and nitrates by Energy Laboratories in Rapid City. Additionally, 70 analyses were completed for fecal coliform, *E. coli*, TSS, TP, and nitrates for quality assurance and quality control (QA/QC).

Fecal coliform concentrations from grab and composite samples that were collected during all baseflow and storm events at four mainstem sites (SPC200, SPC350, SPC450, and SPC500 with percent exceedances of 33 percent, 42 percent, 17 percent, and 22 percent, respectively) exceed the single-sample criterion of 400 cfu/100 mL during the 2010 recreation season (May 1–

Table 5-1. Segment I Monitoring Locations (Page 1 of 2)

Site	General Monitoring Site Location	Latitude (N)	Longitude (W)	Year(s) Monitored	Sampling Type
<i>Spring Creek Monitoring Sites</i>					
SPC025	Spring Creek at Bobcat Road	43.8977	-103.7229	2011	Ambient
SPC050	Spring Creek at Spring Creek Road W	43.8636	-103.6268	2010, 2011	Ambient
SPC100	Spring Creek at Rafter J Road	43.8558	-103.5906	2010, 2011	Ambient
SPC125	Spring Creek above Crooked Creek Resort	43.8978	-103.5914	2011	Ambient
SPC130	Spring Creek below Crooked Creek Resort	43.9006	-103.5919	2011	Ambient
SPC200	Spring Creek upstream of Tracy Park	43.9272	-103.5739	2010, 2011	Ambient & Storm
SPC250	Spring Creek upstream of Confluence with Major Lake	43.9346	-103.5686	2010, 2011	Ambient
SPC290	Spring Creek above Kjerstad Property	43.9371	-103.5599	2011	Ambient
SPC300	Spring Creek downstream of Hill City	43.9379	-103.5606	2010, 2011	Ambient
SPC350	Spring Creek upstream of Mitchell Lake	43.9410	-103.5449	2010, 2011	Ambient & Storm
SPC400	Spring Creek downstream of Mitchell Lake	43.9451	-103.5356	2010, 2011	Ambient
SPC450	Spring Creek upstream of Confluence with Palmer Creek	43.9447	-103.5138	2010, 2011	Ambient & Storm
SPC500	Spring Creek upstream of Sheridan Lake	43.9835	-103.4881	2010, 2011	Ambient & Storm
SPC550	Spring Creek downstream of Sheridan Lake	43.9811	-103.4421	2010	Ambient

Table 5-1. Segment I Monitoring Locations (Page 2 of 2)

Site	General Monitoring Site Location	Latitude (N)	Longitude (W)	Year(s) Monitored	Sampling Type
<i>Tributary Monitoring Sites</i>					
SPC600	Spring Creek upstream of Loss Zone	43.9792	-103.3463	2010	Ambient
PCT410	Palmer Creek upstream of Confluence with Spring Creek	43.8995	-103.5359	2010, 2011	Ambient & Storm
PCT470	Palmer Creek upstream of Highway 16	43.9367	-103.5106	2011	Ambient & Storm
PCT480 ^(a)	Palmer Creek near Confluence of Spring Creek	43.9375	-103.5094	2010	Ambient
SGT110	Sunday Gulch upstream of Confluence of Spring Creek	43.8667	-103.5831	2010	Ambient
SGT180	Sunday Gulch at Confluence of Spring Creek	43.8900	-103.5865	2010	Ambient
NFT340	Newton Fork upstream of Major Lake	43.9364	-103.5714	2011	Ambient
NFT380	Newton Fork below Dam and above Major Lake	43.9346	-103.5680	2011	Ambient
BWT580	Blue Wing (Calumet Creek) upstream of Sheridan Lake	43.9647	-103.4604	2010	Ambient
HCT580	Horse Creek upstream of Sheridan Lake	43.9845	-103.4870	2010	Ambient

(a) Discontinued August of 2011 and moved to Site PCT470. Data from Sites PCT480 and PCT470 were combined for summaries.

September 30). Fecal coliform concentrations at the other 12 sites did not exceed the single-sample criterion.

Fecal coliform samples collected during baseflow at mainstem and tributary sites did not exceed the single-sample criterion of 400 cfu/100 mL. The median concentrations ranged from 3 to 92 cfu/100 mL. Samples collected during storm events show fecal coliform concentrations increase from Site SPC200 in Hill City (median = 360 cfu/100 mL) downstream to Site SPC350 (median = 470 cfu/100 mL) above Mitchell Lake, while concentrations decrease from Site PC450 (median = 200 cfu/100 mL) above Highway 16 downstream to Site SPC500 (median = 170 cfu/100 mL) above Sheridan Lake. Site SPC450 had the lowest percent (23 percent) of storm event samples exceeding the single-sample criterion of 400 cfu/100 mL, while Sites SPC200, SPC350, and SPC500 had exceedances of 46 percent, 57 percent, and 31 percent, respectively.

E. coli samples collected during baseflow did not exceed the single-sample criterion of 235 most probable number per 100 milliliters (mpn/100 mL). Samples collected during storm events show *E. coli* concentrations decrease from Site SPC200 (median = 398 mpn/100 mL) downstream to Site SPC450 (median = 187 mpn/100 mL), while concentrations increase from SPC450 downstream to Site SPC500 (median = 259 mpn/100 mL). Site SPC450 had the lowest percent (46 percent) of storm event samples exceeding the single-sample criterion, while Sites SPC200, SPC350, and SPC500 had exceedances of 62 percent, 50 percent, and 54 percent, respectively.

TSS samples collected during baseflow vary from upstream to downstream. TSS concentrations decrease from Site SPC050 below Spring Creek Road W (median = 29 milligrams per liter [mg/L]) downstream to Site SPC200 in Hill City (median = 19 mg/L) and then increase to Site SPC300 (median = 33 mg/L) at Big Horn Meadow Place and decrease downstream to Site SPC400 below Mitchell Lake. TSS concentrations then increase downstream to Site SPC500 above Sheridan Lake. TSS samples collected during baseflow at seven mainstem sites (SPC050, SPC100, SPC200, SPC250, SPC300, SPC350, and SPC500) exceeded the single-sample TSS criterion of 53 mg/L. Four sites (SPC100, SPC250, SPC300, and SPC350) had the lowest percent (14 percent) exceedances, while Sites SPC050 and SPC500 had the highest percent (29 percent) exceedances. No tributary sites exceeded the TSS criterion during baseflow. TSS samples collected during storm events show that concentrations are consistent from Site SPC200 (median = 45 mg/L) downstream to Site SPC350 (median = 43.5 mg/L), while concentrations decrease at Site SPC450 (median = 25 mg/L) downstream to Site SPC500 (median = 14 mg/L).

