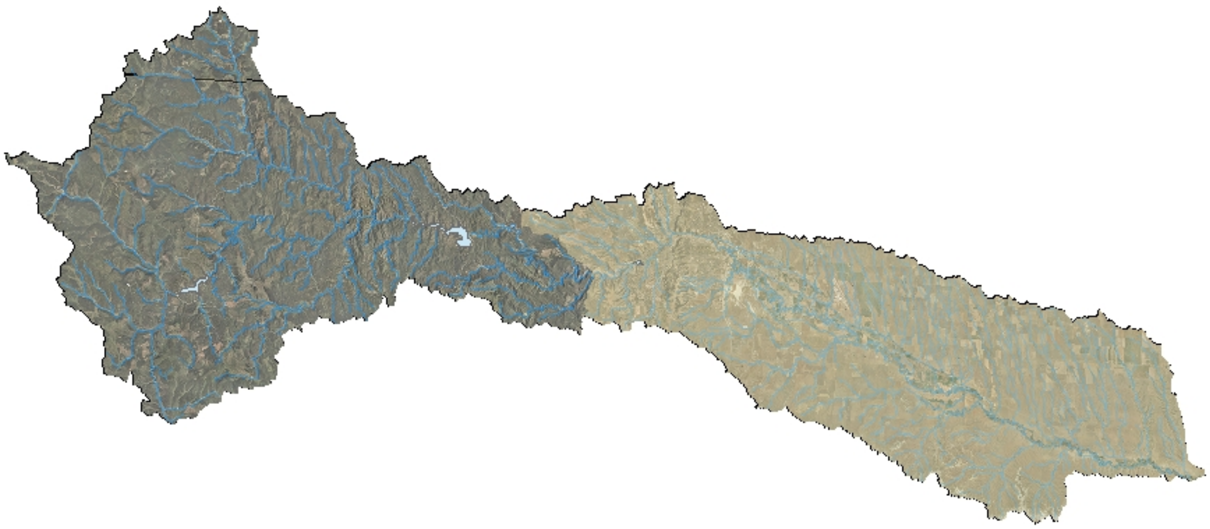
Fecal Coliform, *Escherichia coli* Bacteria Total Maximum Daily Loads (TMDLs) for Lower Rapid Creek, Pennington County, South Dakota



Prepared by:

Dr. Scott Kenner
South Dakota School of Mines and Technology
Department of Civil and Environmental Engineering

&

Robert L. Smith
South Dakota Department of
Environment and Natural Resources
Water Resources Assistance Program

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Total Maximum Daily Load Summary Table

Water Body Name/Description:	Lower Rapid Creek (from Canyon Lake to its confluence with the Cheyenne River)
Assessment Unit IDs:	SD-CH-R-RAPID_03, SD-CH-R-RAPID_04 and SD-CH-R-RAPID_05
Size of Impaired Waterbody:	120 stream kilometers (74.9 stream miles)
Size of Watershed:	90,006 hectares, (222,409 acres)
Location:	Hydrologic Unit Codes (12-digit HUC): 01201100202, 101201100203, 101201100204, 101201100301, 101201100302, 101201100303, 101201100304 and 101201100305
Impaired Designated Use(s):	Immersion recreation waters
Cause(s) of Impairment:	Fecal coliform and *Escherichia coli* bacteria
Cycle First and Most Recently Listed:	
Fecal coliform	2008/2010 (SD-CH-R-RAPID_03), 1998/2010 (SD-CH-R-RAPID_04 and SD-CH-R-RAPID_05)
Escherichia coli	2010 (SD-CH-R-RAPID_05)
Waterbody Type:	Stream
303(d) Listing Parameters:	Fecal coliform bacteria *Escherichia coli* (*E. coli*)
Designated Uses:	Coldwater permanent fish life propagation waters, Warmwater permanent fish life propagation waters, immersion recreation waters, limited-contact recreation waters, fish and wildlife propagation, recreation, and stock watering and irrigation waters
TMDL End Points	
Indicator Names:	Fecal coliform and *E. coli* bacteria
Threshold Values:	
Fecal coliform	Maximum daily concentration of ≤ 400 CFU/100 mL in any one sample or a geometric mean of ≤ 200 CFU/100 mL based on a minimum of 5 samples obtained during separate 24-hour periods for any 30 day period. These criteria apply from May 1st through September 30th.
Escherichia coli	Maximum daily concentration of ≤ 235 CFU/100 mL in any one sample or a geometric mean of ≤ 126 CFU/100 mL based on a minimum of 5 samples obtained during separate 24-hour periods for any 30-day period. These criteria apply from May 1st through September 30th.
Analytical Approach:	Load Duration Curves, Bacterial Indicator Tool and statistical analysis.

TMDL Submittal Table for segments of Lower Rapid Creek, Pennington County, South Dakota.

				TMDL End Points		Wasteload Allocations		Load Allocations		
Waterbody Name / Description	**Waterbody ID**	**Cycle First/Most Recently Listed**	**Cause(s) of Impairment**	**Indicator Name**	**Threshold Values**	**WLA** (CFU*10^9/day)	**WLA Permitted Facilities** (Permit Number)	**LA** (CFU*10^9/day)	**MOS** (CFU*10^9/day)	**TMDL** (CFU*10^9/day)
Rapid Creek (Canyon Lake to S15, T1N, R8E)	SD-CH-R-RAPID_03	2010	Fecal Coliform	Fecal Coliform	≤ 400 CFU/100mL any one sample; ≤ 200 CFU/100mL geometric mean based on a minimum of 5 samples obtained during separate 24-hour periods for any 30-day period	354	SDR41A007	752	245	1,351 Moist Flow Zone (acute)
Rapid Creek (S15, T1N, R8E to above Farmingdale)	SD-CH-R-RAPID_04	1998/2010	Fecal Coliform	Fecal Coliform	≤ 400 CFU/100mL any one sample; ≤ 200 CFU/100mL geometric mean based on a minimum of 5 samples obtained during separate 24-hour periods for any 30-day period	227	SD-0023574	4,242	1,996	6,465 High Flow Zone (acute)
Rapid Creek (Above Farmingdale to Cheyenne River)	SD-CH-R-RAPID_05	1998/2010	Fecal Coliform	Fecal Coliform	≤ 400 CFU/100mL any one sample; ≤ 200 CFU/100mL geometric mean based on a minimum of 5 samples obtained during separate 24-hour periods for any 30-day period	0	0	4,757	2,187	6,944 High Flow Zone (acute)
Rapid Creek (Above Farmingdale to Cheyenne River)	SD-CH-R-RAPID_05	2010	*Escherichia coli*	*Escherichia coli*	≤ 235 CFU/100mL any one sample; ≤ 126 CFU/100mL geometric mean based on a minimum of 5 samples obtained during separate 24-hour periods for any 30-day period	0	0	529	259	788 Moist Flow Zone (acute)

1.0 Introduction and Watershed Description

The intent of this document is to clearly identify the components of these TMDLs, support adequate public participation, and facilitate the US Environmental Protection Agency (US EPA) review. The TMDLs were developed in accordance with Section 303(d) of the federal Clean Water Act and guidance developed by US EPA. This TMDL document addresses the fecal coliform bacteria impairment of Rapid Creek segments SD-CH-R-RAPID_03 from Canyon Lake Reservoir to S15 T1N R8E, segment SD-CH-R-RAPID_04 from S15 T1N R8E to above Farmingdale, SD, and Rapid Creek segment SD-CH-R-RAPID_05 from near Farmingdale to the Cheyenne River. *Escherichia coli* bacteria (*E. coli*) are also listed as impaired in Rapid Creek segment SD-CH-R-RAPID_05 from near Farmingdale to the Cheyenne River. These impairments were assigned a priority 1-category (high-priority) in the 2010 Integrated Report (SD DENR, 2010). Total Suspended Solids (TSS) is another 303(d) listed parameter in Rapid Creek that will be addressed in a separate TMDL summary document.

1.1 CWA Section 303(d) Listing Information

Table 1 303(d) impaired segments in the lower half of Rapid Creek based on the 2010 Integrated Report*

Waterbody AUID	From	To	Parameter
SD-CH-R-RAPID_03	Canyon Lake	S15, T1N, R8E	Fecal Coliform
SD-CH-R-RAPID_04	S15, T1N, R8E to	above Farmingdale	Fecal Coliform
SD-CH-R-RAPID_05	above Farmingdale	Cheyenne River	Fecal Coliform *Escherichia coli* TSS**

*** See Figure 2 map for segment locations**
**** TSS TMDL will be addressed in a separate document**

1.1.1 Fecal Coliform

Lower Rapid Creek was first listed in 1998 as impaired due to exceedence of fecal coliform bacteria criteria and has been listed in every 303(d) listing cycle since: 2002, 2004, 2006, 2008 and 2010. In 1999 through 2004, a watershed assessment of Lower Rapid Creek was completed to evaluate existing and potential pollution problems (SD DENR, 2004). The study found the primary pollution sources in the Lower Rapid Creek basin to be urban stormwater runoff, irrigation withdrawals and return flows, wastewater treatment facility discharge and agricultural runoff. The *1998 South Dakota Report to Congress 305(b) Water Quality Assessment* identified fecal coliform bacteria as the major pollutant in the Lower Rapid Creek watershed.

1.1.2 *Escherichia coli* (*E. coli*)

E. coli bacteria have been collected in the lower segment of Rapid Creek since September of 2000. In the 2010 Integrated Report, the lower segment of Rapid Creek (SD-CH-R-Rapid_05) was listed as impaired for *E coli* bacteria and placed on the 303(d) list (SD DENR, 2010).

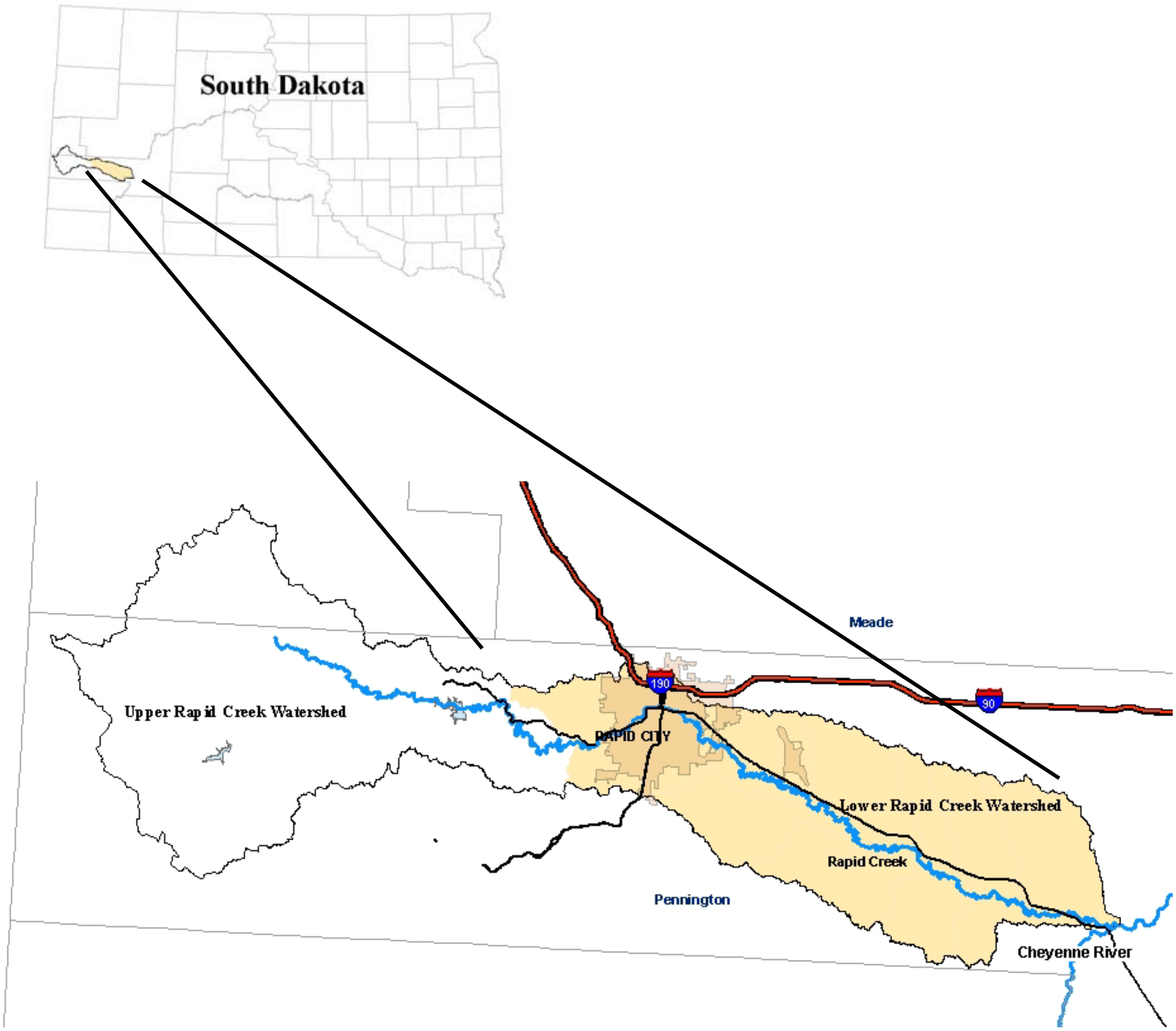

Figure 1 Location of the Upper/Lower Rapid Creek watersheds within South Dakota.

1.2 Topography

Rapid Creek is a perennial mountain stream located in Lawrence and Pennington Counties of South Dakota. Rapid Creek is a tributary of the Cheyenne River, which flows into the Missouri River. The drainage area of Rapid Creek is approximately 718 square miles (1,861 square kilometers) at the confluence with the Cheyenne River.

The impaired (303(d) listed) segments of Rapid Creek have a combined length of 74 stream miles (120 stream kilometers) beginning below Canyon Lake, which has a surface area of 27 acres (11 hectares) and ends where Rapid Creek empties into the Cheyenne River (Figure 1, Figure 2 and Table 1). The drainage area of the 303(d) listed segment is approximately 126 square miles (327 square kilometers).

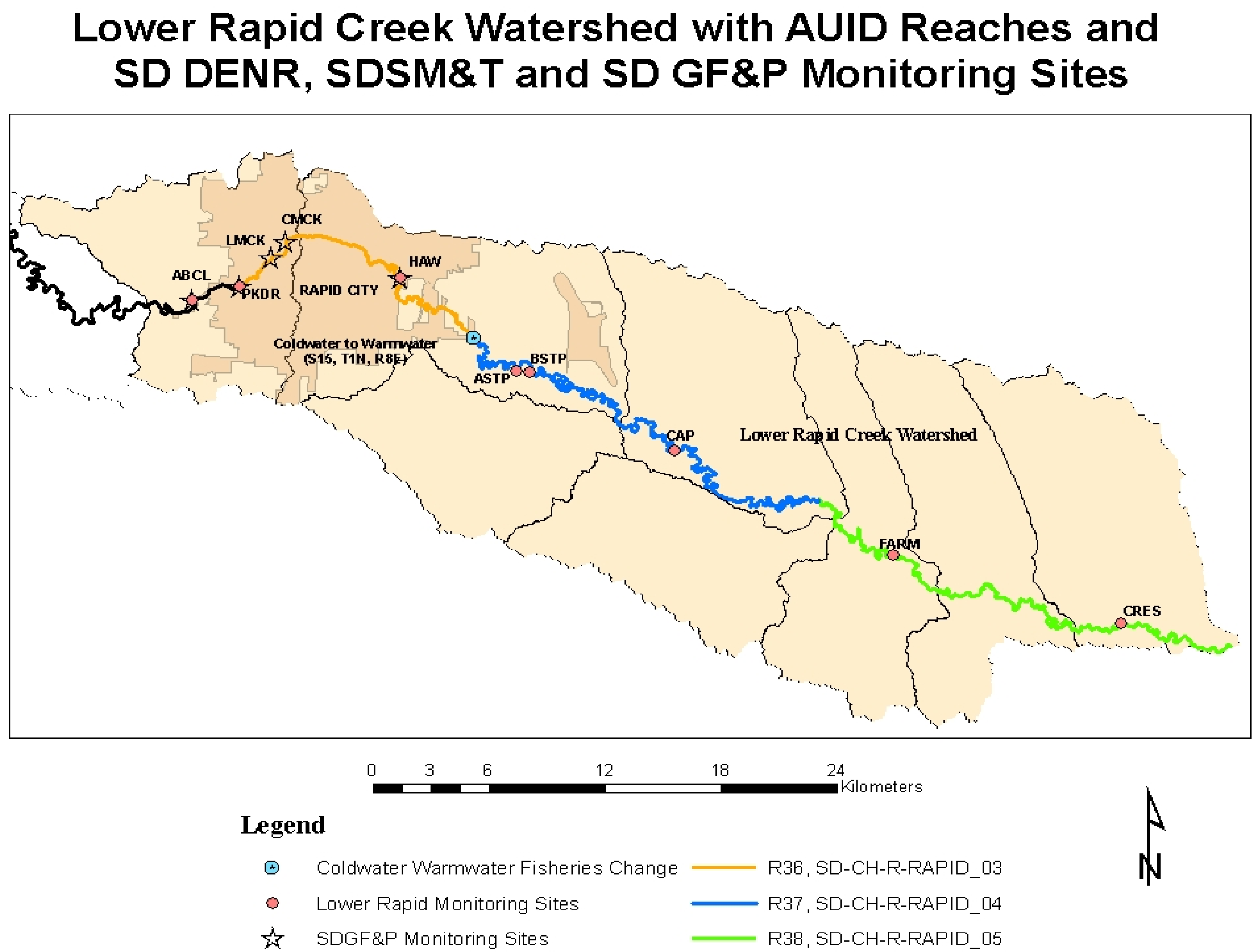

Figure 2 Lower Rapid Creek watershed with monitoring sites, AUID identifiers and current ADB segment lengths.

1.3 Geology and Soils

The upper basin of the watershed is comprised of the Madison Group limestone and dolomite deposits gray to dark-gray phyllite, slate, and mica schist, while the major portion of the Lower Rapid Creek watershed (the study area) is made up of Pierre shale, Terrace deposits and alluvium (SD DENR, 2010).

The watershed's major soil associations along Lower Rapid Creek are the Owanka-Haverson-Colombo, the Nunn-Satanta north of Rapid Creek, Pierre-Kyle, and Samsil-Pierre associations south of Rapid Creek. Owanka-Haverson-Colombo soil associations are deep, well drained, nearly level, loamy and silty soils on terraces, fans and flood plains. The most common soil in the Lower Rapid Creek watershed is Nunn loam, part of the Nunn-Satanta association, and is characterized as deep, well drained, nearly level to strongly sloping, loamy soils on high terraces. The remaining associations, Pierre-Kyle and Samsil-Pierre, are shallow to deep, well drained level to very steep, clayey soils on dissected plains and fans (USDA, 1996).

1.4 Land Use/Land Cover

Much of the upper portion of the watershed (upstream of the study area) is located within the Black Hills National Forest and is predominantly forested with ponderosa pine (83 percent). The lower portion of the watershed is dominated by herbaceous rangeland (61 percent), cropland and pastureland (24 percent) and urban (7 percent).

1.5 Climate and Precipitation

Average annual precipitation in the Rapid Creek watershed based on National Weather Service data at Rapid City was 20.4 inches (0.52 m). Over 70 percent of the annual precipitation occurred during the months of April through August and over 50 percent occurring during the months of May through July.

1.6 Available Water Quality Data

Since 1967, the South Dakota Department of Environment and Natural Resources (SD DENR) have collected fecal coliform bacteria samples at various locations along Lower Rapid Creek shown in Figure 2. *E. coli* bacteria sampling was initiated in the summer of 2000 at WQM 19 (DENR 460910) near Farmingdale, SD.

1.6.1 Fecal Coliform Data

On average, fecal coliform data collected from May through September at Water Quality Monitoring (WQM) sites along Lower Rapid Creek indicated 26 percent of the samples exceeded water quality standards for fecal coliform based on 354 samples (Table 2). Similarly, fecal coliform assessment monitoring samples collected during the project (May through September 1999 and 2000) showed that approximately 24 percent of fecal coliform samples collected on Lower Rapid Creek exceeded fecal coliform bacteria criteria.

Table 2 Data availability for Fecal Coliform analysis by segment in Lower Rapid Creek

Parameter	Assessment Unit ID Segment [1]	Beneficial Use	Number of Samples
Fecal Coliform Bacteria	SD-CH-R-RAPID_03	Immersion recreation	21
	SD-CH-R-RAPID_04	Immersion recreation	151
	SD-CH-R-RAPID_05	Immersion recreation	182
Total			354

Shaded = Exceeded listing criteria for impairment.

[1] = SD-CH-R-RAPID_03 = Canyon Lake to S15, T1N, R8E;
SD-CH-R-RAPID_04 = S15, T1N, R8E to above Farmingdale; and
SD-CH-R-RAPID_05 = Above Farmingdale to Cheyenne River.

1.6.2 *Escherichia coli* Data

In May 2009, SDDENR adopted *Escherichia coli* bacteria (*E. coli*) standards for immersion recreation and limited contact recreation waters beneficial use categories. This bacterium is known to be a better indicator of fecal contamination than fecal coliform because the presence of *E. coli* bacteria is strongly correlated with the presence of pathogens. There are six species of fecal coliform bacteria found in animal and human waste. *E. coli* is one type of the six species of fecal coliform bacteria. A rare strain of *E. coli, E. coli* 0157:H7, can cause potentially dangerous outbreaks and illness.

Currently, South Dakota is transitioning from fecal coliform bacteria as the main indicator of fecal contamination in recreation waters to *E. coli* bacteria. Thirty-four samples have been collected since September of 2000 and were used to determine beneficial use impairment in Lower Rapid Creek (Table 3). Data indicate that 26 percent of the *E. coli* samples collected from WQM 19 exceeded water quality standards for immersion recreation waters.

Table 3 Data availability for *E. coli* bacteria analysis by segment in Lower Rapid Creek

Parameter	Assessment Unit ID Segment [1]	Beneficial Use	Number of Samples
Escherichia coli Bacteria	SD-CH-R-RAPID_05	Immersion recreation	34

Shaded = Exceeded listing criteria for impairment.

[1] = SD-CH-R-RAPID_05 = Above Farmingdale to Cheyenne River.

1.6.3 Stream Flows

United States Geological Survey has monitored or is monitoring four stream gages in the Lower Rapid Creek watershed (Table 4).

Table 4 USGS monitoring sites in Lower Rapid Creek used for long-term flow analysis

USGS Station Number	USGS Site Name	Available Data Dates	AUID Segment
06414000	Rapid Creek at Rapid City, SD	1942-2009	SD-CH-R-RAPID_03
06416000	Rapid Creek below Hawthorn Ditch at Rapid City, SD	1980-1982	SD-CH-R-RAPID_03
06418900	Rapid Creek below Sewage Treatment Plant near Rapid City, SD	1981-2009	SD-CH-R-RAPID_04
06421500	Rapid Creek near Farmingdale, SD	1960-2009	SD-CH-R-RAPID_05

Low flow conditions within the study segment were not identified as a concern. However, the frequency, duration and magnitude of high flows were identified as a concern. The change in duration, frequency and magnitude of high flow conditions can cause scour and bank erosion in the lower segments of the system. In a study on the impact of increases in impervious area, Coon (2000) showed that the magnitude (peak) of runoff from two year through ten year rainfall events increased 600 percent and 71 percent, respectively. The increase in magnitude and frequency of stormwater runoff does increase scour and bank erosion in the lower segments. Additionally, during the 1990s high rainfall required extended periods of release from Pactola Reservoir of flows at or greater than bank full. The duration of these flows can cause excessive bank erosion and scour.

2.0 Water Quality Standards

2.1 Numeric Standards

Each waterbody within South Dakota is assigned beneficial uses. All waters (both lakes and streams) are designated with the use of fish and wildlife propagation, recreation, and stock watering. All streams are assigned the use of irrigation. Additional uses are assigned by the state based on a beneficial use analysis of each waterbody. Water quality standards have been defined in South Dakota state statutes (Administrative Rules of South Dakota, ARSD §74:51:01 – 74:51:03) in support of these uses. These standards consist of suites of criteria that provide physical and chemical benchmarks from which management decisions can be developed.

Individual parameters determine the support of these beneficial uses. Each beneficial use classification has a set of unique, numeric criteria. Water quality values that exceed those criteria impair the beneficial use and violate water quality standards.

Lower Rapid Creek has been assigned the following beneficial uses: coldwater permanent fish life propagation (Canyon Lake to S15 T1N R8E), warmwater permanent fish life propagation (S15 T1N R8E to Cheyenne River), immersion recreation, limited contact recreation, fish and wildlife propagation, recreation and stock watering, and irrigation. Table 5 lists the most stringent criteria that must be met to support the specified beneficial uses. When multiple criteria exist for a particular parameter, the most stringent criterion was used.

Table 5 Numeric surface water quality standards by segment for Lower Rapid Creek, Pennington County, South Dakota 2010

	Segment			
	SD_CH_R_RAPID_04 and SD_CH_R_RAPID_05		SD_CH_R_RAPID_03	
Parameter	**Criterion**	**Special Conditions**	**Criterion**	**Special Conditions**
Total Dissolved Solids			≤ 1,000 mg/l	30-day average
			≤ 1,750 mg/l	daily maximum
Total Suspended Solids	≤ 90	30-day average	≤ 30 mg/l	30-day average
	≤ 158	daily maximum	≤ 53 mg/l	daily maximum
Total Ammonia Nitrogen as N	Equal to or less than the result from Equation 3 in Appendix A (SDCL§74:51:01)	30-day average March 1 – October 31	Equal to or less than the result from Equation 3 in Appendix A (SDCL§74:51:01)	30-day average
	Equal to or less than the result from Equation 4 in Appendix A (SDCL§74:51:01)	30-day average November 1 – February 29		
	Equal to or less than the result from Equation 2 in Appendix A (SDCL§74:51:01)	daily maximum		
			Equal to or less than the result from Equation 1 in Appendix A (SDCL§74:51:01)	daily maximum
Dissolved Oxygen	≥ 5 mg/l		≥ 6.0 mg/l	
			≥ 7.0 mg/l	in spawning areas during spawning
Un-disassociated Hydrogen Sulfide	≤ 0.002 mg/l		≤ 0.002 mg/l	
pH	≥ 6.5 - ≤ 9.0	See SDCL §74:51:01:07	≥ 6.5 - ≤ 9.0	See SDCL §74:51:01:07

Table 5 (Continued). Numeric surface water quality standards by segment for Lower Rapid Creek, Pennington County, South Dakota 2010

	Segment			
	SD_CH_R_RAPID_04 and SD_CH_R_RAPID_05		SD_CH_R_RAPID_03	
Parameter	**Criterion**	**Special Conditions**	**Criterion**	**Special Conditions**
Temperature	≤ 80° F	See SDCL §74:51:01:31	≤ 65° F	See SDCL §74:51:01:31
Fecal Coliform (May 1 to September 30)	≤ 200CFU/100ml	Geometric mean of a minimum of 5 samples during separate 24-hour periods for a 30-day period and may not exceed this value in more than 20 percent of the samples examined in the same 30-day period	≤ 200CFU/100ml	Geometric mean of a minimum of 5 samples during separate 24-hour periods for a 30-day period and may not exceed this value in more than 20 percent of the samples examined in the same 30-day period
	≤ 400CFU/100ml	in any one sample	≤ 400CFU/100ml	in any one sample
Escherichia coli **(May 1 to September 30)**	≤ 126CFU/100ml	Geometric mean of a minimum of 5 samples during separate 24-hour periods for a 30-day period and may not exceed this value in more than 20 percent of the samples examined in the same 30-day period	≤ 126CFU/100ml	Geometric mean of a minimum of 5 samples during separate 24-hour periods for a 30-day period and may not exceed this value in more than 20 percent of the samples examined in the same 30-day period
	≤ 235CFU/100ml	in any one sample	≤ 235CFU/100ml	in any one sample
Total Coliform			≤ 5,000 CFU/100ml	Geometric mean of a minimum of 5 samples during separate 24-hour periods for a 30-day period and may not exceed this value in more than 20 percent of the samples examined in the same 30-day period
			≤ 20,000 CFU/100ml	in any one sample

Table 5 (Continued). Numeric surface water quality standards by segment for Lower Rapid Creek, Pennington County, South Dakota 2010

	Segment			
	SD_CH_R_RAPID_04 and SD_CH_R_RAPID_05		SD_CH_R_RAPID_03	
Parameter	**Criterion**	**Special Conditions**	**Criterion**	**Special Conditions**
Nitrates as N	≤ 50 mg/L	30-day average	≤ 10 mg/l	daily maximum
	≤ 88 mg/L	daily maximum		
Barium			≤ 1.0 mg/l	daily maximum
Chlorides			≤ 100 mg/l	30-day average
			≤ 175 mg/l	daily maximum
Fluoride			≤ 4.0 mg/l	daily maximum
Sulfate			≤ 500 mg/l	30-day average
			≤ 875 mg/l	daily maximum
Sodium adsorption ratio	≤ 10			
Oil and Grease	≤ 10 mg/L			
Total Petroleum Hydrocarbons	≤ 10 mg/L	See § 74:51:01:10	≤ 1.0 mg/l	See § 74:51:01:31

2.2 Narrative Standards

In addition to physical and chemical standards, South Dakota has developed narrative criteria for the protection of aquatic life uses. *All waters of the state must be free from substances, whether attributable to human-induced point source discharge or non-point source activities, in concentration or combinations which will adversely impact the structure and function of indigenous or intentionally introduced aquatic communities* (ASRD § 74:51:01:12).

South Dakota has narrative standards that may also be applied to the undesired eutrophication of lakes and streams. ARSD § 74:51:01:05; 06; 08; and 09 contains language that prohibits the presence of materials causing pollutants to form, visible pollutants, taste and odor producing materials, and nuisance aquatic life. Specific ARSD narrative languages for the above conditions are provided below.

§ **74:51:01:05. Materials causing pollutants to form in waters.** *Wastes discharged into surface waters of the state may not contain a parameter which violates the criterion for the waters' existing or designated beneficial use or impairs the aquatic community as it naturally occurs. Where the interaction of materials in the wastes and the waters causes the existence of such a parameter, the material is considered a pollutant and the discharge of such pollutants may not cause the criterion for this parameter to be violated or cause impairment to the aquatic community.*

§ **74:51:01:06. Visible pollutants prohibited.** *Raw or treated sewage, garbage, rubble, un-permitted fill materials, municipal wastes, industrial wastes, or agricultural wastes which produce floating solids, scum, oil slicks, material discoloration, visible gassing, sludge deposits, sediments, slimes, algal blooms, fungus growths, or other offensive effects may not be discharged or caused to be discharged into surface waters of the state.*

§ **74:51:01:08. Taste- and odor-producing materials.** *Materials which will impart undesirable tastes or undesirable odors to the receiving water may not be discharged or caused to be discharged into surface waters of the state in concentrations that impair a beneficial use.*

§ **74:51:01:09. Nuisance aquatic life.** *Materials which produce nuisance aquatic life may not be discharged or caused to be discharged into surface waters of the state in concentrations that impair an existing or designated beneficial use or create a human health problem.*

3.0 TMDL Targets

3.1 Fecal Coliform

Current fecal coliform criteria for immersion recreation use requires that 1) no sample exceeds 400 CFU/100 mL (acute target) and 2) the geometric mean of a minimum of 5 samples collected during separate 24-hour periods for any 30-day period not exceed 200 CFU/100 mL (chronic target). The geometric mean, as defined in ARSD § 74:51:01:01 is the n^{th} root of a product of n factors. Fecal coliform criteria are applicable from May 1 through September 30, the recreation season. Since only one or two water samples were collected during any 30-day period, compliance with the geometric mean criterion was evaluated using the load duration method and calculating the geometric mean of all samples collected over time within each flow zone. Currently all segments of Lower Rapid Creek (SD-CH-R-RAPID_03, SD-CH-R-RAPID_04, and SD-CH-R-RAPID_05) exceed the immersion recreation acute standard for fecal coliform bacteria in the high flow zone; while only segment SD-CH-R-RAPID_04 exceeds the immersion recreation chronic standard for fecal coliform in the high flow zone.

The 2010 IR also lists the furthest downstream segment of Lower Rapid Creek (SD-CH-R-RAPID_05) as exceeding the acute limited-contact recreation standard for fecal coliform bacteria. Similar to immersion recreation, the limited-contact recreation fecal coliform criteria are applicable from May 1 through September 30. Current fecal coliform criteria for the limited-contact recreation waters requires that 1) no sample exceeds 2,000 CFU/100 mL (acute target) and 2) the geometric mean of a minimum of 5 samples collected during separate 24-hour periods for any 30-day period not exceed 1,000 CFU/100 mL (chronic target). Since Lower Rapid Creek is assigned immersion and limited contact recreation beneficial uses and the limited contact fecal coliform criteria are less stringent than criteria developed for immersion recreation, fecal coliform TMDLs were based on the immersion recreation beneficial use criteria to ensure attainment of the most stringent immersion recreation criteria.

3.2 *Escherichia coli*

South Dakota has adopted *E. coli* criteria for the protection of the limited contact and immersion recreation uses. Based on the current Integrated Report (SD DENR, 2010), the furthest downstream segment of Lower Rapid Creek (SD-CH-R-RAPID_05) exceeds the acute immersion recreation standard for *E. coli* bacteria, was placed on the 303(d) impaired waters list, and requires and *E. coli* TMDL. Immersion recreation standards for *E. coli* requires that 1) no sample exceeds 235 CFU/100 mL (acute target) and 2) the geometric mean of a minimum of 5 samples collected during separate 24-hour periods for any 30-day period not exceed 126 CFU/100 mL (chronic target). *E. coli* data have been collected in segment SD-CH-R-RAPID_05 of Lower Rapid Creek since September of 2000 and indicate that 9 out of 34 samples (26.4 percent) exceeded the acute *E. coli* criterion (235 CFU/100ml). Greater than 10% of samples must exceed water quality criteria for that parameter to be included as a cause of impairment on the 303(d) impaired waters list.

Lower Rapid Creek has also been assigned the beneficial use of limited-contact recreation water with less stringent *E. coli* standards. Current *E. coli* criteria for the limited-contact recreation waters requires that 1) no sample exceeds 1,178 CFU/100 mL (acute target) and 2) the geometric mean of a minimum of 5 samples collected during separate 24-hour periods for any 30-day period not exceed 630 CFU/100 mL (chronic target). Currently segment SD-CH-R-RAPID_05 of Lower Rapid Creek meets limited-contact recreation waters standards

4.0 Significant Sources

4.1 Point Sources

4.1.1 SD-CH-R-RAPID_03, Canyon Lake to S15, T1N, R8E

The City of Rapid City is located in the upper portion of the study area approximately between monitoring sites ABCL and the coldwater/warmwater fisheries change in Rapid Creek S15 T1N R8E (Figure 2). This segment flows through Rapid City (population ~ 67,000) and is impacted by stormwater runoff contributing fecal coliform and *E. coli* loading to Rapid Creek. Rapid City has an approved Municipal Separate Storm Sewer Systems (MS4) stormwater permit (Permit # SDR41A007) which was issued in 2003 by SD DENR.

4.1.2 SD-CH-R-RAPID_04, S15, T1N, R8E to above Farmingdale

Rapid City has a wastewater treatment facility (RC WWTF) that discharges into Rapid Creek between monitoring sites ASTP and BSTP (Figure 2). Rapid City was issued a discharge permit (Permit # SD-0023574) in 2001 by SD DENR. As part of their permit, fecal coliform bacteria are routinely sampled three times per week from May 1st through September 30th each year. This permit will be updated to include monitoring *E. coli* bacteria. The permit will also be updated to include *E. coli* bacteria effluent limitations to ensure that the water quality standards will be met during the recreation season. Beginning in 2009, the RC WWTF began sampling *E. coli* bacteria as part of their routine sampling to monitor and track *E. coli* concentrations in their effluent.

4.1.3 SD-CH-R-RAPID_05, above Farmingdale to Cheyenne River

There are no point source discharges (WLA) in this segment of the Rapid Creek watershed.

4.2 Non-point Sources

Based on review of available information and communication with state and local authorities, the primary non-point sources of fecal coliform and by default *E. coli* bacteria within the Lower Rapid Creek watershed include agricultural runoff, wildlife, and human sources. Using the best available information, potential loadings were estimated based on total production potential for each source and landuse using the EPA's Bacterial Indicator Tool (BIT) based on the density and distribution of animals (livestock and wildlife) and failing septic systems in the watershed (US EPA, 2000). The BIT does not have *E. coli* specific production values incorporated into its reference tables. However, in this watershed, *E. coli* concentrations were significantly related to fecal coliform bacteria concentrations; therefore, fecal coliform bacteria were used as a surrogate for *E. coli* production potential. Thus, fecal coliform production sources and percentages were applied to *E. coli* bacteria sources and percentages and interpreted as bacterial loading.

4.2.1 Agriculture

Manure from livestock is a potential source of fecal coliform/*E. coli* bacteria to streams. Livestock in the basin are predominantly beef cattle, horses and some sheep. Other livestock in the basin include bison, chickens and swine. Livestock population densities in the watershed were estimated using Census of Agriculture data, which is summarized by county. Livestock contribute bacterial loads to Lower Rapid Creek directly by defecating while wading in the stream and indirectly by defecating on rangelands that are washed off during precipitation events. Both the indirect and direct sources of bacteria loads from livestock were represented in the modeling application.

4.2.2 Human

Human fecal coliform/*E. coli* bacteria were identified from bacterial source tracking tests. The Lower Rapid Creek watershed, East of Rapid City is largely rural, with no centralized wastewater collection or treatment facilities. Thus, septic systems are assumed to be the primary human source of bacterial loads to Lower Rapid Creek. Densities of septic systems in the watershed were derived from the 1990 U.S. Census septic data and the 2004 U.S. Census population data.

4.2.3 Natural background/wildlife

Wildlife within the watershed is a natural background source of fecal coliform/*E. coli* bacteria. For watershed modeling purposes, wildlife population density estimates were obtained from the South Dakota Department of Game, Fish and Parks (SD GF&P, 2002). Wildlife contributions to overall bacterial loads in Lower Rapid Creek were minimal based on fecal coliform/*E. coli* modeling.

4.3 Bacterial Source Tracking

Bacteria samples were analyzed to determine sources of fecal coliform bacteria within the watershed. Pulsed-field gel electrophoresis (PFGE), a DNA testing procedure, was used to link bacteria from samples to known sources. From each water sample with a fecal coliform bacteria concentration ≥50 cfu/100ml, laboratory staff attempted to isolate five *E. coli* bacteria colonies to test using the PFGE technique.

Table 6 DNA fingerprinting E.coli results at selected locations on Rapid Creek

Location	Date	Sample Conditions	Fecal Coliform CFU/100 mL	Probable Source	
				Animal	Human
HAW	8/29/2002	non-event	7	5	0
HAW	?	event	> 2,400	3	2
ASTP	8/29/2002	non-event	93	5	0
BSTP	8/29/2002	non-event	15	4	1
CAP	8/29/2002	non-event	23	2	3

Limited supplemental sampling was conducted from May through September 2002, at monitoring stations throughout Lower Rapid Creek. This sampling was sponsored by the Pennington Conservation District and carried out according to the methods and procedures established for the initial monitoring program. Additionally, five samples were collected for DNA fingerprinting of *E.coli*. A non-event and event samples were collected at HAW. These results are presented in Table 6.

The non-event sample collected at Hawthorn (HAW) indicated all five isolates were animal and the fecal coliform concentration was 7 CFU/100 mL. The event sample indicated two out of five isolates in a fecal coliform concentration >2,400 CFU/100 mL. These samples indicate that during base flow conditions the fecal coliform source is mostly animal. However, during event flows there is a human source. Potential sources are 1) surcharge of sewer systems which may increase the pressure within the inverted siphon upstream and thus a higher potential for seepage into Rapid Creek upstream of HAW and 2) stormwater runoff.

The other DNA *E.coli* samples represent base flow conditions. At BSTP and Caputa there are one out of five and three out of five human isolates, respectively. The fecal coliform concentrations were 15 and 23 CFU/100 mL, respectively. The human source is likely associated with the wastewater treatment plant discharge. However, the concentration levels did not exceed beneficial use criteria.

4.4 Source Assessment Modeling Results

Bacterial source assessment modeling was carried out using data from the National Agricultural Statistics Service (NASS, 2009), SD GF&P wildlife assessment (Huxoll, 2002), and the US EPA BIT model (US EPA, 2000). Table 7 lists most animal sources for fecal coliform/*E. coli* in the Lower Rapid Creek watershed based on a per acre basis. Wildlife and livestock data were gathered and densities calculated assuming an equal distribution throughout the watershed.

Table 7 Total bacterial source production percentages by species for Rapid Creek, Pennington County, SD.