Samples collected during baseflow show nitrates sample concentrations increase from Site SPC200 in Hill City (median = 0.15 mg/L) downstream to Site SPC250 (median = 0.3 mg/L), remain consistent downstream to Site SPC500 (median = 0.3 mg/L) upstream from Sheridan Lake, and then decrease at Sites SPC550 and SPC600 downstream from Sheridan Lake.

Samples collected during storm events show nitrate concentrations increase slightly from Site SPC200 (median = 0.1 mg/L) downstream to Site SPC350 (median = 0.15 mg/L), while concentrations remain consistent at Site SPC450 (median = 0.1 mg/L) downstream to Site SPC500 (median = 0.1 mg/L). Exceedances were not calculated because a numerical water-quality standard for nitrates is not established in South Dakota.

TP samples collected during baseflow gradually increase from Site SPC050 (median = 0.05 mg/L) downstream to Site SPC350 (median = 0.07 mg/L), except for a slight decrease at Site SPC200 (median = 0.045 mg/L). Below Mitchell Lake, TP concentrations increase slightly downstream to Site SPC500 (median = 0.06 mg/L) and decrease at Sites SPC550 and SPC600 below Sheridan Lake. TP samples collected during storm events show that concentrations are consistent from Site SPC200 (median = 0.08 mg/L) downstream to Site SPC350 (median = 0.09 mg/L), while concentrations decrease at Site SPC450 (median = 0.05 mg/L) downstream to Site SPC500 (median = 0.05 mg/L). No exceedances were calculated because TP criteria are not assigned for Spring Creek.

5.2.2 2011 Monitoring Results Summary

In 2011, Pennington County, SDSM&T, and RESPEC monitored water quality to establish baseline conditions, identify pollutant sources, and focus implementation efforts. Monthly grab samples were collected during ambient monitoring from June through September at 13 sites on Spring Creek and four tributary sites. Storm composite samples were collected from July through September at three sites on the mainstem of Spring Creek and two sites on Palmer Creek.

From June through September 2011, 101 grab samples were collected during ambient monitoring at 17 sites, and 19 storm-event samples were collected during storm-event monitoring by ISCO automatic samplers at five sites. During 2011, 600 analyses were completed for *E. coli*, *Enterococci*, TSS, TP, nitrates, and 65 QA/QC analyses were completed. Monitoring would have been typically initiated in May at the beginning of the recreation season (May 1 through September 30). However, in 2011, monitoring did not begin until late June because of delays in federal grant funding for the project. All analyses were conducted by Energy Laboratories in Rapid City, South Dakota.

In 2011, *E. coli* ambient sampling on Spring Creek showed that samples did not exceed the single-sample criterion of 235 mpn/100 mL for immersion recreation beneficial use. The mainstem sites on Spring Creek had ambient *E. coli* concentration medians that ranged from a low of 2 mpn/100 mL at Site SPC025 to a high of 147 mpn/100 mL at Site SPC250. Also during 2011, *E. coli* ambient sampling on Palmer and Newton Fork Creeks showed that no samples exceeded the single-sample criterion of 1,178 mpn/100 mL for limited-contact recreation beneficial use. Concentration medians on Palmer Creek ranged from 28 mpn/100 mL at Site PCT410 to 252 mpn/100 mL at Site PCT470. *E. coli* concentration medians on Newton Fork were 35 mpn/100 mL and 11 mpn/100 mL at Sites NFT 340 and NFT380, respectively.

E. coli event mean concentration (EMC) medians during storm sampling on Spring Creek decreased from site SPC200 (median = 714 mpn/100 mL) downstream to site SPC350 (median = 332 mpn/100 mL), while concentrations increased from Site SPC350 downstream to site SPC500 (median = 1,121 mpn/100 mL). The *E. coli* storm sampling results are graphed in Figure A-3. Site SPC350 had the lowest percent (50 percent) of storm event samples exceeding the single-sample criterion of 235 mpn/ 100 mL. Sites SPC200 and SPC500 had exceedances of 75 percent. On Palmer Creek, sites PCT410 and PCT470 had 33 percent and 50 percent, respectively, of storm event samples exceeding the single-sample criterion of 1,178 mpn/100 mL for limited-contact recreation beneficial use.

In 2011, *Enterococci* ambient sampling on Spring Creek has shown that samples did not surpass the EPA's suggested single-sample threshold for *Enterococci* of 61 to 151 mpn/100 mL. The mainstem sites on Spring Creek had ambient *Enterococci* concentration medians that ranged from a low of 9 mpn/100 mL at Site SPC025 to a high of 28 mpn/100 mL at Sites SPC250 and SPC500. Sampling during storm events indicates that the three mainstem sites on Spring Creek (Sites SPC200, SPC350, and SPC500) had 50 percent of the samples surpassing the EPA's suggested threshold for *Enterococci* of 61 to 151 mpn per 100 mL. *Enterococci* concentrations increased from Site SPC200 near Tracy Park in Hill City (median = 359 mpn/100 mL) downstream to Site SPC350 (median = 880 mpn/100 mL) above Mitchell Lake, then decreased significantly from Site SPC350 to site SPC500, Spring Creek upstream of Sheridan Lake (median = 132 mpn/100mL). *Enterococci* concentrations during storm event sampling on Palmer Creek show an increase from site PCT410 (median = 461 mpn/100 mL) downstream to Site PCT 470 (median = 1,396 mpn/100 mL).