Species	#/mi^2	#/acre	CFU/animal/day	CFU/acre/day	Percent
Cattle	19.00	2.97E-02	1.04E+11	3.09E+09	96.32%
Hogs	0.05	7.81E-05	1.08E+10	8.44E+05	0.03%
Sheep	0.25	3.91E-04	1.20E+10	4.69E+06	0.15%
Horse	0.96	1.50E-03	4.20E+08	6.30E+05	0.02%
Wildlife				1.12E+08	3.49%
Total				3.21E+09	100.00%
Wild Turkey	1.97	3.08E-03	9.30E+07	2.86E+05	
Goose	0.57	8.91E-04	4.90E+10	4.36E+07	
Deer	4.22	6.59E-03	5.00E+08	3.30E+06	
Beaver	0.36	5.63E-04	2.50E+08	1.41E+05	
Racoon	1.02	1.59E-03	1.25E+08	1.99E+05	
Coyote	1.04	1.63E-03	4.09E+09	6.64E+06	
Muskrat	1.06	1.66E-03	2.50E+07	4.14E+04	
Skunk	1.11	1.73E-03	4.09E+09	7.09E+06	
Badger	0.72	1.13E-03	4.09E+09	4.60E+06	
Jackrabbit	1.07	1.67E-03	4.09E+09	6.84E+06	
Cottontail	3.24	5.06E-03	4.09E+09	2.07E+07	
Squirrel	2.88	4.50E-03	4.09E+09	1.84E+07	

Bacterial production values by species were taken from BIT model reference data and used to calculate colony forming units per acre per day production estimates. Overall animal production percentages may be used as the source allocations for each animal species. Results show that cattle have the greatest potential for bacterial production in the watershed (Table 7).

The BIT model was then used to identify non-point source total bacterial production in the watershed based on land use using species count and watershed specific information. Point source total bacterial production from the Rapid City WWTP and Rapid City stormwater MS4 was added to the BIT non-point source bacterial production to calculate segment specific and overall bacterial production within the watershed.

Non-point source BIT data were pooled into four main land use categories: urban, agriculture/cropland, pastureland/rangeland, and forest. Overall urban bacterial production values were calculated using SDSM&T and SD GF&P base and event flow data, rainfall, fecal coliform bacteria concentrations collected during the assessment at monitoring sites throughout the Rapid City area, and BIT estimated build-up area bacterial potentials. The Agriculture/cropland category consisted of row, hay, and alfalfa crops with bacterial production from manure application and/or have limited livestock grazing during non-crop or after harvest periods and are harvested or cut while pastureland/rangeland have livestock grazing for an extended period of time. The forest category represents only wildlife bacterial production; while the non-use category was composed of water, barren, and wetlands and was considered non-contributing. The BIT model quantifies bacteria loads from livestock directly defecating in streams and septic tank failures. Livestock and septic sources were included in the BIT model on a watershed wide basis (Table 8). Total bacterial production for the watershed was calculated using the BIT model and pooled by use category, and then those loads were distributed by stream segments using landuse percentages.

Point source bacterial production for segment SD-CH-R-RAPID_03 used the WLA for Rapid City stormwater MS4 was based on measured precipitation, rainfall depth, Maximum Extent Practicable (MEP) estimates and measured water quality data from the Rapid City stormwater MS4 and for segment SD-CH-R-RAPID_04, the WLA for the Rapid City WWTP based on design flow and water quality standards. The WLA was used for the total bacterial production from the Rapid City WWTP because the WLA is their effluent limit based on their permit and they have and are currently operating in compliance with bacterial limits based on compliance monitoring data. There are no permitted animal feeding operations (AFO or CAFO) in the Lower Rapid Creek watershed based on information from SD DENR.

Table 8 Estimated fecal coliform/*E. coli* production sources based on landuse percentage and bacterial production using the Bacterial Indicator Tool (BIT).

	Segment											
	SD-CH-R-RAPID_03			SD-CH-R-RAPID_04			SD-CH-R-RAPID_05			Watershed Wide		
Use	Landuse %	Bacteria Production (CFU/day)	Bacteria Production %	Landuse %	Bacteria Production (CFU/day)	Bacteria Production %	Landuse %	Bacteria Production (CFU/day)	Bacteria Production %	Landuse %	Bacteria Production (CFU/day)	Bacteria Production %
Urban	35.4%	1.59E+15	89.8%	0.7%	3.24E+13	5.2%	0.1%	2.30E+12	0.3%	6.2%	1.62E+15	43.77%
Agriculture/Cropland	6.9%	9.21E+11	0.1%	39.5%	5.25E+12	0.8%	23.3%	3.10E+12	0.4%	24.8%	9.27E+12	0.25%
Pastureland/Rangeland	18.1%	1.78E+14	10.1%	59.1%	5.83E+14	93.9%	73.9%	7.29E+14	99.3%	60.6%	1.49E+15	40.27%
Forest	36.8%	1.11E+08	0.0%	0.4%	1.14E+06	0.0%	0.0%	0.00E+00	0.0%	6.3%	1.12E+08	0.00%
Non-Use	2.9%	0.00E+00	0.0%	0.3%	0.00E+00	0.0%	2.7%	0.00E+00	0.0%	2.1%	0.00E+00	0.00%
Livestock in Streams											5.81E+14	15.69%
Septics											8.76E+09	0.00%
Total (non-point sources)		1.76E+15			6.20E+14			7.35E+14				100.0%
Point Sources												
Rapid City MS4		3.54E+11	0.02%		-	-		-	-		3.54E+11	0.01%
Rapid City WWTP		-	-		2.77E+11	0.04%		-	-		2.77E+11	0.01%
Watershed Total		1.76E+15			6.21E+14			7.35E+14			3.70E+15	100.0%

Non-point source BIT calibration consisted of using the best available and most reliable animal numbers directly from reputable sources. Data sources included agricultural and livestock numbers from NASS 2009, wildlife numbers from SD GF&P, septic numbers from the City if Rapid City and Pennington County. BIT point source calibration consisted of using the WLA developed and calculated from measured rainfall, rainfall depth, MEP estimates and measured water quality data for the Rapid City stormwater MS4 and by using the WLA developed from the permitted bacterial effluent limit for the Rapid City WWTP based on South Dakota water quality standards and plant design flows. These data were used along with Best Professional Judgment (BPJ) to reliably estimate the total bacterial production in the Lower Rapid Creek watershed.

BIT model results were used to provide additional information on potential source contributions based on landuse. These data may be used to identify which landuse types have the highest potential to contribute bacterial load based on animal numbers and total bacterial production. Table 8 allocates the sources for bacteria production in the watershed into four primary landuse categories. Bacteria from the urban landuse had the highest loading potential in segment SD-CH-R-RAPID_03 with 35.4 percent of the watershed producing 89.8 percent of the total bacterial production. Bacterial production from pastureland/rangeland was the only other landuse that appreciably contributed to the overall bacterial production (10.1 percent) in segment SD-CH-R-RAPID_03. Segment SD-CH-R-RAPID_03 as a whole had the highest bacterial production potential in Lower Rapid Creek with most attributed to stormwater and build-up runoff from Rapid City (89.8 percent). Bacterial sources from the urban landscape are anthropogenic in origin such as development, impervious areas, pets, septic, sewers, etc. and can contribute to stormwater runoff and are not unique to Rapid City.

Landuse throughout the lower portion of the watershed (segments SD-CH-R-RAPID_04 and SD-CH-R-RAPID_05) are mainly rural agricultural with significant landuse percentages assigned to pastureland/rangeland and/or agriculture/cropland (Table 8). However, the majority of the bacterial production potentials in segments SD-CH-R-RAPID_04 and SD-CH-R-RAPID_05 in Lower Rapid Creek were attributed to the pastureland/rangeland landuse and were 93.9 percent and 99.3 percent, respectively. Bacterial potentials in segment SD-CH-R-RAPID_04 indicated that only a small percentage of the urban landuse contributes to the overall production in this segment. The upper portion of the watershed in segment SD-CH-R-RAPID_04 is influenced by growth and residential development of Rapid City (urban sprawl). Overall bacterial production in segment SD-CH-R-RAPID_04 was lower than segment SD-CH-R-RAPID_05.

Watershed wide, the majority of bacterial production in Lower Rapid Creek was from urban (43.8 percent), pastureland/rangeland (40.3 percent), and livestock in streams (15.7 percent). Based on these analyses, the major sources of bacteria by segment are stormwater runoff in segment SD-CH-R-RAPID_03 (89.8 percent) and manure management from livestock on pastureland/ rangeland in segments SD-CH-R-RAPID_04 and SD-CH-R-RAPID_05, 93.9 percent and 99.3 percent, respectively. Based on total watershed production, point source bacterial production were very small percentages of the total production. The total production percentages from the Rapid City stormwater MS4 and Rapid City WWTP contributed approximately 0.01 percent of the total bacterial production in the watershed.

5.0 Technical Analysis

5.1 Stream Flows

Average daily discharge data from these sites were used with SD DENR WQM and assessment water quality data to develop segment specific load duration curves for parameter analysis. Flow data from monitoring site 06414000 at Rapid City were compared to the limited flow data available at 06416000 below Hawthorn Ditch (HAW). The Rapid Creek at Rapid City gage is located approximately 4.5 stream miles upstream of the Hawthorn Ditch gage and had similar discharge characteristics. Both USGS sites are within segment SD-CH-R-RAPID_03 of Rapid Creek. Discharge was similar enough to use flows from 06414000 at Rapid City to supplement and expand flow range at 06416000 below Hawthorn Ditch. Stream flows at the other two USGS monitoring sites in Rapid Creek had excellent long-term data sets with segment SD-CH-R-RAPID_04 having 28 years and segment SD-CH-R-RAPID_05 having 49 years.

5.2 Flow Duration Curve Analysis

Flow duration curves for Lower Rapid Creek are plotted together on Figure 3. The curve for segment SD-CH-R-RAPID_03 (orange line) was developed using adjusted flows from USGS monitoring site 06414000 Rapid Creek @ Rapid City. Adjustments consisted of taking the mean difference of the daily values at the USGS site below HAW minus the same daily values at the USGS site @ Rapid City. The mean difference was six cubic feet/second (cfs); thus, all average daily values at USGS monitoring site Rapid Creek @ Rapid City were reduced by six cfs and then plotted as flows for USGS below HAW. All other flow duration curves, segments SD-CH-R-RAPID_04 (blue line) and SD-CH-R-RAPID_05 (yellow line), were developed using long-term un-adjusted USGS mean daily discharge data (Figure 3).

Recreational beneficial use standards are applicable only from May through September (recreation season). Only discharge data collected during the recreation season from each stream segment were used to develop the flow duration curves in Figure 3. Recreational season discharge dates ranged from 1950 through 2008 for segment SD-CH-R-RAPID_03, 1981 through 2009 for segment SD-CH-R-RAPID_04, and 1960 through 2009 for segment SD-CH-R-RAPID_05.

Flow duration characteristics for the recreational season were similar for low, dry and mid-range flows in segments SD-CH-R-RAPID_03 and SD-CH-R-RAPID_04 except for the minimum flow values in the low flow range; where flows from the RC WWTF increased minimum discharge to approximately 10 cubic feet per second in segment SD-CH-R-RAPID_04 of Lower Rapid Creek. Flow duration curves in the moist and high flow zones separated and were higher in segment SD-CH-R-RAPID_04 than in SD-CH-R-RAPID_03 (Figure 3).

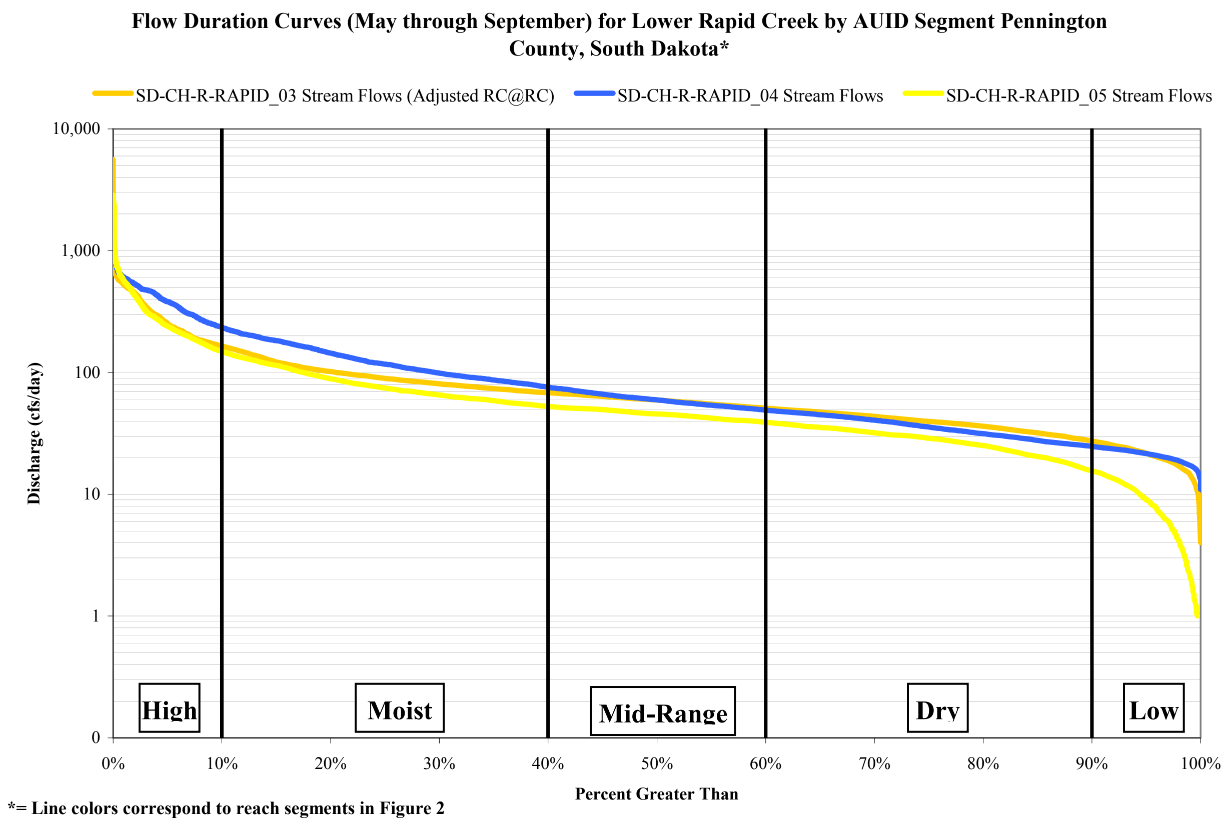

Figure 3 Flow duration curves for stream segments in Lower Rapid Creek, Pennington County South Dakota and were developed using USGS discharge data

Recreation season flows in segment SD-CH-R-RAPID_05 below Farmingdale were lower in all flow zones (low through high) when compared to segments SD-CH-R-RAPID_04 and SD-CH-R-RAPID_03 (Figure 3). These data suggest that low to moist flow zones from segments SD-CH-R-RAPID_03 and SD-CH-R-RAPID_04 show influences from small tributary streams, stormwater discharge and National Pollution Discharge Elimination System (NPDES) permitted flows, resulting in higher overall flows when compared to segment SD-CH-R-RAPID_05 with no perennial tributary, stormwater or NPDES permitted flows.

5.3 Load Duration Curve Analysis

The TMDLs were developed using the Load Duration Curve (LDC) approach, resulting in a flow-variable target that considers the entire flow regime within the recreational season (May 1st – September 30th). The LDC is a dynamic expression of the allowable load for any given day within the recreation season. To aid in interpretation and implementation of the TMDL, the LDC flow intervals were grouped into five flow zones: high flows (0–10%), moist conditions (10–40%), mid-range flows (40–60%), dry conditions (60–90%), and low flows (90–100%) according to EPA's *An Approach for Using Load Duration Curves in the Development of TMDLs* (US EPA, 2006). Flow zones were adjusted based on the number of data points (instantaneous samples) within the each standard LDC flow interval. This was done when the numbers of data points in the regular flow zones were less than two to increase the total number of observed samples for comparison. This procedure was only used in segment SD-CH-R-

RAPID_03 to increase the high and low flow zones by 5% to increase the number of data points within these zones (Figure 4).

Instantaneous or "observed" loads were calculated by multiplying the sample concentrations from SD DENR assessment and ambient water quality data within each AUID segment (Site: HAW-below Hawthorn Ditch segment: SD-CH-R-RAPID_03; Site: 460692-below Rapid City wastewater treatment facility segment: SD-CH-R-RAPID_04; and Site 460910-near Farmingdale segment: SD-CH-R-RAPID_05), with the measured flow at the time the water quality sample was collected, and a unit conversion factor. The locations of the SD DENR water quality monitoring sites on Lower Rapid Creek are shown in Figure 2.

When the instantaneous loads are plotted on LDCs, characteristics of the water quality impairment are shown for each segment. Instantaneous loads that plot above the solid black curve (solid black curve = acute TMDL) are exceeding the daily maximum water quality (acute) criterion, while those below the curve are in compliance. Compliance with the geometric mean (chronic) criterion (solid grey curve) was assessed by comparing the geometric mean of all instantaneous loads collected within each flow zone to the 95^{th} percentile chronic criterion load within each flow zone.

The LDCs shown in Figures 4 through 6 and Figure 8 represents a dynamic expression of parameter-specific TMDLs for each impaired segment of Lower Rapid Creek that are based on the daily maximum fecal coliform bacteria, *E. coli* bacteria, resulting in a unique maximum daily load that corresponds to a measured average daily flow.

5.3.1 Fecal Coliform Bacteria

5.3.1.1 Segment: SD-CH-R-RAPID_03

The LDC-based fecal coliform TMDL for segment SD-CH-R-RAPID_03 was developed using 1980 through 1982 USGS discharge below Hawthorn Ditch (HAW). The HAW discharge range was expanded using USGS discharge from USGS monitoring site Rapid Creek at Rapid City (06414000) located approximately four stream miles upstream of the HAW site. Instantaneous fecal coliform data consisted of 1999 and 2000 SDSM&T assessment and 2001 through 2002 SDGF&P data collected at the Hawthorn (HAW) monitoring site (Figure 2).

Acute and chronic fecal coliform load duration curves and instantaneous daily loads are displayed in Figure 4. SDSM&T and SDGF&P instantaneous loads tend to exceed the maximum daily load acute criteria (TMDL) in the dry mid-range, moist and high flow zones. The geometric mean loads within the mid-range, moist and high flow zones were also above acute and chronic criteria. Overall loading throughout all flow zones exceeded acute standards by approximately 48 percent (Table 9).

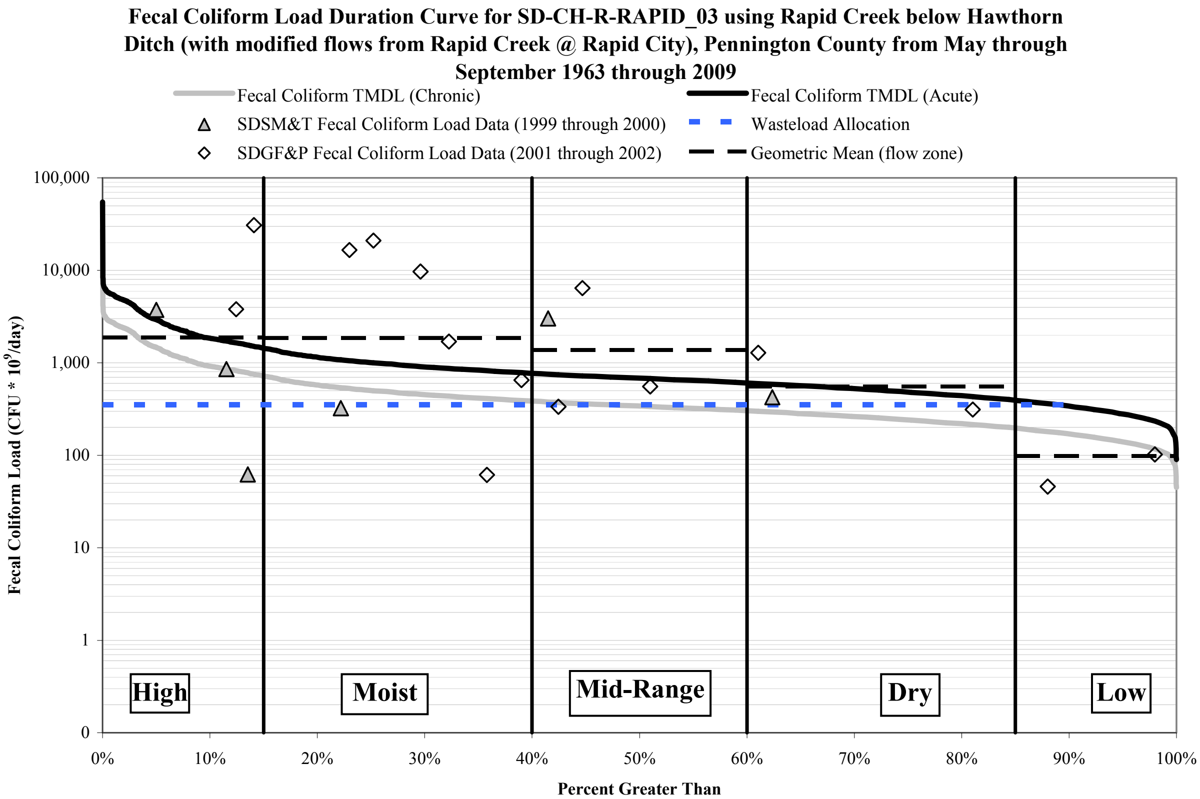

Figure 4 Fecal coliform load duration curve for segment: SD-CH-R-RAPID_03 representing allowable daily fecal coliform loads based daily maximum fecal coliform criteria (≤ 400 CFU/100 mL) during the recreations seasons 1980 through 1982 and 1999 through 2000. Instantaneous fecal coliform loads from 1999 through 2009 are also displayed.

At this time, limited instantaneous fecal coliform loading data exists for the high and low flow zones; however, data points do show exceedence in the high flow zone and compliance in the low flow zone. This trend fits the overall trend observed in fecal coliform loading at this and other monitoring sites in Lower Rapid Creek, the predominance of event-based exceedence (Figure 4 and Table 9). This suggests fecal coliform criteria applicable to the recreation season routinely exceed acute and chronic standards during runoff events. Most of the runoff to this segment of Rapid Creek comes from urban and stormwater runoff. The fecal coliform wasteload allocation depicted in Figure 4 was set by treating all runoff to a depth of 0.5 inches based on the exponential distribution of all rainfall events and treatment to the Maximum Extent Practicable (MEP) which is the 78.9th percentile and developed for Rapid City MS4 (stormwater) permit (Appendix B).

Table 9 Fecal coliform exceedence percentages based on acute standards for Lower Rapid Creek segment SD-CH-R-RAPID_03 using all data.

Flow Zone	All Data Flow Zone Exceedence Percentage	Flows (cfs)
High	60.0	147 - 5,600
Moist	57.1	79 -146
Mid-Range	50.0	62 - 78
Dry	33.3	41 - 61
Low	0.0	9.2 -40
Overall	47.6	9.2 - 5,600

The critical condition for segment SD-CH-R-RAPID_03 of Lower Rapid Creek watershed based on LDCs are event based runoff conditions during the recreation season. Water quality violations occurring in the high, moist, mid-range and dry flow zones show a decreasing percent exceedence with decreasing flows.

5.3.1.2 Segment: SD-CH-R-RAPID_04

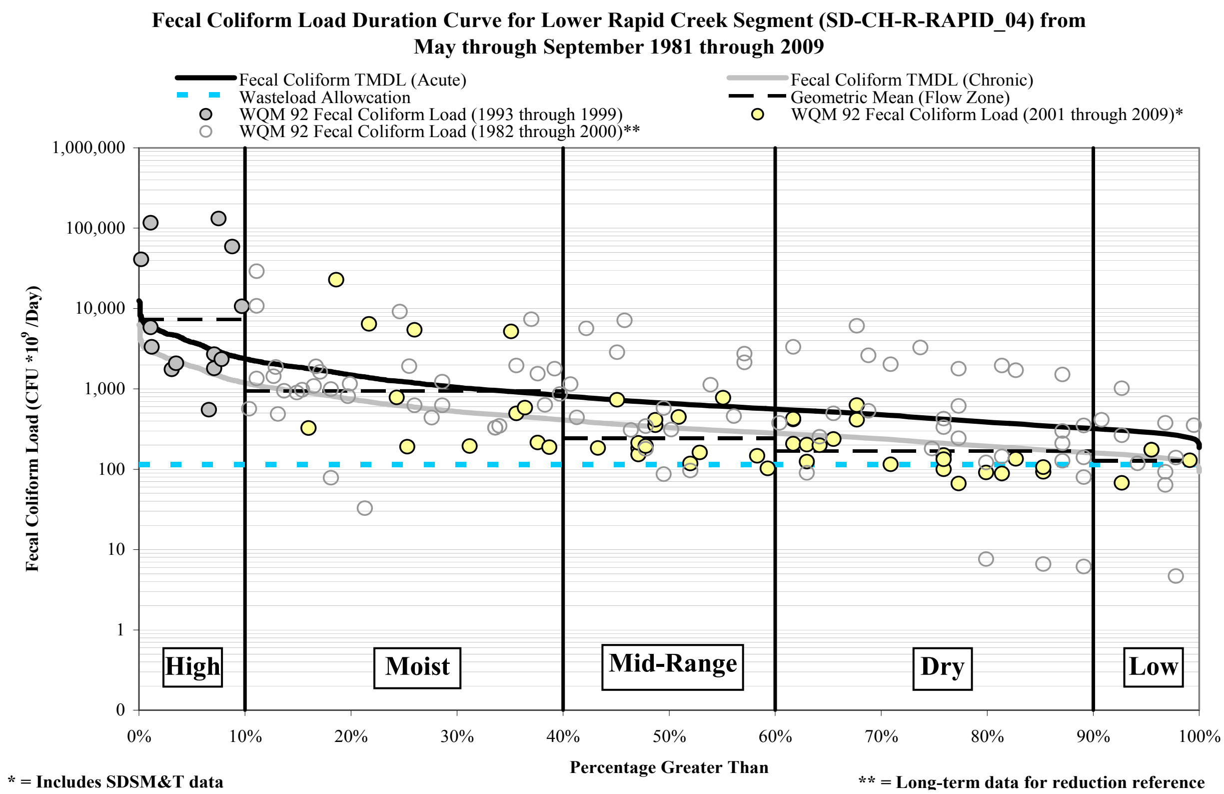

Figure 5 Fecal coliform load duration curves for segment: SD-CH-R-RAPID_04 representing allowable daily fecal coliform loads based daily maximum (acute) fecal coliform criterion (≤ 400 CFU/100 mL) and the 30-day geometric mean (chronic) fecal coliform criterion (≤ 200 CFU/100 mL) during the recreation seasons 1981 through 2009. Instantaneous fecal coliform loads collected from 1993 through 1999 (high flow zone) and 2001 through 2009 during the recreation season are also displayed.

Seasonal fecal coliform loadings (1982 through 2009) indicate fecal coliform exceeds acute water quality standard (>400 CFU/100 mL) an average of 19 percent and 48 percent based on the chronic standard (>200 CFU/100 mL) using all data points throughout the entire flow range. However, in 2000 a concentrated feeding area was removed from the watershed which discharged above SD DENR monitoring site DENR 460692 (WQM 92) and was identified as a contributing source of fecal coliform to this segment of Rapid Creek. Then in 2003, the City of Rapid City wastewater treatment facility installed additional equipment to further treat effluent from the plant. The treatment consisted of installing banks of ultra-violet lights to further treat (reduce) fecal coliform and *E. coli* bacteria concentrations in their effluent loading Rapid Creek especially during the recreation season. The combination of these reductions may be seen in Figure 5 by comparing the 2001 through 2009 data points (yellow circles) to the 1982 through 2000 data points (colorless circles). The 2001 through 2009 fecal coliform data show a marked decrease in daily loading with much less data spread (variability) especially in the mid-range, dry and low flow zones (Figure 5).

Based on the more recent data (1993 through 1999 for the high flow zone and 2001 through 2009 for the moist, mid-range, dry and low flow zones), the overall percent violations dropped when using the modified date ranges from 36 percent to 23 percent based on the acute standard (Table 10).

Table 10 Fecal coliform loading exceedence percentages (long-term and recent (2001 through 2009) based on acute standards for Lower Rapid Creek segment SD-CH-R-RAPID_04.

Flow Zone	All Data Flow Zone Exceedence Percentage	Recent Flow Zone Exceedence Percentage	Flows (cfs)
High	46.2	46.2	235 - 1,270
Moist	35.6	33.3	76 - 233
Mid-Range	33.3	14.3	49 - 75
Dry	36.7	10.5	25 - 48
Low	35.7	0.0	11 - 24
Overall	**36.4**	**22.6**	**11 – 1,270**

The critical condition for segment SD-CH-R-RAPID_04 of Lower Rapid Creek watershed based on LDCs is event based runoff conditions with the majority of water quality violations occurring in the high and moist flow zones.

5.3.1.3 Segment SD-CH-R-RAPID_05

The LDC-based TMDL for fecal coliform (Figure 6) was developed using long-term USGS discharge data collected from May through September (recreation season) 1960 through 2009 at USGS site 06421500, Rapid Creek near Farmingdale, SD. Instantaneous fecal coliform data consisted of SD DENR ambient monitoring site DENR 460910 (WQM 19) from May, 1967 through September 2009 and assessment data from with data collected immediately downstream of the USGS monitoring site (Figure 2).

In May through September 2002, the Pennington County Conservation District and Rapid Valley Water District sponsored additional monitoring. Included in this monitoring, fecal coliform samples were collected for ribotyping analysis. Fecal coliform data has also been collected at this site during the Lower Cheyenne River watershed assessment project (2007 through 2009) and are included in Figure 6 (orange triangles).

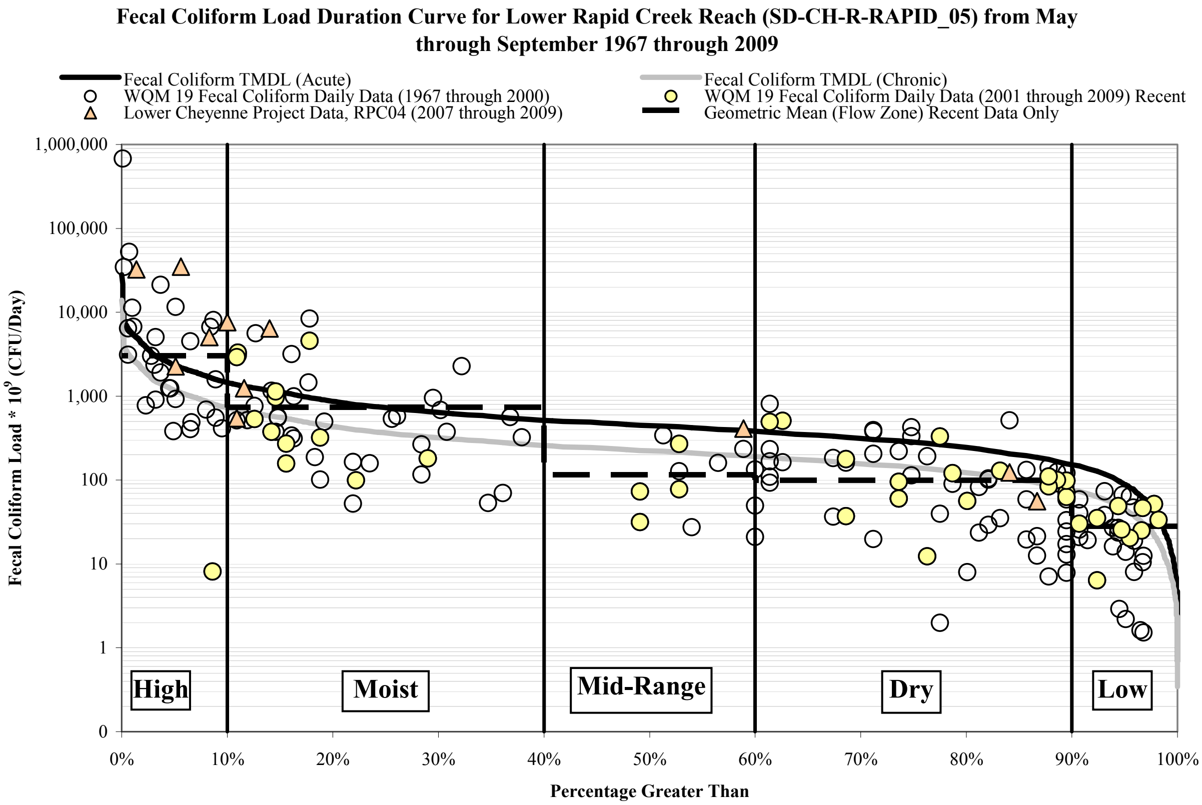

Figure 6 Fecal coliform load duration curves for segment: SD-CH-R-RAPID_05 representing allowable daily fecal coliform loads based daily maximum (acute) fecal coliform criterion (≤ 400 CFU/100 mL) and the 30-day geometric mean (chronic) fecal coliform criterion (≤ 200 CFU/100 mL) during the recreation seasons 1981 through 2009. Instantaneous fecal coliform loads collected from 1993 through 1999 (high flow zone), 2001 through 2009, and the Cheyenne River watershed project (2007 through 2009) collected during the recreation season are also displayed.

The acute load duration curve represents the daily maximum load based on flow and the chronic represents the 30-day geometric mean from a minimum of five samples collected in separate 24-hour periods (Figure 6). Geometric means were calculated using more recent instantaneous daily loads (2001 through 2009) within each flow zone to determine if the chronic standard is being met within each flow zone.

Similar to the trends observed in segment SD-CH-R-RAPID_03 and SD-CH-R-RAPID_04, fecal coliform exceeded acute water quality standards at greater rates (higher percentages) in the higher flow zones (high and moist flow zones) depicting an event-based exceedence system (Figure 6 and Table 11). Exceedence percentages by flow zone were higher when using the more recent data (2001 through 2009) than when using all data (1967 through 2009). However, the observed scenario may be an artifact of a smaller sample set within each flow zone producing higher exceedence percentage rates compared to the long-term data set (Table 11). Most of the more recent samples in the high flow zone were collected for the Lower Cheyenne River watershed assessment project (RPC04) which tended to sample event conditions, with 72.7 percent of the samples collected were in the high and moist flow zones (Figure 6).

Table 11 Fecal coliform loading exceedence percentages for long-term and recent (2001 through 2009) datasets based on acute standards for Lower Rapid Creek segment SD-CH-R-RAPID_05.

Flow Zone	All Data Flow Zone Exceedence Percentage	Recent Flow Zone Exceedence Percentage	Flows (cfs)
High	48.6	66.7	149 - 2,860
Moist	31.7	33.3	53 -148
Mid-Range	5.9	20.0	39 - 52
Dry	14.6	15.8	16 - 38
Low	4.7	10.0	1 -15
Overall	**21.4**	**25.5**	**1 – 2,860**

Thirty-day average geometric mean values by flow zone for segment SD-CH-R-RAPID_05 of Lower Rapid Creek were below the chronic water quality standards (grey line) throughout the high, mid-range, dry and low flow zones (Figure 6). The geometric mean of instantaneous load values for the moist flow zone was above the 95th percentile of allowable loads based the chronic criterion.

The critical condition for segment: SD-CH-R-RAPID_05 of Lower Rapid Creek watershed based on LDCs is event based runoff conditions with the majority of water quality violations occurring in the high, moist, mid-range and dry flow zones.

Applying conservative methodologies to TMDL development within segment SD-CH-R-RAPID_05, the TMDL will be developed based on the daily maximum acute criteria of 400 CFU/100 mL throughout all flow zones, because percent reductions required were greater based on the acute criterion than the chronic criterion.

5.3.2. *E. coli* Bacteria

5.3.2.1. Segment SD-CH-R-RAPID_05

The LDC-based TMDL for *E. coli* was developed for segment SD-CH-R-RAPID_05 using long-term seasonal (May through September) USGS discharge data collected from monitoring site 06421500, Rapid Creek near Farmingdale, SD. Instantaneous *E. coli* data consisted of SD DENR ambient monitoring site DENR 460910 (WQM 19) from September, 2000 through September 2009 (recreation season) with data collected immediately downstream of the USGS monitoring site (Figure 2 and Figure 8).

Fecal coliform were also sampled while collecting *E. coli* samples during DENR ambient monitoring at DENR 460910 from September 2000 through September 2009. These data were used to analyze the relationship between *E. coli* bacteria and fecal coliform bacteria within this segment of Lower Rapid Creek. This was done to increase the size of the data set in the high flow zone with only one data point and to increase flow zone geometric mean resolution. Thirty-four fecal coliform and *E. coli* bacteria sample pairs are plotted in Figure 7 and fitted with a second-degree, polynomial regression line.

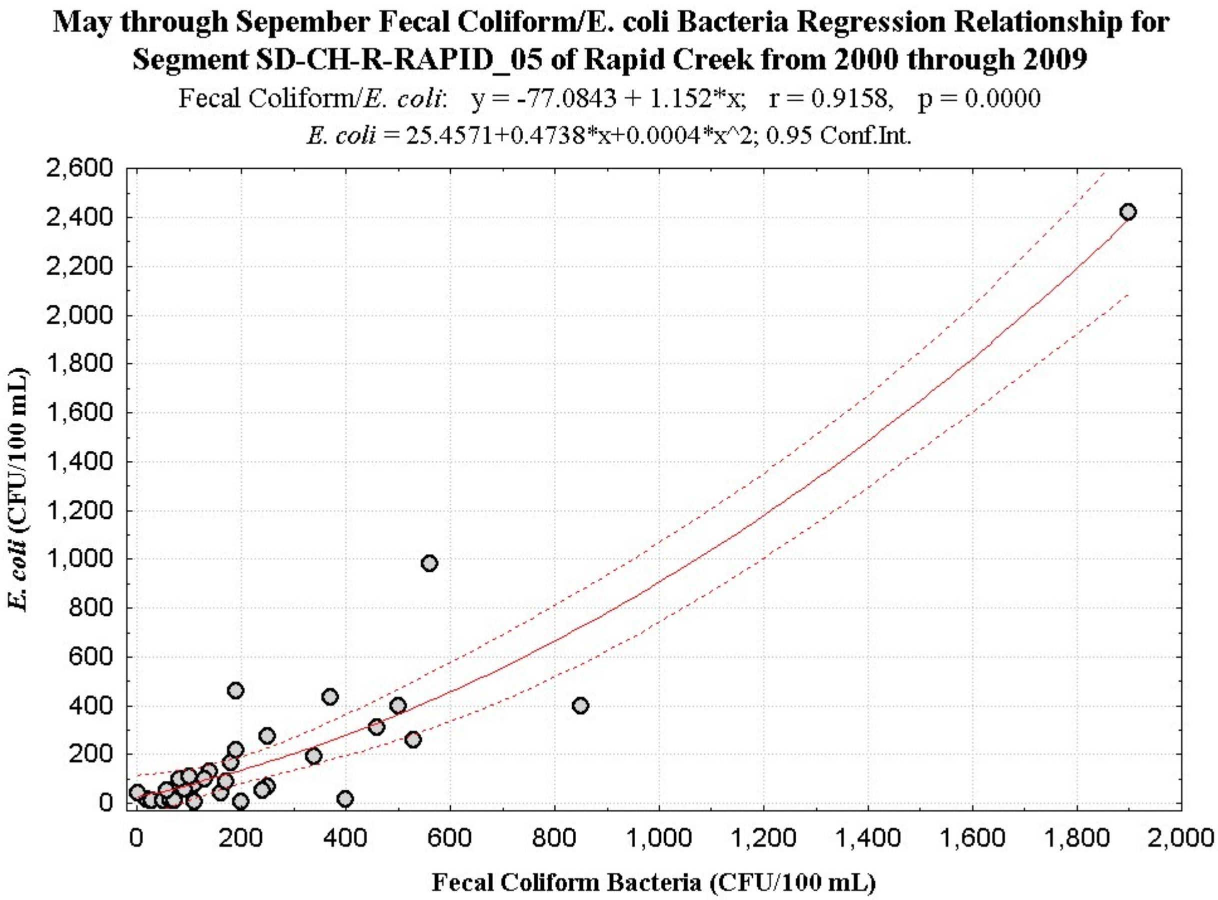

Figure 7 Best fit, second-degree polynomial regression equation for predicting *E. coli* bacteria concentrations (CFU/100 mL) based on fecal coliform concentrations for Segment SD-CH-R-RAPID_05 in Lower Rapid Creek. *E. coli* and fecal coliform data were collected at the same time and date from September 2000 through September 2009.

A significant relationship between fecal coliform and *E. coli* was observed for segment SD-CH-R-RAPID_05 with statistically significant ($p < 0.05$) relationship and high correlation coefficient ($r = 0.9158$) and coefficient of determination ($r^2 = 0.8387$). The correlation coefficient indicates the measure of intensity of the association between fecal coliform and *E. coli* and the coefficient of determination expresses the amount of common variation between the two variables. Results show that fecal coliform and *E. coli* have a highly significant relationship in this segment of Rapid Creek (Figure 7). Using the regression equation developed for fecal coliform concentrations to predict *E. coli* concentrations and converting those to loads using USGS daily discharge to determine load was used to expand the *E. coli* data set to calculate geometric mean loading values within the high flow zone. The remaining flow zones had sufficient instantaneous *E. coli* data sets to calculate geometric mean loading values within each zone.