TSS ambient monitoring has shown that no samples collected on Spring Creek, Palmer Creek, and Newton Fork have exceeded the criterion of 53 mg/L for the cold-water permanent fish life propagation beneficial use. Site SPC025 (Spring Creek at Bobcat Road) had a median value of 9 mg/L. Ambient TSS concentrations increased slightly downstream from Site SPC300, Spring Creek below Hill City (median = 7 mg/L), to Site SPC450, Spring Creek upstream of U.S. Highway 16 (median = 10 mg/L), and then decreased slightly at Site SPC500, just upstream of Sheridan Lake, (median = 7 mg/L). TSS concentrations on Palmer Creek remained constant from Site PCT410 (median = 5 mg/L) to Site PCT470 (median = 5 mg/L). TSS concentration medians on Newton Fork increased from 5 mg/L at Site NFT340 to 7 mg/L at Site NFT380. Of the TSS samples collected during storms at Sites SPC200, SPC350, PCT470, and SPC500, 50 percent exceeded the 53 mg/L criterion. TSS median concentrations decreased from 100 mg/L at site SPC200 to 81 mg/L at site SPC350 and further decreased downstream to 38 mg/L at Site SPC500, just upstream of Sheridan Lake. TSS concentrations on Palmer Creek increased from site PCT410 (median = 5 mg/L) downstream to Site PCT470 (median = 38 mg/L).

In 2011, ambient sampling showed nitrate concentrations increased from Site SPC025 (median = 0.1 mg/L) downstream to Site SPC050 (median = 0.2 mg/L) and then decreased slightly to SPC200 (median = 0.15 mg/L). Nitrate median concentrations varied

between 0.2 mg/L and 0.3 mg/L from Site SPC250 downstream to Site SPC500 (median = 0.2 mg/L). During storm events, nitrate median concentrations remained constant at Site SPC200 (median = 0.25 mg/L) and Site SPC350 (median = 0.25 mg/L) and then increased slightly downstream to Site SPC500 (median = 0.3 mg/L). Nitrate median concentrations during storm events on Palmer Creek increased downstream from Site PCT410 (median = 0.1 mg/L) to Site PCT470 (median = 0.3 mg/L). South Dakota has established total ammonia nitrogen water-quality criteria for cold-water permanent fish life propagation beneficial use but an applicable nitrate criteria does not exist for this beneficial use. In 2011, all ambient and storm samples were below the current water-quality criterion for nitrate as nitrogen of 88 mg/L for the fish and wildlife propagation, recreation, and stock watering beneficial use [Administrative Rules of South Dakota, 2010].

In 2011, ambient monitoring showed that TP concentrations increased from Site SPC025 (median = 0.02 mg/L) downstream to Site SPC200 (median = 0.05 mg/L) and then decreased to Site SPC500 (median = 0.035 mg/L). TP median concentrations on Palmer Creek also decreased slightly from 0.08 mg/L at PCT410 to 0.07 mg/L at Site PCT470. TP median concentrations on Newton Fork remained constant at 0.03 mg/L between Sites NFT340 and NFT380. TP concentrations during storm events decreased from Site SPC200 (median = 0.17 mg/L) downstream to Site SPC350 (median = 0.13 mg/L) and then decreased to Site SPC500 (median = 0.085 mg/L). TP median concentrations on Palmer Creek increased from 0.11 mg/L at Site PCT410 to 0.22 mg/L at Site PCT470. In 2011, all of the ambient and storm samples surpassed the EPA's suggested single-sample criterion for TP of 0.01 mg/L. A numerical water-quality standard for TP does not exist in South Dakota; therefore, no water-quality criteria were exceeded.

5.3 OTHER MONITORING

No known monitoring was conducted on Spring Creek outside of this project.

5.4 QUALITY ASSURANCE REPORTING

Water-quality samples obtained over the 2010 and 2011 monitoring seasons were collected in accordance with the SDDENR [2005]. The majority of the water-quality samples were collected by Pennington County and their partners with the exception of samples collected by landowners. All entities were informed of and educated in the Standard Operating Procedures [SDDNER, 2005] and collected samples accordingly.

5.5 RESULTS OF BEST MANAGEMENT PRACTICES OPERATION AND MAINTENANCE REVIEWS

Pennington County and their consultant were responsible for ensuring that BMPs cost-shared with the Clean Water Act Section 319 Grant funds were installed and all systems operated and maintained properly for the duration of each contract. Compliance for BMPs installed using Clean Water Act Section 319 Grant funds followed NRCS Environmental Quality Incentive Program (EQIP) criteria. These criteria are found in Section 515.113 of the EQIP program manual.

Any landowners and operators who do not maintain practices funded by this project for the length of the agreed contract are required to repay all cost-share funds and any liquidated damages incurred. Currently, all contract requirements are being fulfilled and no funds need to be repaid. Pennington County, supported by the consultant acting on behalf of Pennington County, is responsible for landowner contact information, developing landowner mailing lists, keeping records, submitting vouchers and reports, and recording cash and in-kind matches.

6.0 SUCCESSES AND CHALLENGES OF THE PROJECT

Some challenges were initially encountered in developing locally acceptable project-ranking methods and cost-share rates. However, these were overcome by the end of Segment I through valuable discussion and collaboration among the SCWAG members.

The greatest success of this project was in generating landowner interest and in developing the local sense of watershed ownership. The project was also successful in developing the project planning documents, defining the framework, and providing direction for continuation. Additionally, comprehensive monitoring has increased understanding of hydrologic and water-quality processes in the watershed, which helps to narrow implementation efforts of this project going forward.

7.0 PROJECT BUDGET/EXPENDITURES

Pennington County received a \$576,000 EPA Section 319 Grant through the SDDENR to implement BMPs recommended by Kenner and Larson [2008]. Tables 7-1a and 7-2a provide the planned budgets for Segment I 319 and 319 matching funds, which include funds approved in the Segment I amendment. Tables 7-1b and 7-2b display the final expenditure budgets for Segment I 319 and 319 matching funds after the Segment I amendment was approved.