The acute load duration curve for *E. coli* represents the daily maximum load based on flow while the chronic curve represents the 30-day geometric mean value from a minimum of five samples collected in separate 24-hour periods (Figure 8). Geometric means were calculated using all instantaneous daily loads within the moist, mid-range, dry and low flow zones while predicted and instantaneous *E. coli* loading values were used in the high flow zone to determine if the overall chronic *E. coli* standard (95^{th} percentile of the chronic TMDL curve within each flow zone) is being met within each flow zone.

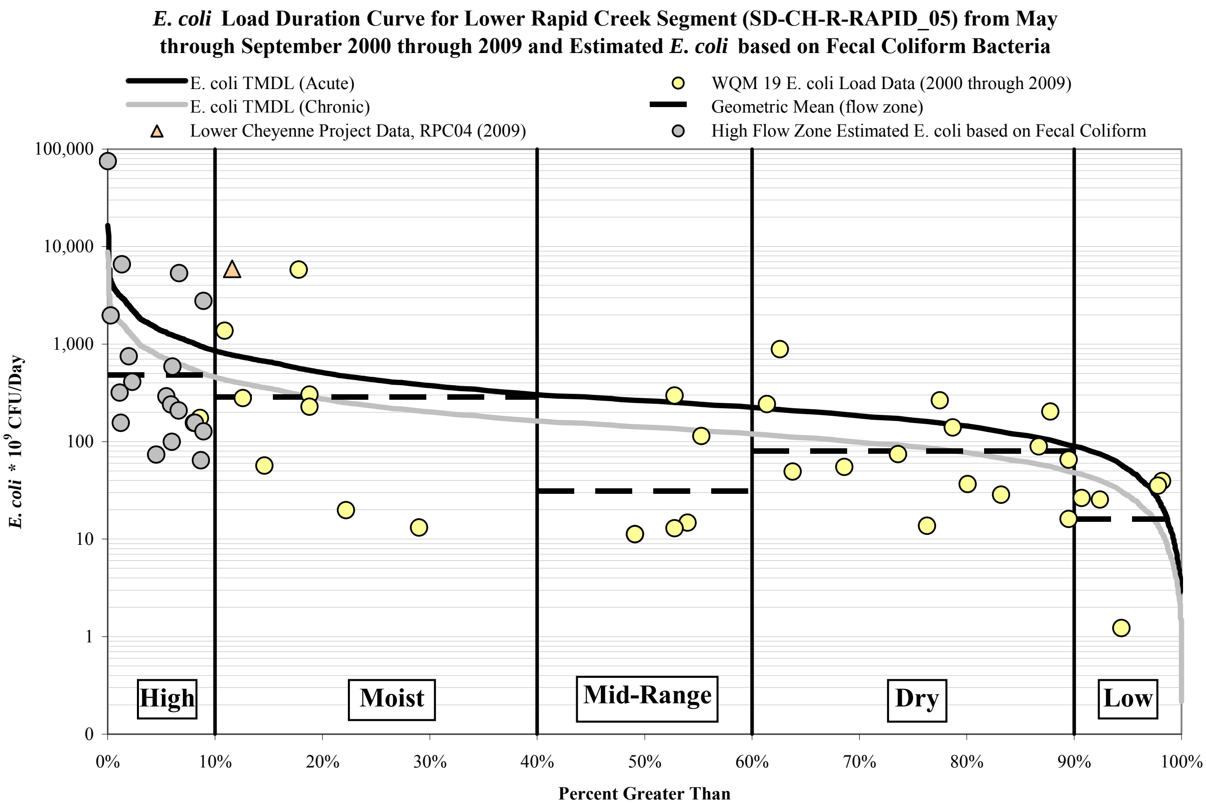

Figure 8 Load duration curve representing allowable daily *E. coli* bacteria loads based on daily maximum acute *E. coli* criteria (≤ 235 CFU/100 mL) and the 30-day geometric mean chronic criteria (≤ 126 CFU/100 mL) during the recreation seasons 1982 to 2009. Recent instantaneous *E. coli* loads were WQM data collected from September 2000 through September 2009 time periods, predicted *E. coli* loads based on fecal coliform bacteria (high flow zone) and the Cheyenne River watershed project (2009) are also displayed.

E. coli bacteria loading exceeded acute water quality standards (> 10 percent) in the high, moist, mid-range, dry and low flow zones (Figure 8 and Table 12). The acute *E. coli* bacteria loading trend based on flow for segment SD-CH-R-RAPID_05, with similar exceedence percentages throughout event and base flows; was not similar to the fecal coliform bacteria trend with higher exceedence percentages occurring during higher flows (Table 11 and Table 12).

Table 12 *E. coli* loading exceedence percentages (September 2000 through September 2009) based on acute standards for Lower Rapid Creek segment SD-CH-R-RAPID_05

Flow Zone	Flow Zone Exceedence Percentage	Flows (cfs)
High*	20.0	149 - 2,860
Moist	33.3	53 -148
Mid-Range	20.0	39 - 52
Dry	28.6	16 - 38
Low	40.0	0.07 -15
Overall	26.4	0.07 – 2,860

*** = High flow zone exceedence percentage calculated using instantaneous and predicted *E. coli* data set.**

Thirty-day average geometric mean chronic values for *E. coli* by flow zone for segment SD-CH-R-RAPID_05 of Rapid Creek were below the chronic water quality standards (grey line) throughout all flow zones base on the 95th percentile of the chronic water quality standard load within each flow zone (Figure 8).

The critical condition for segment SD-CH-R-RAPID_05 appears to be throughout all flow regimes based on acute water quality violation percentages (Table 12). Applying conservative methodologies to TMDL development within segment SD-CH-R-RAPID_05, the beneficial use based TMDL throughout all flow zones will be developed for *E. coli* based on the daily maximum acute criteria of 235 CFU/100 mL because percent reductions required to meet the acute TMDL (Table 21) were greater than the 30-day geometric mean chronic TMDL standard (Table 22).

5.4 Loading Sources

In Section 4.0, significant sources of fecal coliform loading were defined as non-point source pollution originating from livestock. One of the more important concerns regarding non-point sources is variability in stream flows. Variable stream flows often cause different source areas and loading mechanisms to dominate (Cleland, 2003). Because there was long-term hydrologic data available within each impaired segment of Lower Rapid Creek, five flow regimes (i.e., high, moist, mid-range, dry and low) were selected to represent the hydrology of the TMDL watersheds. By relating runoff and loading characteristics based on LDCs for each flow regime, inference can be made as to which sources are most likely to contribute to fecal coliform and *E. coli* bacteria loading within each impaired segment.

5.4.1. Fecal Coliform and *E. coli* Sources

5.4.1.1. Point Sources

Two point sources were identified in the Lower Rapid Creek watershed. One source, stormwater runoff, was identified in segment SD-CH-R-RAPID_03 and was from the City of Rapid City (Permit # SDR41A007). Fecal coliform/*E. coli* potential to pollute were estimated to be high during event conditions (high, moist and mid-range flow zones), moderate during dry flows, and low for the low flow zone (Table 13).

Table 13 Point and non-point sources of pollution and the potential to pollute[1] based on flow and load duration curves for Lower Rapid Creek, Pennington County, South Dakota 2010.

Impaired Segment	Parameter	Source	Flow Regime: High	Moist	Mid-Range	Dry	Low
SD-CH-R-RAPID_03	Fecal Coliform	Point Source					
		Stormwater Runoff	H	H	H	M	L
		Non-Point Source					
		Riparian Area Grazing	M	M	M	M	M
		Manure Application to pastureland/rangeland	H	H	M	L	L
		Wildlife	L	L	L	L	L
SD-CH-R-RAPID_04	Fecal Coliform	Point Source					
		Rapid City WWTP	L	L	L	L	L
		Non-Point Source					
		Riparian Area Grazing	H	H	H	H	H
		Manure Application to pastureland/rangeland	H	H	M	L	L
		Intensive Grazing	H	M	M	L	L
		Wildlife	L	L	L	L	L
SD-CH-R-RAPID_05	Fecal Coliform/*E. coli*	Non-Point Source					
		Riparian Area Grazing	H	H	H	H	H
		Manure Application to pastureland/rangeland	H	H	M	L	L
		Intensive grazing	H	M	M	L	L
		Wildlife	L	L	L	L	L

[1] = Potential to pollute (H – High, M – Moderate and L - Low)

The other point source was the Rapid City WWTP continuous discharge (Permit # SD-0023574). This facility discharges directly into segment SD-CH-R-RAPID_04 of Rapid Creek. Potential to pollute estimates for fecal coliform/*E. coli* were developed using flow and LDCs developed for this segment of Rapid Creek (Figure 5). Potentials were estimated to be uniformly low throughout all flow zones due to the marked reduction in loading observed in the data after improvements (ultra violet light treated effluent) were made at the RC WWTF (Table 13).

5.4.1.2. Non-point Sources

Animals grazing in the riparian area contribute fecal coliform bacteria by depositing manure where it has an immediate impact on water quality. Due to the close proximity of manure to the stream or by direct deposition in the stream, riparian grazing impacts water quality in all flow zones throughout segments SD-CH-R-RAPID_04 and SD-CH-R-RAPID_05 of Lower Rapid Creek watershed (Table 13). The potential fecal coliform/*E. coli* loading impact of riparian grazing were considered high in all flow zones and similar in both segments of Lower Rapid Creek. Restricting livestock from riparian areas will significantly reduce or eliminate the potential of direct manure deposition to the creek.

Manure application to pasture/rangeland in the lower portion of segment SD-CH-R-RAPID_03 and segments SD-CH-R-RAPID_04 and SD-CH-R-RAPID_05 is done to improve alfalfa and grass production. During runoff events (high and moist flow zones), manure spread on pasture/rangeland has a high potential to mobilize, wash off (sheet and rill erosion), and contribute fecal coliform/*E. coli* bacteria load to Lower Rapid Creek (Table 13). Loading potentials in the mid-range flow zone were estimated to be moderate and low potentials in dry and low flow zones in Lower Rapid Creek.

Intensive grazing of livestock in upland areas build-up manure containing fecal coliform/*E. coli* bacteria and, similar to manure application, have the potential to mobilize and wash off upland areas of the watershed. These areas in the watershed are usually away from the impaired waterbody, which increases travel time and decreases the loading potential in the moist and mid-range flow zones compared to manure application. Flow and LDC-based estimates indicate a high potential to impact water quality in the high flow zone, moderate potentials in the moist and mid-range flow zones and low potential in dry and low flow zones (Table 13).

Wildlife fecal coliform/*E. coli* loading potentials in segments SD-CH-R-RAPID_03, SD-CH-R-RAPID_04 and SD-CH-R-RAPID_05 of the Lower Rapid Creek watershed were estimated to be low throughout all flow zones (Table 13). Estimates were based on SD GF&P Wildlife Game Assessment Reports and Bacterial Indicator Tool (BIT) output with estimated wildlife loading potentials for the watershed of 3.4 percent (Table 7).

6.0 Margin of Safety and Seasonality

6.1 Margin of Safety (MOS)

An explicit MOS was identified using statistical analysis and is basically unallocated assimilative capacity intended to account for uncertainty (e.g., loads from tributary streams, effectiveness of controls, etc). Each explicit MOS (fecal coliform and *E. coli*) was calculated as the Inner Quartile Range (IQR) of the assimilative capacity within each of the five flow zones (75th percentile minus the 25th percentile). The IQR method is a viable way to account for natural variability because it excludes the extreme fluctuations in loading based on flow within each flow zone. Because the allocations are a direct function of flow, accounting for potential flow and loading variability is an appropriate way to address the MOS.

6.2 Seasonality

Stream flows in Lower Rapid Creek displayed seasonal variation for the period of record (1960 through 2009). Highest stream flows typically occur during June throughout the watershed based on the May 1st through September 30th recreation season (Table 14). The lowest daily mean stream flows during the recreation season were not similar throughout the Lower Rapid Creek watershed, with the lowest flows in segments SD-CH-R-RAPID_03 and SD-CH-R-RAPID_04 occurring in the summer (August and September, respectively) and spring for segment SD-CH-R-RAPID_05 (Table 14). Fecal coliform bacteria concentrations were not well correlated with stream flow with only segment SD-CH-R-RAPID_05 significantly correlated with flow (r = 0.79). All the other segments (SD-CH-R-RAPID_03 and SD-CH-R-RAPID_04) were not well correlated with flow r = 0.12 and 0.31, respectively. The correlation coefficients for *E. coli* (r = 0.15) for segment SD-CH-R-RAPID_05 were also not significantly correlated with stream flow.

Table 14 Highest and lowest mean daily flow for USGS monitoring sites in Lower Rapid Creek, Pennington County, South Dakota from 1960 through 2009.

		Highest Flows		Lowest Flows		
Segment	**Parameter**	**Month**	**Flow**	**Month**	**Flow**	**Season**
SD-CH-R-RAPID_03*	Fecal	June	1,050	August	10	May through September
SD-CH-R-RAPID_04	Fecal	June	1,270	September	11	May through September
SD-CH-R-RAPID_05	Fecal	June	5,600	May	0.07	May through September

***= Supplemental flows developed from USGS site 06414000 (Rapid Creek at Rapid City)**

Since the criteria for fecal coliform and *E. coli* bacteria concentrations are in effect from May 1 through September 30, the TMDLs developed for these parameters and segments are also applicable only during this time period.

7.0 TMDL

The TMDL can be described by the following equation**:**

TMDL = WLA + LA + MOS, where:

TMDL = loading capacity (LC), or the greatest loading a waterbody can receive without violating water quality standards;
WLA = wasteload allocation, or the portion of the TMDL allocated to existing or future point sources;
LA = load allocation, or the portion of the TMDL allocated to existing or future non-point sources;
MOS = margin of safety, or an accounting of uncertainty about the relationship between pollutant loads and receiving water quality. The margin of safety can be provided implicitly through analytical assumptions or explicitly by reserving a portion of loading capacity.

To ensure that all applicable fecal coliform and *E. coli* criteria are met and aid in the implementation of these TMDLs, load allocations for fecal coliform and *E. coli* were calculated for each of the five flow zones using both the acute (daily maximum) and chronic (geometric mean) criteria using only data collected during the recreation season (May through September). The criterion requiring the greatest load reduction from baseline conditions, which varies by flow zone, was used to establish the TMDL allocations. Methods used to calculate the TMDL allocations are discussed in more detail below.

Flow duration curves were developed for each segment based on USGS stream gages, and defined flow duration intervals were used as a general indicator of hydrologic condition (i.e., wet vs. dry conditions, and to what degree). These intervals (or zones) provide additional insight about conditions and patterns associated with the impairments due to fecal coliform and *E.coli* bacteria concentrations (US EPA, 2007). As depicted in Figure 3, all flow duration curves for Lower Rapid Creek were plotted on one graph and uniformly divided into five zones. These zones represent high flow zones (0-10 percent), moist flow zones (10-40 percent), mid-range flow zones (40-60 percent), dry flow zones (60-90 percent), and low flow zones (90-100 percent). Flow intervals were defined by examining the range of flows for each of the sites based on flow duration curves plotted on Figure 3. A secondary factor in determining flow intervals used in the analysis was the number of fecal coliform or *E. coli* bacteria observations available for each flow interval.

To develop fecal coliform and *E. coli* bacteria load allocations (LAs), the loading capacities (LCs) were first determined. Both the daily maximum (acute) criterion (400 CFU/100ml) and the geometric mean (chronic) criterion (200 CFU/100ml) were used for the fecal coliform calculations of the LCs for segments SD-CH-R-RAPID_03, SD-CH-R-RAPID_04 and SD-CH-R-RAPID_05. For *E. coli*, the daily maximum (acute) criterion (235 CFU/100ml) and the geometric mean (chronic) criterion (126 CFU/100ml) were used for the calculation of the LC for segment SD-CH-R-RAPID_05. LCs for each applicable parameter (fecal coliform and *E. coli* bacteria) and segment (SD-CH-R-RAPID_03, SD-CH-R-RAPID_04, and SD-CH-R-RAPID_05) were produced for Lower Rapid Creek based on the acute and chronic criterion. LCs were calculated by multiplying the acute and chronic fecal coliform and *E. coli* bacteria criteria by segment specific USGS daily average flow measurements. Thus, TMDLs were developed using the LDC approach, resulting in a flow-variable target that considers the entire flow regime within the recreational season (May 1^{st} – September 30^{th}) for fecal coliform and *E. coli*.

For each of the five flow zones, the 95^{th} percentile of the range of LCs within each zone was set as the flow zone goal. Bacterial (fecal coliform and *E.coli*) loads experienced during the largest stream flows (e.g. top 5 percent) can not be feasibly controlled by practical management practices. Thus, setting the flow zone goal at the 95^{th} percentile of the range of LCs will protect the immersion recreation, limited contact recreation beneficial uses and allow for the natural variability of the system.

The TMDL is the sum of WLA, LA, and MOS. Portions of the LC (TMDL) were allocated to non-point sources as a load allocation (LA), point sources as a wasteload allocation (WLA) and a margin of safety (MOS) to account for uncertainty in the calculations of load allocations. The method used to calculate the MOS is described in Section 6.1. The WLAs for segment SD-CH-R-RAPID_03 is stormwater discharge and for segment SD-CH-R-RAPID_04 is discharge from the RC WWTP. The WLA for fecal coliform in segment SD-CH-R-RAPID_03 was calculated by SDSM&T personnel and approved by SD DENR Surface Water Quality Program (SWQP) staff, while the WLA for segment SD-CH-R-RAPID_04 was calculated and assigned by SD

DENR SWQP staff. Segment SD-CH-R-RAPID_05 does not have any permitted facilities (point sources) that discharge fecal coliform or *E. coli* bacteria into the impaired segment of Lower Rapid Creek and were assigned zero values. The overall LAs were determined by subtracting WLA and MOS from the TMDL.

7.1 Fecal Coliform

7.1.1 Segment SD-CH-R-RAPID_03

As discussed previously, the high and low flow zones in segment SD-CH-R-RAPID_03 were expanded from 0-10% to 0-15% and from 90-100% to 85-100%, respectively. Using these modified flow zones increased the number of data points within the high and low flow zones which improved current loading estimates. Modifying the high and low flow zones also adjusted (reduced) the moist and dry flow ranges. TMDLs for each flow zone were calculated based on modified flow ranges which better reflect actual loading estimates and required reductions within each flow zone.

The WLAs in this segment, Canyon Lake to S15, T1N, R8E, is comprised of stormwater runoff from urban and sub-urban areas around Rapid City, SD. WLAs affect acute and chronic fecal coliform loading in segment SD-CH-R-RAPID_03 during storm events from the dry through high flow zones (Table 15 and Table 16). WLA allocations were set by treating all runoff to a depth of 0.5 inches based on the exponential distribution of all rainfall events and treatment to the MEP.

Table 15 Acute fecal coliform TMDL for segment SD-CH-R-RAPID_03 of Lower Rapid Creek, Pennington County, South Dakota 2010

Fecal Coliform TMDL for SD-CH-R-RAPID_03 (Acute)

		Flow Zone				
		High*	**Moist**	**Mid-Range**	**Dry**	**Low***
TMDL Component		**147-5,600 cfs**	**79-146 cfs**	**62-78 cfs**	**41-61 cfs**	**9.2-40 cfs**
WLA	(CFU*10^9/day)	354	354	354	354	0
LA	(CFU*10^9/day)	3,492	752	331	135	303
MOS	(CFU*10^9/day)	1,732	245	78	98	88
TMDL (95th Percentile)	(CFU*10^9/day)	5,578	1,351	763	587	391
Current Load (95th Percentile)	(CFU*10^9/day)	25,332	19,671	5,929	1,201	99
Load Reduction		78%	93%	87%	51%	0%

***= Flow zones were modified to increase the number of data points for analysis, High – zero to fifteen percent and Low – eighty five to one hundred percent.**

Table 15 indicates that the current load based on the acute fecal coliform TMDL exceeded water quality standards in four flow zones (high, moist, mid-range and dry) while the low flow zone meets current water quality standards. To ensure that all applicable water quality standards are met, TMDL goals were set according to the criterion (either acute or chronic) that required the greatest load reduction percentage by flow zone; thus, the TMDL goal for fecal coliform in segment SD-CH-R-RAPID_03 is acute-based for the high, moist, mid-range and dry flow zones (Table 15 and Table 16).