7.1 319 BUDGET

The planned 319 budget was amended in June 2011 for a request of an additional \$252,000. This request consisted of the following: (1) \$60,000 for Task 1: Riparian Vegetation and Manure Management Improvements; (2) \$50,700 for Task 2: Septic System Improvements; (3) \$100,000 for Task 3: Public Outreach and Education, Implementation Record Keeping, and Report and Future Grant Writing; (4) \$1,300 for Task 5: Stormwater Management Plan Study and Final Document; (5) \$10,000 for Task 6: Spring Creek Watershed 10-Year Strategic Implementation Plan; (6) \$30,000 for Task 7: Evaluation and Monitoring.

7.2 MATCHING FUNDS BUDGET

All federal match requirements were met in this project. Final (nonfederal) match dollars were 39 percent of total expenditures and \$186,612 less than originally planned. The actual match for Product 1 (Riparian Projects) was 43 percent of total expenditures and \$85,999 less than planned because participant cost-share was estimated for the plan and fewer BMP projects were installed than planned. The match for Product 2 (OWTS Projects) was 54 percent of total expenditures and \$85,299 less than planned. This lesser amount is because fewer BMPs were installed than planned. The match for Product 3 (Project Management) was 14 percent of total expenditures and \$3,111 greater than planned. The match for Product 4 (OWTS Management Plan) was 5 percent of total expenditures and \$37,571 less than planned. The OWTS Management Plan has not yet been completed and the money was transferred to Product 7. The match for Product 5 (Stormwater Management Plan) was 27 percent of total expenditures and \$2,415 greater than planned, and the match for Product 6 (10-Year Strategic Implementation Plan) was less than 1 percent of total expenditures and \$14,932 less than planned. The 10-Year Strategic Implementation Plan has not yet been completed. The match for Product 7 (Water-Quality Monitoring) was 81 percent of total expenditures and \$31,664 greater than planned.

Table 7-1a. Planned Budget of 319 Funds

Project Description	Consultants (\$)	SDSM&T (\$)	Local Citizens (\$)	Totals (\$)
Objective 1. Implement BMPs Recommended in the Fecal Coliform Bacteria TMDL for Spring Creek.				
<i>Task 1. Riparian Vegetation and Manure Management Improvements</i>				
Product 1. Riparian Vegetation Pilot Projects	–	–	60,000	60,000
<i>Task 2. Septic System Improvements</i>				
Product 2. Septic System Pilot Project	–	–	40,000	40,000
Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, and Report and Future Grant Writing.				
<i>Task 3. Public Outreach and Education, Implementation Record Keeping, Report and Future Grant Writing</i>				
Product 3. Public Outreach/Project Management	90,000	–	–	90,000
Objective 3. Develop Project Planning Documents.				
<i>Task 4. Septic System Management Plan Study and Final Document</i>				
Product 4. Septic System Management Plan Document	50,000	–	–	50,000
<i>Task 5. Stormwater Management Plan Study and Final Document</i>				
Product 5. Stormwater Management Plan Document	–	74,000	–	74,000
<i>Task 6. Spring Creek Watershed 10-Year Strategic Implementation Plan</i>				
Product 6. Spring Creek Watershed 10-Year Implementation Plan Document	10,000	–	–	10,000
Objective 4. Complete Essential Water-Quality Monitoring.				
<i>Task 7. Evaluation and Monitoring</i>				
Product 7. Compile Water-Quality Monitoring Data	–	–	–	–
Project Totals	\$150,000	\$74,000	\$100,000	\$324,000

Table 7-1b. Actual Budget of 319 Funds

Project Description	Consultants (\$)	SDSM&T (\$)	Local Participants (\$)	Totals (\$)
Objective 1. Implement BMPs Recommended in the Fecal Coliform Bacteria TMDL for Spring Creek.				
<i>Task 1. Riparian Vegetation and Manure Management Improvements</i>				
Product 1. Riparian Vegetation Pilot Projects	–	–	120,000	120,000
<i>Task 2. Septic System Improvements</i>				
Product 2. Septic System Pilot Project	–	–	90,700	90,700
Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, and Report and Future Grant Writing.				
<i>Task 3. Public Outreach and Education, Implementation Record Keeping, Report and Future Grant Writing</i>				
Product 3. Public Outreach/Project Management	190,000	–	–	190,000
Objective 3. Develop Project Planning Documents.				
<i>Task 4. Septic System Management Plan Study and Final Document</i>				
Product 4. Septic System Management Plan Document	50,000	–	–	50,000
<i>Task 5. Stormwater Management Plan Study and Final Document</i>				
Product 5. Stormwater Management Plan Document	–	75,300	–	75,300
<i>Task 6. Spring Creek Watershed 10-Year Strategic Implementation Plan</i>				
Product 6. Spring Creek Watershed 10-Year Implementation Plan Document	20,000	–	–	20,000
Objective 4. Complete Essential Water-Quality Monitoring.				
<i>Task 7. Evaluation and Monitoring</i>				
Product 7. Compile Water-Quality Monitoring Data	30,000	–	–	30,000
Project Totals	\$290,000	\$75,300	\$210,700	\$576,000

Table 7-2a. Planned U.S. Environmental Protection Agency 319 and Matching Funds Budget

Project Description	EPA 319 (\$)	Amendment EPA 319 (\$)	Sum of EPA 319 (\$)	Matching Funds							Sum of Matching Funds
				Participants (\$ and (in-kind))	Pennington County (\$ and (in-kind))	SDSM&T (in-kind)	City of Hill City (\$)	City of Rapid City (\$)	WDWDD (\$)	SDGFP (\$)	
Objective 1. Implement BMPs Recommended in the Fecal Coliform Bacteria TMDL for Spring Creek.											
Task 1. Riparian Vegetation and Manure Management Improvements											
Product 1. Riparian Vegetation Pilot Projects	\$60,000	\$60,000	\$120,000	\$100,000	\$3,000	—	—	—	—	—	\$103,000
Task 2. Septic System Improvements											
Product 2. Septic System Pilot Project	\$40,000	\$50,700	\$90,700	\$91,159	\$19,241	—	—	—	—	—	\$110,400
Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, and Report and Future Grant Writing.											
Task 3. Public Outreach and Education, Implementation Record Keeping, Report and Future Grant Writing											
Product 3. Public Outreach/Project Management	\$90,000	\$100,000	\$190,000	—	\$26,654	—	—	—	—	—	\$26,654
Objective 3. Develop Project Planning Documents											
Task 4. Septic System Management Plan Study and Final Document											
Product 4. Septic System Management Plan	\$50,000	—	\$50,000	—	\$39,980	—	—	—	—	—	\$39,980
Task 5. Stormwater Management Plan Study and Final Document											
Product 5. Stormwater Management Plan	\$74,000	\$1,300	\$75,300	—	—	\$17,118	—	—	\$8,700	—	\$25,818
Task 6. Spring Creek Watershed 10-Year Strategic Implementation Plan											
Product 6. Spring Creek Watershed 10-year Implementation Plan	\$10,000	\$10,000	\$20,000	—	\$15,020	—	—	—	—	—	\$15,020
Objective 4. Complete Essential Water-Quality Monitoring											
Task 7. Evaluation and Monitoring											
Product 7. Compile Water-Quality Monitoring Data	—	\$30,000	\$30,000	—	\$45,515	\$4,000	\$17,200	\$30,000	\$11,300	\$20,000	\$128,015
Project Totals	\$324,000	\$252,000	\$576,000	\$191,159	\$149,410	\$21,118	\$17,200	\$30,000	\$20,000	\$20,000	\$448,887

Table 7-2b. Actual U.S. Environmental Protection Agency 319 and Matching Funds Budget

Project Description	EPA 319 (\$)	Matching Funds											Sum of Matching Funds	Other (Federal) Funds
		Participants (\$ and (in-kind))	Pennington County (\$) and (in-kind)	SDSM&T (in-kind)	City of Hill City (\$)	City of Rapid City (\$)	WDWDD (\$)	Pennington Conservation District (\$)	BHRC&D (\$)	RESPEC (\$)	Black Hills Flyfishers (\$)	SDGFP (\$)		
Objective 1. Implement BMPs Recommended in the Fecal Coliform Bacteria TMDL for Spring Creek.														
Task 1. Riparian Vegetation and Manure Management Improvements														
Product 1. Riparian Vegetation Pilot Projects	\$22,441	\$16,842	\$159	—	—	—	—	—	—	—	-	—	\$17,001	—
Task 2. Septic System Improvements														
Product 2. Septic System Pilot Project	\$20,965	\$22,841	\$2,260	—	—	—	—	—	—	—	—	—	\$25,101	—
Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, and Report and Future Grant Writing.														
Task 3. Public Outreach and Education, Implementation Record Keeping, Report and Future Grant Writing														
Product 3. Public Outreach/ Project Management	\$190,000	—	\$28,006	—	—	—	—	\$439	\$1,320	—	—	—	\$29,765	—
Objective 3. Develop Project Planning Documents														
Task 4. Septic System Management Plan Study and Final Document														
Product 4. Septic System Management Plan	\$50,000		\$2,409										\$2,409	
Task 5. Stormwater Management Plan Study and Final Document														
Product 5. Stormwater Management Plan	\$75,300	—	\$61	\$19,472	—	—	\$8,700	—	—	—	—	—	\$28,233	—
Task 6. Spring Creek Watershed 10-Year Strategic Implementation Plan														
Product 6. Spring Creek Watershed 10-year Implementation Plan	\$20,000	—	\$88	—	—	—	—	—	—	—	—	—	\$88	—
Objective 4. Complete Essential Water-Quality Monitoring														
Task 7. Evaluation and Monitoring														
Product 7. Compile Water-Quality Monitoring Data	\$36,688	—	\$37,030	\$3,649	\$27,200	\$30,000	\$21,300	\$1,500	\$1,500	\$12,500	\$5,000	\$20,000	\$159,679	\$6,861
Project Totals	\$415,393	\$39,683	\$70,011	\$23,121	\$27,200	\$30,000	\$30,000	\$1,939	\$2,820	\$12,500	\$5,000	\$20,000	\$262,275	\$6,861

8.0 FUTURE ACTIVITY RECOMMENDATIONS

Five additional project segments are planned in the coming years for the Spring Creek Watershed Management and Project Implementation Plan. The BMPs that are outlined by Kenner and Larson [2008] and Krajewski and Rausch [2014] are planned to be completed throughout the five remaining project segments. Installing the previously outlined BMPs will ensure that the overall goal for the watershed is met, which is to comply with the state of South Dakota water-quality standards.

9.0 REFERENCES

Kenner, S. J. and A. M. Larson, 2008. *Fecal Coliform Bacteria Total Maximum Daily Load for Spring Creek, Pennington County, South Dakota*, prepared by the South Dakota School of Mines & Technology, Rapid City, SD and the South Dakota Department of Environment and Natural Resources, for the South Dakota Department of Environment and Natural Resources, Pierre, SD.

Krajewski, J. W. and P. P. Rausch, 2014. *Spring Creek Watershed Total Maximum Daily Load Strategic Implementation Plan*, RSI-2416, prepared by RESPEC, Rapid City, SD, for Pennington County, Rapid City, SD (Draft).

Oswald, J. K., 2010. *Spring Creek Watershed Management and Project Implementation Plan Segment I*. RSI/P-2576, prepared by RESPEC, Rapid City, SD, for South Dakota Department of Environment and Natural Resources, Rapid City, SD.

South Dakota Department of Environmental Natural Resources, 2005. *Standard Operating Procedures for Field Samplers, Volume I, Tributary and In-Lake Sampling Techniques*, prepared by the South Dakota Department of Environment and Natural Resources Watershed Assessment Team, for the South Dakota Department of Environment and Natural Resources Water Resources Assistance Program, Pierre, SD.