Table 16 Chronic fecal coliform TMDL for segment SD-CH-R-RAPID_03 of Lower Rapid Creek, Pennington County, South Dakota 2010

Fecal Coliform TMDL for SD-CH-R-RAPID_03 (Chronic)

		Flow Zone				
		High*	**Moist**	**Mid-Range**	**Dry**	**Low***
TMDL Component		**147-5,600 cfs**	**79-146 cfs**	**62-78 cfs**	**41-61 cfs**	**9.2-40 cfs**
WLA	(CFU*10^9/day)	177	177	177	177	0
LA	(CFU*10^9/day)	1,746	371	166	68	152
MOS	(CFU*10^9/day)	866	127	39	49	44
TMDL (95th Percentile)	(CFU*10^9/day)	2,789	675	382	294	196
Geometric Mean (Flow Zone)	(CFU*10^9/day)	1,876	1849	1379	555	68
Load Reduction		0%	63%	72%	47%	0%

***= Flow zones were modified to increase the number of data points for analysis, High – zero to fifteen percent and Low – eighty five to one hundred percent.**

The critical condition for segment SD-CH-R-RAPID_03 of the Lower Rapid Creek watershed based on the LDC TMDL is event-based runoff conditions with all water quality violations occurring in the high, moist, mid-range, and dry flow zones. Thus, allocations listed for the high, moist, mid-range, and dry flow zones in Table 15 (using the acute criterion (400 CFU/100 mL)) represent the TMDL goals to attain compliance with all applicable water quality standards for fecal coliform bacteria in segment SD-CH-R-RAPID_03.

7.1.2. Segment SD-CH-R-RAPID_04

WLA in segment SD-CH-R-RAPID_04 of Rapid Creek is from the RC WWTF discharge. The Rapid City plant continuously discharges approximately 10,000,000 gallons of water per day (15 cfs). However, the WLA was calculated using average design flow of the facility representing approximately 15,000,000 gallons of water per day (~23.2 cfs) which affects the hydrology throughout all flow zones in this segment of Lower Rapid Creek because of continuous discharges.

Table 17 Acute fecal coliform TMDL for segment SD-CH-R-RAPID_04 of Lower Rapid Creek, Pennington County, South Dakota 2010

Fecal Coliform TMDL for SD-CH-R-RAPID_04 (Acute)

		Flow Zone				
TMDL Component		High	Moist	Mid-Range	Dry	Low
		235 - 1,270	76 - 233	49 - 75	25 - 48	**24 - 11**
WLA	(CFU*10^9/day)	227	227	227	227	227
LA	(CFU*10^9/day)	4,242	1,232	445	184	47
MOS	(CFU*10^9/day)	1,996	695	127	127	39
TMDL (95th Percentile)	(CFU*10^9/day)	6,465	2,154	799	538	313
Current Load **(95th Percentile)**	(CFU*10^9/day)	122,440	13,766	748	446	175
Load Reduction		95%	84%	0%	0%	0%

Current loading based on the acute fecal coliform TMDL exceeded water quality standards in the high and moist flow zones by 95 percent and 84 percent, respectively; while the mid-range, dry and low flow zones meet water quality standards (Table 17). Fecal coliform loading in the high flow zone also exceeded chronic criteria based on flow zone geometric mean by 56 percent (Table 18). Current loading indicates that mid-range, dry and low flow zones currently meets acute and chronic standards while loading in the moist flow zone also meets the chronic standard (Table 17 and Table 18).

TMDL goals are generally set based on the criterion (either acute or chronic) requiring the highest required load reduction percentage by flow zone; thus, the TMDL goals for fecal coliform in segment SD-CH-R-RAPID_04 is based on the acute criterion (400 CFU/100 mL) in the high and moist flow zones (Table 17). These goals, when met, will attain compliance with all applicable water quality standards for fecal coliform bacteria in segment SD-CH-R-RAPID_04.

Table 18 Chronic fecal coliform TMDL for segment SD-CH-R-RAPID_04 of Lower Rapid Creek, Pennington County, South Dakota 2010

Fecal Coliform TMDL for SD-CH-R-RAPID_04 (Chronic)

TMDL Component		Flow Zone High	Moist	Mid-Range	Dry	Low
		235 - 1,270	76 - 233	49 - 75	25 - 48	**24 - 11**
WLA	(CFU*10^9/day)	114	114	114	114	114
LA	(CFU*10^9/day)	2,121	616	221	91	23
MOS	(CFU*10^9/day)	998	347	64	64	20
TMDL (95th Percentile)	(CFU*10^9/day)	3,233	1,077	399	269	157
Geometric Mean **(Flow Zone)**	(CFU*10^9/day)	7,322	935	241	167	128
Load Reduction		56%	0%	0%	0%	0%

The critical condition for segment SD-CH-R-RAPID_04 of Lower Rapid Creek watershed based on the TMDL is event-based runoff conditions with all the water quality violations occurring in the high and moist flow zones.

7.1.3. Segment SD-CH-R-RAPID_05

Currently there are no point sources (permitted facilities) that discharge into segment SD-CH-R-RAPID_05 of Lower Rapid Creek, thus WLA was set to zero (Table 19 and Table 20).

Current loading exceeded acute fecal coliform quality standards in three flow zones (high, moist and dry flow zones) while the mid-range and low flow zones meet water quality standards (Table 19). Generally, fecal coliform exceedences in the higher flow zones (high and moist) of segment SD-CH-R-RAPID_05 were similar to exceedences observed upstream segment SD-CH-R-RAPID_04. However, the TMDL exceedence in the dry flow zone of segment SD-CH-R-RAPID_05 suggests possible increases in riparian zone use by livestock and wildlife during lower flow conditions (16 to 38 cfs). The riparian zone in segment SD-CH-R-RAPID_05 may be more developed; or water, trees, and vegetation in the riparian zone of segment SD-CH-R-RAPID_05 may be the only available cover in the area, attracting livestock and wildlife to these areas.

Table 19 Acute fecal coliform TMDL for segment SD-CH-R-RAPID_05 of Lower Rapid Creek, Pennington County, South Dakota 2010

Fecal Coliform TMDL for SD-CH-R-RAPID_05 (Acute)

		Flow Zone				
		High	**Moist**	**Mid-Range**	**Dry**	**Low**
TMDL Component		**149-2,860 cfs**	**53-148 cfs**	**39-52 cfs**	**16-38 cfs**	**0.07-15 cfs**
WLA	(CFU*10^9/day)	0	0	0	0	0
LA	(CFU*10^9/day)	4,757	901	421	254	82
MOS	(CFU*10^9/day)	2,187	440	78	108	65
TMDL (95th Percentile)	(CFU*10^9/day)	6,944	1,341	499	362	147
Current Load (95th Percentile)	(CFU*10^9/day)	34,384	5,111	383	494	50
Load Reduction		80%	74%	0%	27%	0%

The geometric mean of instantaneous fecal coliform loading by flow zone in segment SD-CH-R-RAPID_05 only exceeded chronic criteria in the moist flow zone by nine percent (Table 20). The remaining flow zones (high, mid-range, dry and low) currently meet chronic water quality standards for fecal coliform based on flow zone-specific geometric means.

Table 20 Chronic fecal coliform TMDL for segment SD-CH-R-RAPID_05 of Lower Rapid Creek, Pennington County, South Dakota 2010

Fecal Coliform TMDL for SD-CH-R-RAPID_04 (Chronic)

		Flow Zone				
TMDL Component		**High**	**Moist**	**Mid-Range**	**Dry**	**Low**
		149-2,860 cfs	**53-148 cfs**	**39-52 cfs**	**16-38 cfs**	**0.07-15 cfs**
WLA	(CFU*10^9/day)	0	0	0	0	0
LA	(CFU*10^9/day)	2,378	450	211	127	41
MOS	(CFU*10^9/day)	1,094	220	39	54	32
TMDL (95th Percentile)	(CFU*10^9/day)	3,472	670	250	181	73
Geometric Mean **(Flow Zone)**	(CFU*10^9/day)	3,052	737	115	100	28
Load Reduction		0%	9%	0%	0%	0%

Critical conditions for segment SD-CH-R-RAPID_05 of Lower Rapid Creek watershed are event-based runoff conditions with all water quality violations occurring in the high and moist flow zones and during base flow conditions in the dry flow zone.

Based on highest load reduction percentages needed to meet the TMDLs by flow zone, the TMDL goals for fecal coliform in segment SD-CH-R-RAPID_05 are based on acute TMDLs in the high, moist and dry flow zones and are designed to attain compliance with all applicable water quality standards for fecal coliform in segment SD-CH-R-RAPID_05.

7.2. *E. coli* Bacteria

7.2.1. Segment SD-CH-R-RAPID_05

Similar to the fecal coliform TMDL developed for segment SD-CH-R-RAPID_05, no point source dischargers exist for *E. coli* bacteria in segment SD-CH-R-RAPID_05 of Lower Rapid Creek, thus WLA for *E. coli* was set at zero (Table 21 and Table 22).

Table 21 Acute *E. coli* TMDL for segment SD-CH-R-RAPID_05 of Lower Rapid Creek, Pennington County, South Dakota 2010

***Escherichia coli* TMDL for SD-CH-R-RAPID_05 (Acute)**

		Flow Zone				
		High*	Moist	Mid-Range	Dry	Low
TMDL Component		149-2,860 cfs	54-148 cfs	39-53 cfs	16-38 cfs	0.07 -15 cfs
WLA	(CFU * 10^9/Day)	0	0	0	0	0
LA	(CFU * 10^9/Day)	2,795	529	247	150	48
MOS	(CFU * 10^9/Day)	1,285	259	46	63	38
TMDL (95th Percentile)	(CFU * 10^9/Day)	4,080	788	293	213	86
Current Load (95th Percentile)	(CFU * 10^9/Day)	10,006	5,878	251	482	39
Load Reduction		59%	87%	0%	56%	0%

* = Current load calculated using one recent and nineteen predicted loads

Since *E. coli* bacteria has only been collected in this segment since September of 2000, the high flow zone had only one instantaneous loading data point to determine exceedence or compliance with acute and/or chromic TMDLs developed for this flow zone. To increase the data set size, predicted *E. coli* loading data based on the fecal coliform/*E.coli* relationship expressed through the regression equation in Figure 7 were included in the high flow zone and used for analysis. Using this data for the high flow zone and recent *E. coli* loading data for the remaining flow zones, the 95th percentile was then calculated and used to estimate the required load reductions by flow zone for both the acute and chronic criteria (Table 21 and Table 22).

Based on recent *E. coli* and predicted loading data, acute criteria for the high, moist and dry flow zones exceeded TMDL standards (Table 21). Flow zones that exceed TMDLs in segment SD-CH-R-RAPID_05 for *E. coli* are the same as those developed for fecal coliform, indicating consistent bacteria sources (Table 21 and Table 19). As with fecal coliform loading in segment SD-CH-R-RAPID_05, TMDL exceedence in the dry flow zone suggest increased livestock and wildlife usage in the riparian zone along this segment of Rapid Creek during dry flows (16 to 38 cfs).

Geometric mean loading within each flow zone currently meets TMDLs based on the chronic criteria for *E. coli* developed for each flow zone in segment SD-CH-R-RAPID_05 (Table 22).

Table 22 Chronic *E. coli* TMDL for segment SD-CH-R-RAPID_05 of Lower Rapid Creek, Pennington County, South Dakota 2010

***Escherichia coli* TMDL for SD-CH-R-RAPID_05 (Chronic)**

		Flow Zone				
		High*	Moist	Mid-Range	Dry	Low
TMDL Component		149-2,860 cfs	54-148 cfs	39-53 cfs	16-38 cfs	0.07 -15 cfs
WLA	(CFU * 10^9/Day)	0	0	0	0	0
LA	(CFU * 10^9/Day)	1,498	283	132	80	26
MOS	(CFU * 10^9/Day)	689	139	25	34	20
TMDL (95th Percentile)	(CFU * 10^9/Day)	2,187	422	157	114	46
Geometric Mean (Flow Zone)		482	197	31	80	16
Load Reduction		0%	0%	0%	0%	0%

* = Geometric mean using one recent and nineteen predicted loads

Critical conditions for segment SD-CH-R-RAPID_05 of the Lower Rapid Creek watershed based on the *E. coli* TMDL are event-based runoff conditions with all water quality violations occurring in the high and moist flow zones and in base flow conditions in the dry flow zone.

Based on highest load reduction percentages needed to meet the TMDLs by flow zone, the TMDL goal for *E. coli* in segment SD-CH-R-RAPID_05 is based solely on acute criteria (235 CFU/100 mL) for the high, moist, and dry flow zones (Table 21) and, when met, will attain compliance with all applicable water quality standards for *E. coli* in this segment of Rapid Creek.

8.0 Allocations and Recommendations

8.1 Wasteload Allocations (WLAs)

8.1.1. Fecal Coliform

Fecal coliform bacteria is the only 303(d) listed parameter for segments SD-CH-R-RAPID_03 and SD-CH-R-RAPID_04 and each segment has one permitted facility discharging to Rapid Creek. Fecal coliform is also one of the listed parameters on the 303(d) list impairing segment SD-CH-R-RAPID_05 of Rapid Creek. Wasteload allocations for fecal coliform are discussed below.

8.1.1.1. Segment SD-CH-R-RAPID_03

The City of Rapid City (population ~ 67,000) impacts Rapid Creek via stormwater runoff that contributes fecal coliform bacteria loading. Rapid City has an approved MS4 stormwater permit (Permit # SDR41A007) which was issued in 2003 by SD DENR. The WLA for Rapid City was set at 354 * 10^9 CFU/day and was set by treating all stormwater runoff to a depth of 0.5 inches based on the exponential distribution of all rainfall events and treatment to the Maximum Extent Practicable (MEP). Based on these calculations Best Management Practices (BMPs) would treat 85 percent of all runoff occurring in Rapid City. Thirty-four percent of the landuse in segment SD-CH-R-RAPID_03 is urban, but urban areas contribute the majority of the fecal coliform bacteria load (89.8 percent) to this segment via stormwater runoff. Rapid City WLA for stormwater comprised 6.3 percent of the loading capacity (TMDL) in the high flow zone and requires an 81.2 percent reduction to meet water quality standards in Rapid Creek. High flow loadings in this segment are caused by urban stormwater runoff from impervious areas. To achieve this load reduction, a performance standard based on MEP is recommended. Stormwater BMPs should be designed to treat all runoff from rainfall events up to 0.5 inches. Treatment will occur for larger events but removal efficiencies will be reduced. Initially, BMPs should be implemented to control stormwater runoff from existing highly impervious areas, namely commercial land use areas. The TMDL analysis reflects current conditions, thus it will be important to develop and implement stormwater quality control measures for future development. There are various types of stormwater BMPs. Applicability of BMPs for stormwater quality control will depend on various characteristics of the watershed. Several references are available to identify feasible BMPs (Water Environment Federation, 1998; Craft, 1997; and American Society of Civil Engineers, 2001).

8.1.1.2. Segment SD-CH-R-RAPID_04

Rapid City has a wastewater treatment facility (RC WWTF) that discharges into Rapid Creek. Rapid City was issued a discharge permit in 2001 by SD DENR (Permit # SD-0023574). As part of their permit, fecal coliform bacteria are routinely sampled three times per week from May 1st through September 30th each year. The WLA was calculated using average design flow of 15 MGD (~23.2 cfs) for a WLA based on the acute standard (400 CFU/100 mL) of $227 * 10^9$ CFU/day and $114 * 10^9$ CFU/day based on the chronic standard (200 CFU/100 mL). These WLAs were calculated by SD DENR SWQP. Water quality and discharge data provided by RC WWTF show that discharge from the Rapid City wastewater treatment facility meets their National Pollution Discharge Elimination System (NPDES) permit limits issued by the State of South Dakota and the treatment plant continues to upgrade their facility to improve water quality in Rapid Creek.

8.1.1.3. Segment SD-CH-R-RAPID_05

No permitted facilities (point sources) exist in segment SD-CH-R-RAPID_05 of Rapid Creek, consequently, the WLA for fecal coliform bacteria in this segment was set to zero.

8.1.2. *E. coli* Bacteria

Segments SD-CH-R-RAPID_03 and SD-CH-R-RAPID_04 of Lower Rapid Creek are not listed as impaired for *E. coli* bacteria in the 2010 Impaired Waters List. However, segment SD-CH-R-RAPID_05 of Lower Rapid Creek was listed in the 2010 303(d) list as impaired for *E. coli* bacteria. Wasteload allocations for *E. coli* are discussed below.

8.1.2.1. Segment SD-CH-R-RAPID_05

There are no point source dischargers in this segment of the Rapid Creek watershed. Therefore, the WLA for *E. coli* was considered a zero value. The TMDL is considered wholly included within the “load allocation” component of the equation.

8.2 Load Allocation (LA)

8.2.1. Fecal Coliform Bacteria

Fecal coliform load allocations for segments SD-CH-R-RAPID_03, SD-CH-R-RAPID_04, and SD-CH-R-RAPID_05 for Lower Rapid Creek are discussed below.

8.2.1.1. Segment SD-CH-R-RAPID_03

All excess load allocations in segment SD-CH-R-RAPID_03 originate within segment SD-CH-R-RAPID_03 based on discharge data collected at USGS monitoring site 06412500 above Canyon Lake, near Rapid City and water quality monitoring data collected at SD DENR 460669, WQM 69. The fecal coliform LDC for segment SD-CH-R-RAPID_02 shows no water quality violations of the acute or chronic standards throughout the entire flow regime (Figure 9). Based on this, all fecal coliform loads from segment SD-CH-R-RAPID_02 have little impact on loading in Segment SD-CH-R-RAPID_03 where fecal coliform loads increase significantly via urban runoff.

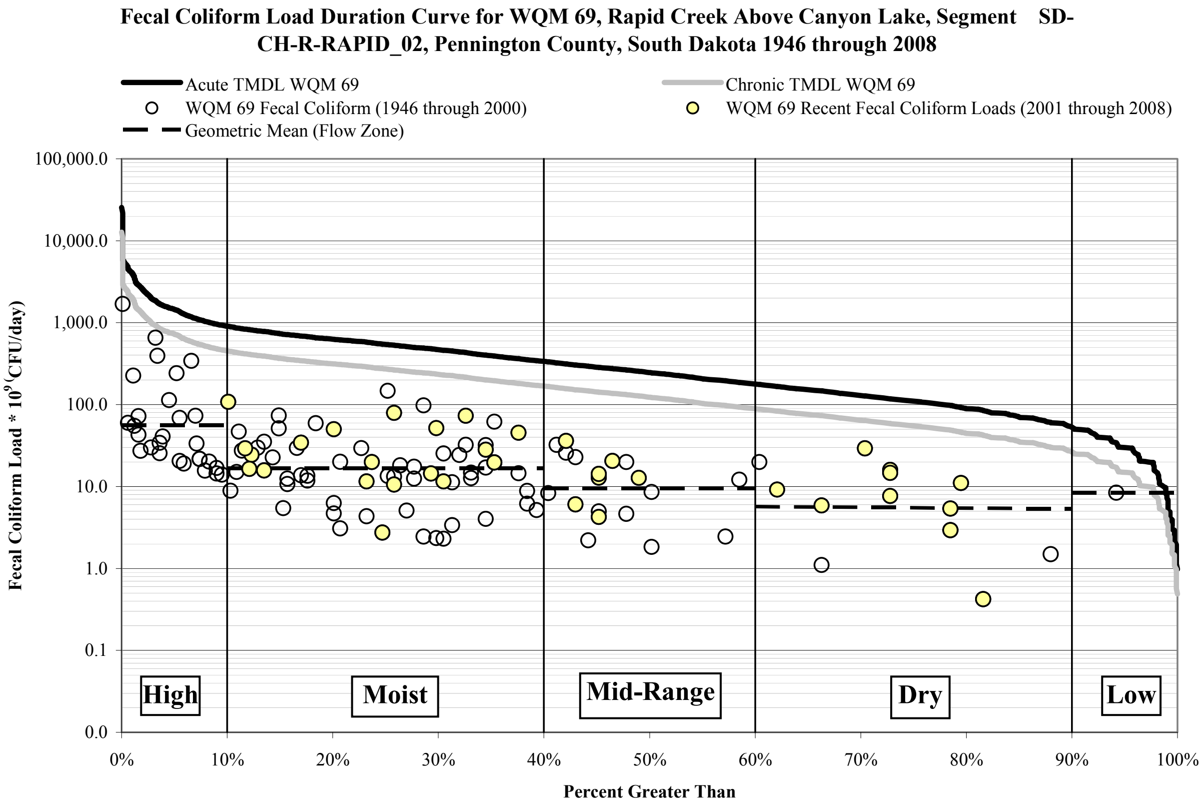

Figure 9 Fecal coliform load duration curves for segment: SD-CH-R-RAPID_02 representing allowable daily fecal coliform loads based daily maximum (acute) fecal coliform criterion (≤ 400 CFU/100 mL) and the 30-day geometric mean (chronic) fecal coliform criterion (≤ 200 CFU/100 mL) during the recreation seasons 1946 through 2008. Instantaneous fecal coliform loads collected from 1975 through 2008 during the recreation season are also displayed.