South Dakota Legislature, 2010. "Chapter 74:51:01 Surface Water Quality Standards," legis.state.sd.us, retrieved February 23, 2010, from <http://legis.state.sd.us/rules/DisplayRule.aspx?Rule=74:51:01>

APPENDIX A

WATER-QUALITY MONITORING RESULTS

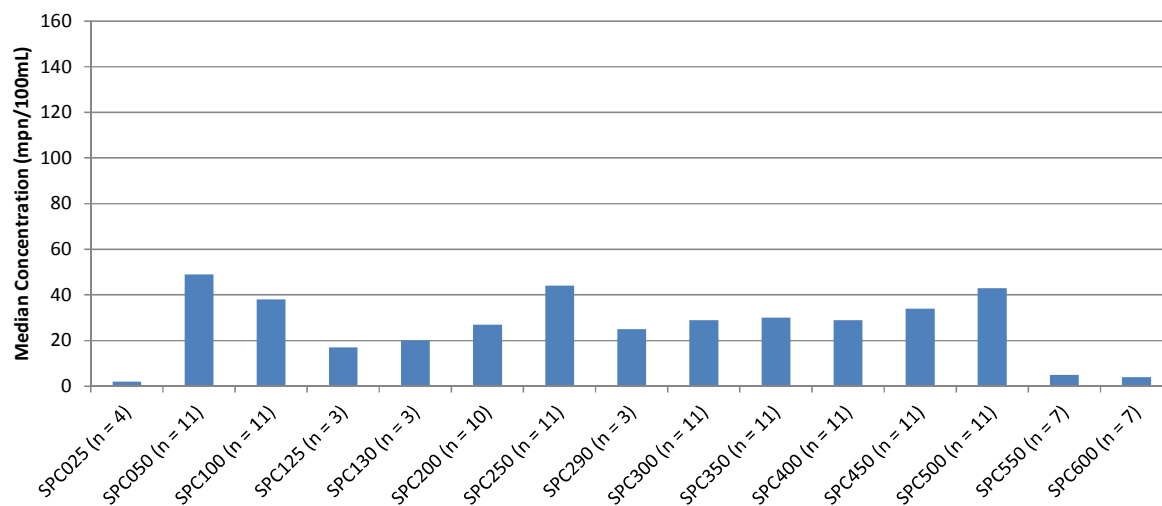


Figure A-1. *E. coli* Ambient Means–Spring Creek.

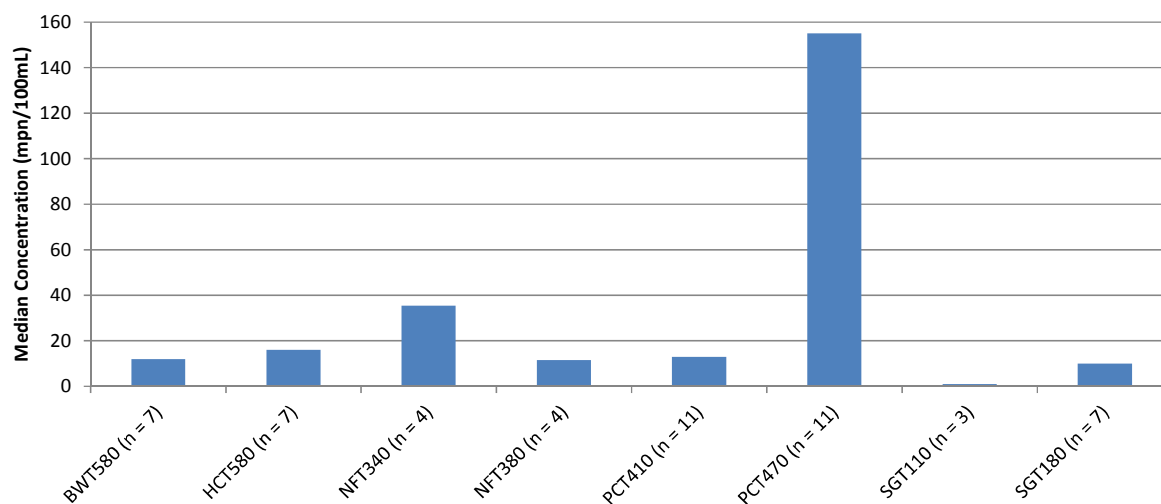


Figure A-2. *E. coli* Ambient Means–Tributaries.

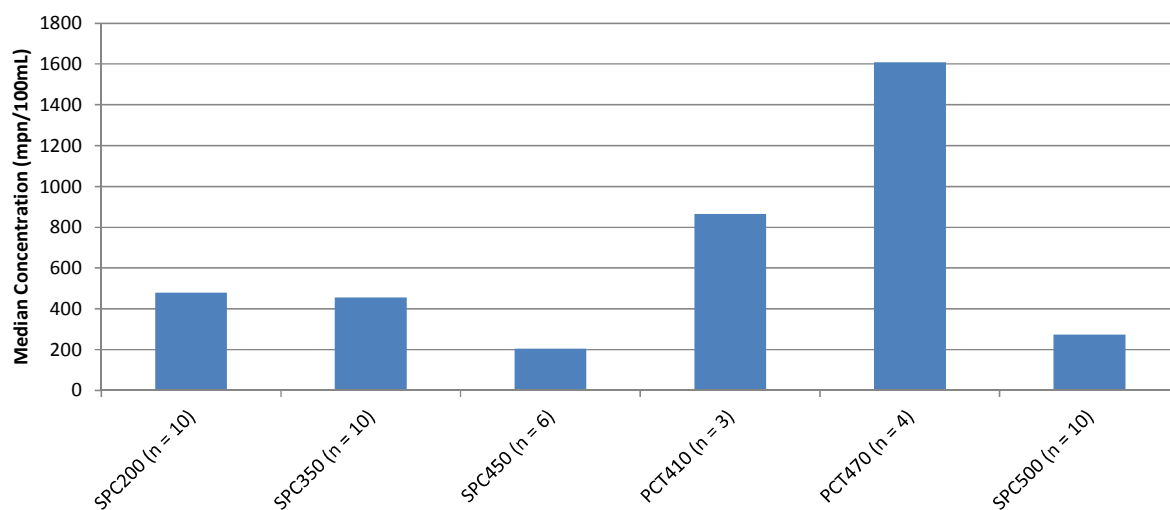


Figure A-3. *E. coli* Storm Composite Medians.

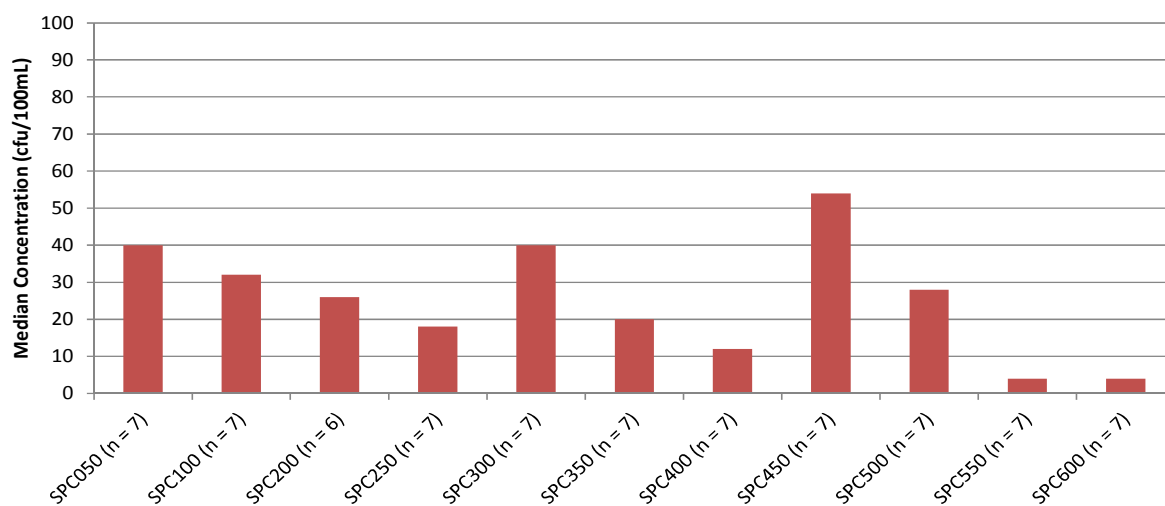


Figure A-4. Fecal Coliform Ambient Medians–Spring Creek.

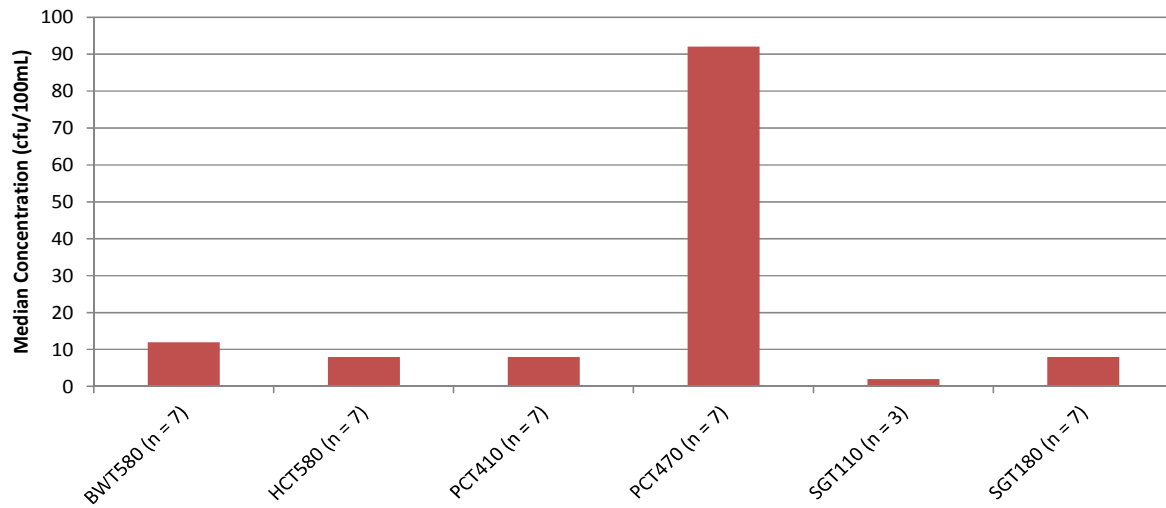


Figure A-5. Fecal Coliform Ambient Medians-Tributaries.

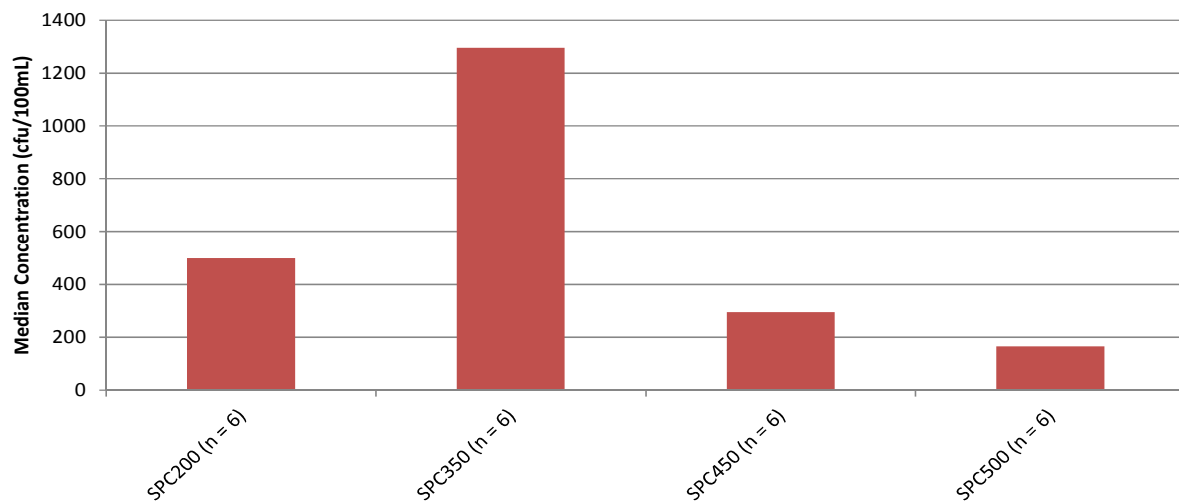


Figure A-6. Fecal Coliform Storm Composite Medians.