Fecal coliform results tend to indicate a steady increase in the coliform concentrations from late spring to midsummer during base flow conditions. These high concentrations are due to a combination of landuse practices and lower stream flows. Possible sources of fecal coliform loading during base flow conditions in this segment include wildlife, domestic animals, septic systems and potential leaking sewers. A major BMP recommended for this segment during base flows is to identify and repair failing septic systems and leaking sewers. Exceedence of fecal coliform criteria also occurred during event sampling and shows a different system response than during non-event sampling. Additionally, high concentrations of fecal coliform occur due to runoff from urban and suburban landuse areas during rainfall events. Initial fecal coliform management issues are landuse practices along the stream during this time period. The majority of the load occurs during high-flow/event conditions.

Landuse below the HAW monitoring site gradually transitions from urban to agricultural cropland, pastureland, rangeland, with some rural development and increasing numbers of septic systems. Load allocation sources based on production potentials by landuse type comprised livestock and manure management on agricultural and pastureland/rangeland. BMPs to address these sources should include riparian zone management, increasing the size and supplementing structure of the riparian zone, and significantly reducing the prolonged livestock access to riparian zones through exclusion and off-stream watering. Based on LDC TMDL analysis, current LAs will need to be reduced by approximately 78 percent to meet the TMDL developed for this segment of Rapid Creek in the high flow zone.

8.2.1.2. Segment SD-CH-R-RAPID_04

Load allocations will require a significant load reduction in the high and moist flow zones. Based on recent data, the TMDL specifies a 95 percent reduction in the fecal coliform loading in the high flow zone and 84 percent in the moist flow zone with the remaining flow zones meeting TMDL standards based on the acute criteria. Most of the landuse in this segment is agricultural (mostly pastureland/rangeland and cropland) which make up approximately 92 percent of the landuse. Possible sources of excess fecal coliform loading during high flow conditions in this segment include riparian area grazing by livestock, manure application to pastureland/rangeland and cropland, intensive grazing and over-wintering livestock in the riparian zone. BMPs recommended for this segment consist of riparian zone management of livestock limiting access to the stream. This can be provided through grazing management, exclusionary fencing, off-stream watering practices, and instillation of livestock stream crossing structures.

Another primary source of increased fecal coliform loading in this segment of Rapid Creek is failing septic systems. Based on public input and information from local agencies, the largest numbers of suspected failing septic systems exist in this segment and are presumed to be located above the WQM monitoring site below the RC WWTF. A program to inspect, identify and repair failing systems should be implemented in this watershed. Septic systems by definition are considered non-point source load and thus are wholly part of the load allocation portion of the TMDL. An estimated 27 percent reduction from failing septic systems is necessary to achieve the overall load reduction needed to help meet the TMDL set for this segment of Rapid Creek.

A portion of the LA in this segment is from fecal coliform loading upstream of Reservoir Road with an estimated 40 percent of the fecal coliform load originating in segment SD-CH-R-RAPID_03 during lower flow conditions. A plan to develop and implement BMPs to control fecal coliform loading from developed and undeveloped areas in segment SD-CH-R-RAPID_03 should significantly improve/reduce loading in segment SD-CH-R-RAPID_04 and is recommended. BMPs recommended for low flow conditions will also apply to high-flow/event conditions.

8.2.1.3. Segment SD-CH-R-RAPID_05

Landuse in segment SD-CH-R-RAPID_05 is similar to segment SD-CH-R-RAPID_04 in that most of the landuse is agricultural (pastureland/rangeland) and comprises 98 percent of all landuse. TMDL specifies an 80 percent reduction in fecal coliform loading for the high flow zone and a 74 percent load reduction in the moist flow zone. Sources of excess fecal coliform loading during high flow conditions in this segment are similar to segment SD-CH-R-RAPID_04 and include runoff from riparian area grazing, manure application to pastureland/rangeland, wintering livestock in and around the riparian zone, and intensive grazing practices. It is assumed that a significant portion of the local load reductions necessary to meet water quality standards in segment SD-CH-R-RAPID_05 will be achieved through BMP reductions in fecal coliform realized in upstream segment SD-CH-R-RAPID_04.

Unlike segment SD-CH-R-RAPID_04, reductions in LAs are required (27 percent) within the dry flow zone. Excess loading sources in the dry flow zone may be from increased wildlife and livestock use in and around the stream during the recreation season. This may be due to the increased amount of riparian wetland vegetation along this segment of Rapid Creek (segment SD-CH-R-RAPID_05) compared to segment SD-CH-R-RAPID_04. BMPs for the lower flow zones consist of riparian zone management of livestock access to the stream is recommended for this segment. This can be provided through grazing management, exclusionary fencing, off-stream watering practices, and instillation of livestock stream crossing structures.

A significant uncertainty for this segment is the persistence of fecal coliform in the stream and bank sediments. From October through April, fecal coliform discharges from the RC WWTF are significant. If fecal coliform can survive in various microhabitats within stream sediment, they are subject to re-suspension during high-flow/event conditions in spring and early summer. As part of an implementation plan, it would be beneficial to supply funds to investigate the survival, longevity and decay rate of pathogens in the sediments of Rapid Creek over extended periods of time.

8.2.2. *E. coli* Bacteria

8.2.2.1. Segment SD-CH-R-RAPID_05

Flow zones requiring reductions to meet flow zone-specific *E. coli* bacteria TMDLs were identical to flow zones based on fecal coliform bacteria for this stream segment (SD-CH-R-RAPID_05). *E. coli* loads in the high flow zone were estimated using regression analysis between *E. coli* and fecal coliform bacteria and applying the regression equation to fecal coliform concentrations in the high flow zone to predict *E. coli* concentrations and ultimately loading in the high flow zone.

Load allocation sources and flow zones requiring reductions for *E. coli* bacteria for segment SD-CH-R-RAPID_05 are identical to those identified for fecal coliform bacteria in segment SD-CH-R-RAPID_05. Thus, all identified sources, reductions and BMPs outlined for fecal coliform in segment SD-CH-R-RAPID_05 and realized reductions from segment SD-CH-R-RAPID_04 apply to the *E. coli* bacteria impairment of segment SD-CH-R-RAPID_05.

9.0 Public Participation

Six public meetings have been held. The first meeting, held February 15, 2001 at Pennington County 4H building (Rapid City), had a limited attendance (9) primarily due to bad weather conditions. The second meeting, held March 29, 2001 in the basement of the Caputa Community Center, was well attended (28) with good representation from the Lower Rapid Creek ranchers. The third meeting was held April 19, 2001 again at the Pennington County 4H building and had

8 in attendance. Two key issues that seem to reflect the meetings were the control of flows on Rapid Creek through the operation of Pactola Reservoir and the impacts of Rapid City on both the quality and quantity (both urban runoff and the Rapid City Waste Water Treatment Facility discharge). Several additional presentations have been given to present results of the study, March 29, 2001 in the basement of the Caputa Community Center, May 2001 to a work group session of the City of Rapid City Council, to the Pennington County Commission meeting May 2001 and most recently to a meeting of stake holders (City of Rapid City, Pennington Conservation District, Pennington County, SD DENR, Natural Resources Conservation Service) was held November 8, 2004. Several technical presentations have also been given to various groups including South Dakota Engineering Society, Agricultural Resource Services, SD Society of Environmental Professionals and Black Hills Hydrology Conference with special emphasis on septic tank issues.

A significant component of this project has been collaboration with several agencies including the South Dakota GFP, Pennington County Conservation District, Natural Resource Conservation Service, Rapid Valley Water District, City of Rapid City, and Pennington County Commission. The SD GFP conducted an extensive monitoring program over the period April 2001-November 2001 and April 2002-November 2002. The focus of this work was on monitoring stormwater runoff events from the sub-urban segment through Rapid City.

From 2004 through 2006, the City of Rapid City and Pennington County held numerous public meetings to develop an On-Site Wastewater Disposal and Treatment Ordinance. In March 2006 the City of Rapid City approved Ordinance NO. 4083 and added to Rapid City Municipal Code § 13.09. This Ordinance allows the City of Rapid City to regulate and inspect on-site wastewater systems in City limits and also within a one-mile buffer surrounding the corporate limits. Inspections in the aforementioned areas started in 2007. An additional (>30) public and committee meetings (public informational, clean water committee, planning commission, and county commission meetings) were held by the County to further develop the Pennington County On-Site Wastewater Treatment Ordinance. County ordinance 34-08 was approved and adopted in July 2010. The basis for these ordinances were partially due to the results from the Rapid Creek Fecal Coliform/*E. coli* Report and TMDL and Rapid Creek being listed on the 303(d) list as impaired for fecal coliform and *E. coli*. Assessment and TMDL data were used to emphasize the need for these ordinances as adaptive and proactive BMP measures to help reduce point and non-point source bacterial loading to Rapid Creek.

In 2007, the original document was revised to include updated SD DENR WQM data sets and re-formatted for informal submittal to US EPA for review. The report and TMDL was submitted to US EPA in January 2008 with comments received in February 2008. After reviewing US EPA responses, SD DENR pulled the document from the submittal process due to significant alterations required to restructure the document to conform to US EPA comments and updated submittal requirements. The current document was significantly updated and modified in 2008 and 2009 and incorporates all US EPA informal comments originally received in 2008.

Meetings in 2010 with South Dakota School of Mines and Technology (SDSM&T) and the City of Rapid City on WLAs assigned to Rapid City in segment SD-CH-R-RAPID_03 of the Rapid Creek TMDL have resulted in SDSM&T entering into an agreement (contracts) with the City of Rapid City to study and model three urban watersheds within Rapid City to determine fecal coliform and *E. coli* loading to Rapid Creek with varying degrees of urbanized development and runoff. Data will be used help assess the impact stormwater and development has on bacterial loading in Rapid Creek and the MS4 permit over the next five years.

All comments and public input from meetings, written, or personal communications regarding the Rapid Creek report and TMDL results including current US EPA comments were addressed and incorporated in the current document. Specific responses to US EPA specific comments are attached in Appendix C.

In 2009, Rapid Creek TMDL data, sampling and analysis methodologies, and results were presented and discussed at multiple meetings with interested parties (SD DENR, Hill City, SDSM&; Pennington County, US Forest Service, RESPEC Consulting Services, City of Rapid City and interested stakeholders) during design and development of the Spring Creek Implementation Project.

10.0 Monitoring Strategy

During and after the implementation of management practices, monitoring will be necessary to assure attainment of the TMDL. Stream water quality monitoring will be accomplished through SD DENR's ambient water quality monitoring stations on Rapid Creek existing and future WQM monitoring sites sampled on a monthly basis. SD DENR is in the process of adding a monthly ambient WQM site and installing a permanent stage recorder at the Hawthorn monitoring site in Rapid City to monitor water quality and stream flows in the recently modified segment SD-CH-R-RAPID_03 in Rapid Creek. During the recreation season increased bacterial monitoring should be increased to sample collect at least 5 samples per month to monitor the geometric mean criterion. Additional monitoring and evaluation efforts should be targeted toward designed urban and rural BMPs to document the effectiveness of implemented BMPs. Monitoring locations should be based on the location and type of BMPs installed.

SD DENR may adjust the load and/or wasteload allocations in this TMDL to account for new information or circumstances that develop during the implementation phase of the TMDL. New information generated during TMDL implementation may include monitoring data, BMP effectiveness information and land use information. SD DENR will propose adjustments only in the event that any adjusted LA or WLA will not result in a change to the loading capacity; the adjusted TMDL, including its WLAs and LAs, will be set at a level necessary to implement the applicable water quality standards; and any adjusted WLA will be supported by a demonstration that load allocations are practicable. SD DENR will notify EPA of any adjustments to this TMDL within 30 days of their adoption. Adjustment of the load and waste load allocation will only be made following an opportunity for public participation.

11.0 Reasonable Assurance

Reasonable assurance means a demonstration that the wasteload and load allocations will be realized through regulatory or voluntary actions. Rapid Creek segments SD-CH-R-RAPID_03 and SD-CH-R-RAPID_04 are impaired by both point and non-point sources and that these TMDLs have been developed for wasteload allocations may reflect anticipated or expected reductions of pathogen indicators from other sources if those anticipated or expected reductions are supported by a reasonable assurance that they will occur (CFR 40-130.2g).

Reasonable assurance of the TMDL established for segment SD-CH-R-RAPID_03 and SD-CH-R-RAPID_04 in Lower Rapid Creek will require a comprehensive approach that addresses:

- regulated stormwater and wastewater discharges under MS4 and NPDES permits
- non-point source pollution outside MS4 area
- existing and potential future sources
- regulatory and voluntary approaches

There is reasonable assurance that the goals of these TMDLs established for Lower Rapid Creek can be met with proper planning between state and local regulatory agencies, organizations and stakeholders, BMP implementation, and access to adequate financial resources.

The TMDL wasteload allocation (WLA) for segment SD-CH-R-RAPID_03 is from the Rapid City stormwater discharge that is regulated through the Rapid City MS4 permit; while the WLA for segment SD-CH-R-RAPID_04 is from the Rapid City WWTP which is regulated by the Rapid City NPDES permit.

Point Sources

Rapid City has adopted City Ordinance NO. 5355, 5356 and 5357 dealing with stormwater runoff and has installed two stormwater detention/infiltration ponds along Rapid Creek to control TSS and bacteria concentrations in segment SD-CH-R-RAPID_03. The Rapid City WWTP located in segment SD-CH-R-RAPID_04 continues to operate in compliance with their NPDES permit and has been upgrading their treatment system with new technology to improve plant efficiencies and water quality in Lower Rapid Creek.

Stormwater MS4

- Construct additional stormwater ponds along Rapid Creek
- Construct stormwater wetlands near stormwater outfalls
- Construct linear wetlands along drainage basins
- Continue stormwater monitoring and modeling
- Continue pet clean-up/education: Education programs for pet owners can improve water quality of runoff from urban areas.

Rapid City WWTP

- Continue scheduled sewer repair
- Continue upgrading treatment system as new technologies become available
- Extend ultra-violet effluent treatment from the recreation season (May through September) to year round to help reduce fecal coliform/*E. coli* concentrations in Rapid Creek which may decrease or control possible sediment source bacterial re-suspension during higher event flows.

Previous and continued commitment and support from local governments (City of Rapid City) to permit compliance, facility improvement, and improving water quality provide a reasonable assurance that future efforts in point source reduction and control will continue towards achieving TMDL targets and improved water quality in Lower Rapid Creek watershed.

Non-point Source
The City of Rapid City and Pennington County have adopted On-Site Wastewater Treatment Ordinances regulating septic systems within Rapid City and Pennington County, Ordinance NO. 4083 and 34-08, respectively. These ordinances require periodic inspections of on-site treatment systems throughout the Lower Rapid Creek watershed and if deficiencies are found require timely mitigation. When fully implemented, these ordinances should reduce fecal coliform and *E. coli* concentrations in segments SD-CH-R-RAPID_03, SD-CH-R-RAPID_04, and SD-CH-R-RAPID_05 of Lower Rapid Creek.

There are many active watershed groups that provide watershed stewardship and have vested interest in the Lower Rapid Creek watershed. These include the City of Rapid City, Rapid Valley Water District, Pennington County, South Dakota GFP, Pennington County Conservation District, Natural Resource Conservation Service, Black Hills Fly Fishers, Cheyenne River Watershed Partnership, South Dakota School of Mines and Technology, and the United States Geological Survey. These groups have supported the Lower Rapid Creek Assessment Project with comments, technical and/or financial support and are eager to plan and support an upcoming implementation project.

The City of Rapid City and Pennington County are committed to reducing non-point source bacterial concentrations in Lower Rapid Creek by enacting on-site wastewater treatment ordinances requiring inspections and mitigation. The past and present support from local governments and the substantial number of active watershed groups that support an implementation project in Lower Rapid Creek provides reasonable assurance that future efforts in non-point source reductions achieving TMDL targets and improved water quality in Lower Rapid Creek watershed.

Reasonable assurance for non-point sources by segment in Lower Rapid Creek will be accomplished through methods and projects outlined in Section 12.0 Restoration Strategy but are not exhaustive.

12.0 Restoration Strategy

Implementation of BMPs is required to achieve the recommended TMDLs for Lower Rapid Creek. The study area is represented by three segments 1) Canyon Lake downstream to Rapid Creek at S15 T1N R8E (SD-CH-R-RAPID_03), 2) S15 T1N R8E downstream to Rapid Creek above Farmingdale (SD-CH-R-RAPID_04), and 3) above Farmingdale to the confluence with Cheyenne River (SD-CH-R-RAPID_05).

The recommended priority for implementation of BMPs is segment SD-CH-R-RAPID_03, segment SD-CH-R-RAPID_04 and segment SD-CH-R-RAPID_05, respectively. Segments SD-CH-R-RAPID_03 and SD-CH-R-RAPID_04 are clearly higher priority than segment SD-CH-R-RAPID_05 above Farmingdale. However, the priority difference between segment SD-CH-R-RAPID_03 and SD-CH-R-RAPID_04 is not significant. Priority ranking was based on the overall percent exceedence reductions required within each segment.

The critical area within segment SD-CH-R-RAPID_03 is treatment of stormwater runoff from the highly impervious commercial area of Rapid City, representing segment SD-CH-R-RAPID_03. BMPs that reduce fecal coliform/*E. coli* loads and control stormwater runoff should include but are not limited to:

- continue development and implementation of a stormwater management program with BMPs designed to treat runoff from rainfall events up to 0.5 inch, however, as part of the stormwater permit modifications and implementation plan consider looking at BMPs that will treat reduce runoff in addition to just targeting treatment designs.
- implementation of low impact development techniques, especially for future development,
- continued implementation of the septic system inspection program within one-mile of Rapid City limits to document the condition of existing septic tank systems, identify failing systems and develop a mechanism/program to repair or replace failing systems, and,
- phase in inspections for on-site wastewater treatment systems within Pennington County as per county ordinance # 34-08 adopted 2010, especially along the riparian zones of Rapid Creek.

Within segment SD-CH-R-RAPID_04, BMPs that reduce fecal coliform/*E. coli* loads should include but are not limited to:

- relocation or implementation of stormwater runoff treatment systems from critical concentrated livestock feeding areas adjacent to Rapid Creek,
- implement management practices to improve and protect the riparian buffer zone through grazing management practices with off-stream watering and residential zoning,
- continued implementation of the septic system inspection program within one-mile of Rapid City limits to document the condition of existing septic tank systems, identify failing systems and develop a mechanism/program to repair or replace failing systems
- investigate the survival, longevity and decay rate of pathogens in the sediments of Rapid Creek over extended periods of time.

For segment SD-CH-R-RAPID_05, a significant reduction in fecal coliform/*E. coli* will take place with implementation of BMPs upstream and should include but are not limited to:

- implement management practices to improve and protect the riparian buffer zone through grazing management practices with off-stream watering and vegetation development,
- riparian and stream bank erosion control measures, and
- development of cattle crossing areas for reduced stream access and erosion.

When designing an implementation project for Rapid Creek monies should be made available to do a comprehensive watershed model for bacteria and Total Suspended Solids covering the entire Rapid Creek watershed. The City of Rapid City may want to fund as part of the implementation project, a SWMM model for Rapid City.

A water quality monitoring program should be continued with the primary monitoring sites being BSTP and FARM. One additional long-term WQM site (HAW) will be initiated and come on line in 2010 and should be sampled monthly. This monitoring program should require a representative sampling of events due to stormwater runoff. Fecal coliform/*E. coli* must be significantly reduced in segments SD-CH-R-RAPID_03 and SD-CH-R-RAPID_04. Several pollutant sources were identified. Ribotyping of samples would help to refine prioritization, selection and implementation of BMPs.

Sufficient sample data to evaluate the geometric mean criterion were unavailable. Increased fecal coliform and *E. coli* bacteria sampling during the recreation season should be initiated to attain more than five bacterial samples per site per month to monitor attainment of the chronic (geometric mean) standard.

The Rapid City WWTF NPDES permit allows discharge of high concentrations of fecal coliform from October through April. There is limited knowledge on the survival of fecal coliform bacteria and associated pathogens in the stream and bank sediments. With survival, these pathogens are subject to re-suspension with high flows or other channel disturbances in spring and summer. As part of an implementation plan, it would be beneficial to supply funds to investigate the survival, longevity and decay rate of pathogens in the sediments of Rapid Creek over extended periods of time.