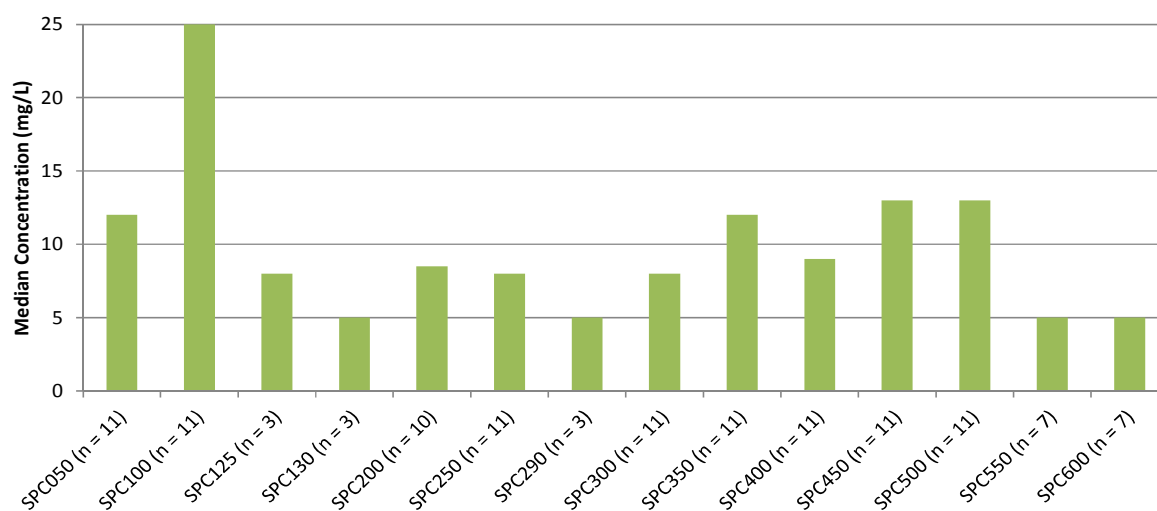


Figure A-7. Total Suspended Solids Ambient Medians–Spring Creek.

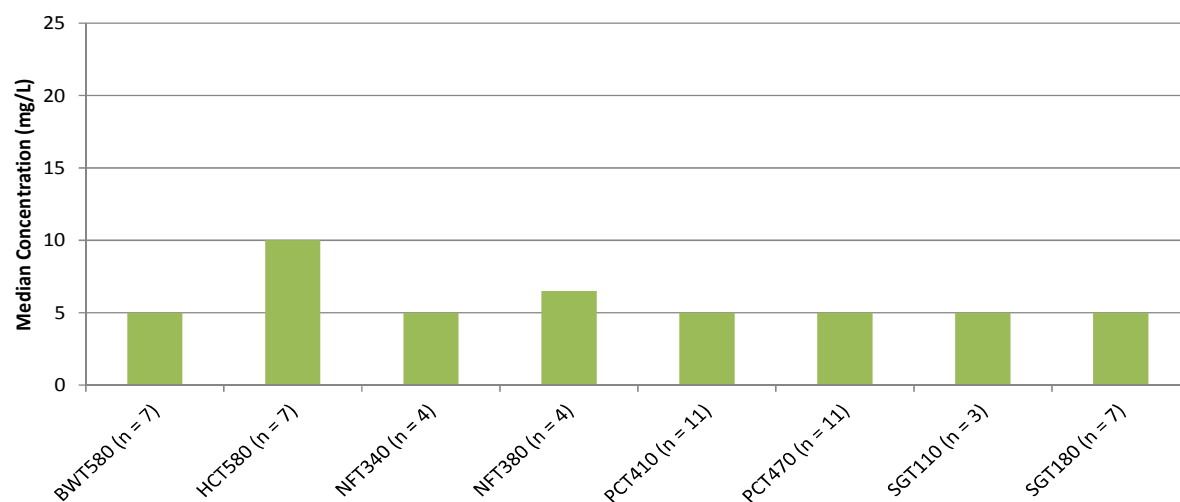


Figure A-8. Total Suspended Solids Ambient Medians–Tributaries.

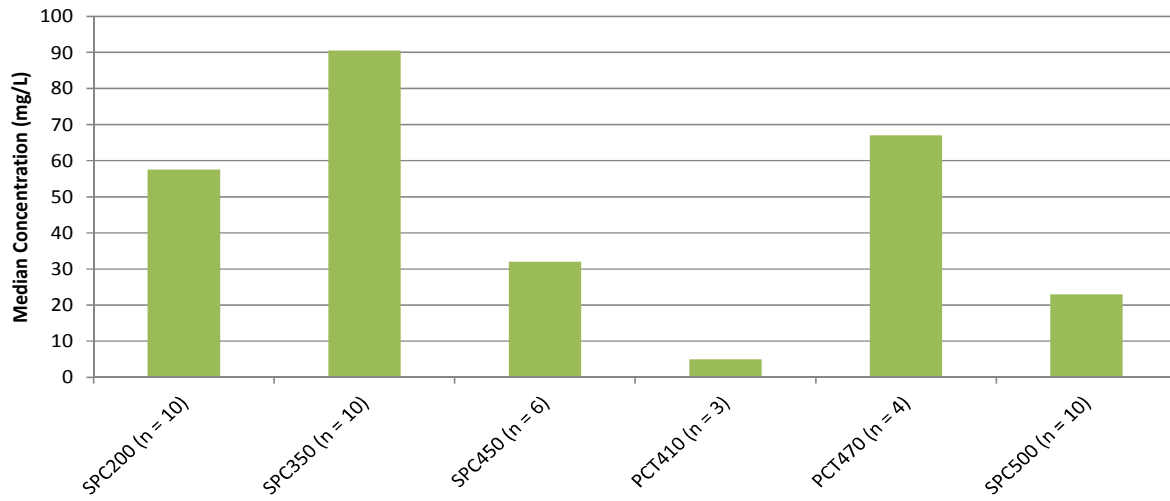


Figure A-9. Total Suspended Solids Storm Composite Medians.