The Lower Cheyenne River Watershed Assessment Project nearing completion and broad support to begin an implementation project is evident. Rapid Creek is part of the Cheyenne River watershed and could be included in a larger, basin-wide implementation project. Major entities that should be involved in planning, funding and supporting this project as it pertains to Rapid Creek are the West Dakota Water Development District, Pennington County, Pennington County Conservation District, the City of Rapid City, Cheyenne River Partnership and the Natural Resource Conservation Service. In 2010, the Pennington County Conservation District has expressed interest in sponsoring a Lower Rapid Creek Implementation Project.

The TMDL to allocate a single WLA to all MS4 stormwater sources, without understanding which outfalls or landuse types (e.g., residential, commercial, industrial) contribute larger loads, will present additional challenges during implementation when prioritizing implementation resources. The following web sites and documents are by no means the only resources available, but may provide a beginning point for implementation design:

http://www.epa.gov/owow/tmdl/pdf/tmdl-sw_permits11172008.pdf
http://www.epa.gov/owow/nps/lid/
http://www.epa.gov/ne/npdes/stormwater/assets/pdfs/IncorporatingLID.pdf
http://www.lowimpactdevelopment.org/

Funds to implement watershed water quality improvements can be obtained through the SD DENR. SD DENR administers three major funding programs that provide low interest loans and grants for projects that protect and improve water quality in South Dakota. They include: Consolidated Water Facilities Construction program, Clean Water State Revolving Fund (SRF) program, and the Section 319 Non-point Source Program.

13.0 Literature Cited

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APPENDIX A: Bacteria Sample Data

Fecal Coliform Data from Hawthorn (HAW) monitoring site

Date	Agency	Flows (cfs)	Fecal Coliform (colonies/100 mL)
09/01/1999	SDSM&T	175	200
05/09/2000	SDSM&T	159	16
06/28/2000	SDSM&T	110	120
08/03/2000	SDSM&T	77	1,600
08/11/2000	SDSM&T	300	510
08/31/2000	SDSM&T	60	290
06/25/2001	SDGF&P	69	330
07/26/2001	SDGF&P	81	330
09/05/2001	SDGF&P	44	290
09/28/2001	SDGF&P	25	170
05/22/2002	SDGF&P	84	30
07/18/2002	SDGF&P	77	180
08/28/2002	SDGF&P	61	860
09/25/2002	SDGF&P	38	50
08/21/2002	SDGF&P	90	2,000
07/08/2002	SDGF&P	155	20,000
08/22/2001	SDGF&P	102	23,000
06/25/2001	SDGF&P	75	330
06/30/2001	SDGF&P	169	1,800
07/30/2001	SDGF&P	108	20,000
09/18/2002	SDGF&P	93	5,800

Fecal Coliform Data from WQM 92 below treatment facility

Date	Agency	Flows (cfs)	Fecal Coliform (colonies/100 mL)
05/06/1982	SD DENR	33	300
06/16/1982	SD DENR	76	955
05/18/1983	SD DENR	231	100
06/09/1983	SD DENR	52	360
07/13/1983	SD DENR	30	196
08/04/1983	SD DENR	26	2,370
09/08/1983	SD DENR	30	2,650
05/10/1984	SD DENR	199	100
07/10/1984	SD DENR	166	400
08/08/1984	SD DENR	61	120
09/14/1984	SD DENR	51	1,710
05/08/1985	SD DENR	31	10
06/11/1985	SD DENR	33	2,200
07/18/1985	SD DENR	39	2,110
08/22/1985	SD DENR	51	2,200
09/03/1985	SD DENR	23	1,800
05/06/1986	SD DENR	56	70
06/04/1986	SD DENR	58	220
07/07/1986	SD DENR	26	470
08/13/1986	SD DENR	220	5,400
09/24/1986	SD DENR	59	400
05/14/1987	SD DENR	44	460
06/10/1987	SD DENR	117	3,200
07/16/1987	SD DENR	25	130
08/12/1987	SD DENR	35	210
09/03/1987	SD DENR	20	130
05/25/1988	SD DENR	36	3,700
06/07/1988	SD DENR	27	10
07/11/1988	SD DENR	75	470
08/22/1988	SD DENR	23	470
09/12/1988	SD DENR	47	2,900
05/09/1989	SD DENR	19	10
06/19/1989	SD DENR	34	510
07/12/1989	SD DENR	65	1,800
08/09/1989	SD DENR	33	760
09/18/1989	SD DENR	19	300
05/01/1990	SD DENR	25	10
05/14/1990	SD DENR	63	200

Fecal Coliform Data from WQM 92 below treatment facility (continued)

Date	Agency	Flows (cfs)	Fecal Coliform (colonies/100 mL)
06/06/1990	SD DENR	34	400
06/11/1990	SD DENR	31	160
07/18/1990	SD DENR	26	200
08/07/1990	SD DENR	22	220
08/13/1990	SD DENR	46	80
09/10/1990	SD DENR	20	190
09/17/1990	SD DENR	16	900
05/09/1991	SD DENR	25	230
05/13/1991	SD DENR	160	20
06/12/1991	SD DENR	105	170
07/08/1991	SD DENR	24	700
08/14/1991	SD DENR	41	530
09/10/1991	SD DENR	70	3,300
05/20/1992	SD DENR	42	5,900
06/10/1992	SD DENR	20	770
07/21/1992	SD DENR	41	2,600
08/12/1992	SD DENR	29	2,400
09/16/1992	SD DENR	26	330
05/13/1993	SD DENR	78	330
06/09/1993	SD DENR	241	1,800
07/26/1993	SD DENR	201	380
08/10/1993	SD DENR	73	640
09/30/1993	SD DENR	89	150
05/18/1994	SD DENR	134	10
06/21/1994	SD DENR	61	230
07/13/1994	SD DENR	113	690
08/09/1994	SD DENR	80	790
09/20/1994	SD DENR	25	570
05/11/1995	SD DENR	476	150
06/22/1995	SD DENR	594	8,000
07/12/1995	SD DENR	144	230
08/23/1995	SD DENR	89	150
09/28/1995	SD DENR	45	230
05/28/1996	SD DENR	798	2,100
06/19/1996	SD DENR	467	182
07/23/1996	SD DENR	102	250
08/21/1996	SD DENR	72	250
09/19/1996	SD DENR	84	950

Fecal Coliform Data from WQM 92 below treatment facility (continued)

Date	Agency	Flows (cfs)	Fecal Coliform (colonies/100 mL)
05/29/1997	SD DENR	596	400
06/26/1997	SD DENR	220	250
07/28/1997	SD DENR	307	360
08/25/1997	SD DENR	259	9,300
09/24/1997	SD DENR	169	460
05/13/1998	SD DENR	111	230
06/17/1998	SD DENR	299	18,000
07/16/1998	SD DENR	307	240
08/20/1998	SD DENR	290	330
09/24/1998	SD DENR	143	330
05/20/1999	SD DENR	321	70
06/21/1999	SD DENR	591	230
07/19/1999	SD DENR	220	2,000
08/10/1999	SD DENR	193	200
09/01/1999	SD DENR	202	290
09/23/1999	SD DENR	88	160
05/09/2000	SD DENR	181	220
05/24/2000	SD DENR	184	200
06/28/2000	SD DENR	171	260
06/29/2000	SD DENR	160	253
07/20/2000	SD DENR	102	490
08/03/2000	SD DENR	81	3,700
08/12/2000	SD DENR	63.4	4,600
08/22/2000	SD DENR	48	320
08/31/2000	SD DENR	54	850
09/28/2000	SD DENR	59	60
05/22/2001	SD DENR	80	110
06/14/2001	SD DENR	155	6,000
07/10/2001	SD DENR	118	270
08/28/2001	SD DENR	82	290
09/25/2001	SD DENR	60	240
05/20/2002	SD DENR	77	100
06/19/2002	SD DENR	45	180
06/28/2002	SD DENR	34	120
07/22/2002	SD DENR	85	2,500
07/31/2002	SD DENR	49	85
08/19/2002	SD DENR	47	180
08/29/2002	SD DENR	34	180

Fecal Coliform Data from WQM 92 below treatment facility (continued)

Date	Agency	Flows (cfs)	Fecal Coliform (colonies/100 mL)
09/18/2002	SD DENR	68	110
05/15/2003	SD DENR	42	400
06/11/2003	SD DENR	57	320
07/14/2003	SD DENR	62	120
08/25/2003	SD DENR	53	600
09/18/2003	SD DENR	50	120
05/17/2004	SD DENR	60	280
06/15/2004	SD DENR	29	190
07/15/2004	SD DENR	33	82
08/25/2004	SD DENR	44	220
09/16/2004	SD DENR	21	340
09/16/2004	SD DENR	21	340
06/23/2005	SD DENR	27	140
07/20/2005	SD DENR	47	360
07/20/2005	SD DENR	47	370
08/18/2005	SD DENR	17	310
09/22/2005	SD DENR	23	120
05/23/2006	SD DENR	46	180
06/22/2006	SD DENR	56	86
07/27/2006	SD DENR	111	2,000
08/17/2006	SD DENR	30	120
09/25/2006	SD DENR	27	160
05/07/2007	SD DENR	46	110
06/21/2007	SD DENR	42	610
07/17/2007	SD DENR	34	160
08/23/2007	SD DENR	131	2,000
09/11/2007	SD DENR	61	130
05/19/2008	SD DENR	31	120
06/11/2008	SD DENR	114	68
07/08/2008	SD DENR	65	460
08/21/2008	SD DENR	84	240
09/24/2008	SD DENR	55	120
05/14/2009	SD DENR	175	76
06/24/2009	SD DENR	94	84
07/21/2009	SD DENR	62	100
08/13/2009	SD DENR	62	140
09/09/2009	SD DENR	39	120

Fecal Coliform Data from WQM 19 below Farmingdale

Date	Agency	Flows (cfs)	Fecal Coliform (colonies/100 mL)
06/27/1967	SD DENR	570	812
07/28/1967	SD DENR	108	128
08/21/1967	SD DENR	31	26
05/08/1968	SD DENR	44	118
06/13/1968	SD DENR	115	197
07/16/1968	SD DENR	8	42
07/31/1968	SD DENR	34	44
08/29/1968	SD DENR	39	22
09/25/1968	SD DENR	27	3
06/30/1969	SD DENR	39	52
07/13/1969	SD DENR	18	16
08/10/1969	SD DENR	23	52
09/21/1969	SD DENR	16	20
05/11/1970	SD DENR	290	270
06/07/1970	SD DENR	94	44
09/18/1973	SD DENR	59	37
06/06/1974	SD DENR	7	10
08/19/1974	SD DENR	19	27
09/30/1974	SD DENR	25	13
05/27/1975	SD DENR	65	430
06/25/1975	SD DENR	72	330
07/24/1975	SD DENR	38	870
08/19/1975	SD DENR	29	470
09/24/1975	SD DENR	11	60
05/11/1976	SD DENR	16	33
06/22/1976	SD DENR	308	670
07/14/1976	SD DENR	40	240
08/24/1976	SD DENR	16	150
09/29/1976	SD DENR	30	82
05/23/1977	SD DENR	96	80
06/29/1977	SD DENR	29	160
07/26/1977	SD DENR	33	200
08/23/1977	SD DENR	9	10
09/26/1977	SD DENR	41	160
05/01/1978	SD DENR	98	3,500
06/06/1978	SD DENR	334	370
07/10/1978	SD DENR	66	590
08/08/1978	SD DENR	27	60

Fecal Coliform Data from WQM 19 below Farmingdale (continued)

Date	Agency	Flows (cfs)	Fecal Coliform (colonies/100 mL)
09/06/1978	SD DENR	15	70
05/08/1979	SD DENR	10	110
06/06/1979	SD DENR	8	240
07/05/1979	SD DENR	127	1,800
08/07/1979	SD DENR	55	240
05/07/1980	SD DENR	23	180
06/03/1980	SD DENR	38	100
07/02/1980	SD DENR	23	185
08/06/1980	SD DENR	20	120
09/10/1980	SD DENR	19	46
05/14/1981	SD DENR	6	10
06/22/1981	SD DENR	15	57
07/08/1981	SD DENR	12	130
05/06/1982	SD DENR	10	12
06/16/1982	SD DENR	139	900
07/15/1982	SD DENR	107	380
08/19/1982	SD DENR	140	150
09/09/1982	SD DENR	92	220
05/18/1983	SD DENR	241	65
06/09/1983	SD DENR	14	56
07/13/1983	SD DENR	26	142
08/04/1983	SD DENR	31	520
09/08/1983	SD DENR	37	180
05/10/1984	SD DENR	206	80
07/10/1984	SD DENR	128	244
08/08/1984	SD DENR	9	290
09/14/1984	SD DENR	28	280
05/08/1985	SD DENR	6	68
06/11/1985	SD DENR	62	1,500
07/18/1985	SD DENR	21	1,000
08/22/1985	SD DENR	56	410
09/03/1985	SD DENR	20	40
06/04/1986	SD DENR	17	300
08/13/1986	SD DENR	171	1,600
09/24/1986	SD DENR	68	70
05/14/1987	SD DENR	38	250
06/10/1987	SD DENR	99	600
07/16/1987	SD DENR	11	100

Fecal Coliform Data from WQM 19 below Farmingdale (continued)

Date	Agency	Flows (cfs)	Fecal Coliform (colonies/100 mL)
08/12/1987	SD DENR	34	220
09/03/1987	SD DENR	31	270
05/25/1988	SD DENR	16	85
06/07/1988	SD DENR	18	320
07/11/1988	SD DENR	16	310
08/22/1988	SD DENR	6	82
09/12/1988	SD DENR	15	110
05/09/1989	SD DENR	16	44
06/19/1989	SD DENR	12	250
07/12/1989	SD DENR	29	600
08/09/1989	SD DENR	15	160
09/18/1989	SD DENR	16	62
05/09/1991	SD DENR	24	40
06/12/1991	SD DENR	118	400
07/08/1991	SD DENR	10	96
08/14/1991	SD DENR	20	270
09/10/1991	SD DENR	45	310
05/20/1992	SD DENR	8	320
06/10/1992	SD DENR	24	140
07/21/1992	SD DENR	31	500
08/12/1992	SD DENR	8	100
09/16/1992	SD DENR	9	64
05/13/1993	SD DENR	107	120
06/09/1993	SD DENR	237	2,000
07/26/1993	SD DENR	165	2,000
08/10/1993	SD DENR	68	160
09/30/1993	SD DENR	78	83
05/18/1994	SD DENR	162	400
06/21/1994	SD DENR	38	180
07/13/1994	SD DENR	17	220
08/09/1994	SD DENR	30	300
09/20/1994	SD DENR	22	65
05/11/1995	SD DENR	549	500
06/22/1995	SD DENR	632	3,400
07/12/1995	SD DENR	132	160
08/23/1995	SD DENR	64	240
09/28/1995	SD DENR	57	50
05/28/1996	SD DENR	2,130	13,000

Fecal Coliform Data from WQM 19 below Farmingdale (continued)

Date	Agency	Flows (cfs)	Fecal Coliform (colonies/100 mL)
06/19/1996	SD DENR	658	400
07/23/1996	SD DENR	73	300
08/21/1996	SD DENR	39	140
09/19/1996	SD DENR	115	200
05/29/1997	SD DENR	883	1,600
06/26/1997	SD DENR	309	120
07/28/1997	SD DENR	254	200
08/25/1997	SD DENR	237	160
09/24/1997	SD DENR	154	110
05/13/1998	SD DENR	108	1,200
06/17/1998	SD DENR	289	3,000
07/16/1998	SD DENR	252	200
08/20/1998	SD DENR	312	310
09/24/1998	SD DENR	162	140
05/20/1999	SD DENR	396	80
06/21/1999	SD DENR	639	200
07/19/1999	SD DENR	205	900
08/10/1999	SD DENR	177	160
09/23/1999	SD DENR	82	26
05/24/2000	SD DENR	203	98
06/29/2000	SD DENR	116	132
07/20/2000	SD DENR	82	82
08/22/2000	SD DENR	38	118
09/28/2000	SD DENR	43	26
05/22/2001	SD DENR	67	110
06/14/2001	SD DENR	140	850
07/10/2001	SD DENR	27	500
08/28/2001	SD DENR	28	18
09/25/2001	SD DENR	46	28
05/20/2002	SD DENR	81	50
06/19/2002	SD DENR	10	200
07/22/2002	SD DENR	116	400
08/19/2002	SD DENR	13	20
05/15/2003	SD DENR	46	65
06/11/2003	SD DENR	44	72
07/14/2003	SD DENR	16	250
08/25/2003	SD DENR	15	82
09/18/2003	SD DENR	33	46

Fecal Coliform Data from WQM 19 below Farmingdale (continued)

Date	Agency	Flows (cfs)	Fecal Coliform (colonies/100 mL)
05/17/2004	SD DENR	44	250
06/15/2004	SD DENR	30	130
07/15/2004	SD DENR	6	160
08/25/2004	SD DENR	17	240
09/16/2004	SD DENR	33	220
06/01/2005	SD DENR	139	970
06/23/2005	SD DENR	18	250
07/20/2005	SD DENR	6	300
08/18/2005	SD DENR	8	100
09/22/2005	SD DENR	10	110
05/23/2006	SD DENR	16	160
06/22/2006	SD DENR	16	180
07/27/2006	SD DENR	13	110
08/17/2006	SD DENR	18	190
09/25/2006	SD DENR	37	560
05/07/2007	SD DENR	98	1,900
06/21/2007	SD DENR	4	370
07/17/2007	SD DENR	5	460
08/23/2007	SD DENR	38	530
09/11/2007	SD DENR	26	190
05/19/2008	SD DENR	22	240
06/11/2008	SD DENR	128	170
07/08/2008	SD DENR	94	140
08/21/2008	SD DENR	25	92
09/24/2008	SD DENR	30	82
05/14/2009	SD DENR	166	2
06/24/2009	SD DENR	118	130
07/21/2009	SD DENR	111	58
08/13/2009	SD DENR	111	100
09/09/2009	SD DENR	116	340

E. coli bacteria Data from WQM 19 below Farmingdale

Date	Agency	Flows (cfs)	*E. coli* (colonies/100 mL)
09/28/2000	SD DENR	43	14
05/22/2001	SD DENR	67	8
06/14/2001	SD DENR	140	400
07/10/2001	SD DENR	27	400
08/28/2001	SD DENR	28	20
09/25/2001	SD DENR	46	10
05/20/2002	SD DENR	81	10
06/19/2002	SD DENR	10	5
07/22/2002	SD DENR	116	20
05/15/2003	SD DENR	46	10
06/11/2003	SD DENR	44	12
08/25/2003	SD DENR	15	72
09/18/2003	SD DENR	33	68
05/17/2004	SD DENR	44	276
05/23/2006	SD DENR	16	41
06/22/2006	SD DENR	16	167
07/27/2006	SD DENR	13	80
08/17/2006	SD DENR	18	461
09/25/2006	SD DENR	37	980
05/07/2007	SD DENR	98	2420
06/21/2007	SD DENR	4	436
07/17/2007	SD DENR	5	313
08/23/2007	SD DENR	38	260
09/11/2007	SD DENR	26	219
05/19/2008	SD DENR	22	53
06/11/2008	SD DENR	128	89
07/08/2008	SD DENR	94	132
08/21/2008	SD DENR	25	60
09/24/2008	SD DENR	30	101
05/14/2009	SD DENR	166	43
05/25/2009	SD DENR	387	457
06/24/2009	SD DENR	94	99
07/21/2009	SD DENR	36	56
08/13/2009	SD DENR	42	111
09/09/2009	SD DENR	19	192

APPENDIX B: Rapid City WLA Calculation

Fecal Coliform/*E. coli* Event Based Load Analysis and WLA

Fecal coliform loadings during high flow conditions are primarily a function of stormwater runoff from May to September. Stormwater runoff varies along the study segment with the level of development. Evaluation of the monitoring data and historical data show that it requires a relatively large rainfall event to cause runoff from the lower portion of the watershed where the land use is primarily range land. As stated earlier, during the 1999-2000 monitoring program the only observed runoff in the lower basin occurred in March during a rainstorm which followed closely behind a large snowfall event. High flow in the lower part of the basin is often based on management of Pactola Reservoir and stormwater runoff from more developed segments upstream (i.e. Rapid City and surrounding urban complex).

Monitoring station HAW represents rainfall runoff conditions in segment SD-CH-R-RAPID_03 of Rapid Creek. Event based conditions for this segment of Rapid Creek is due primarily to stormwater runoff from impervious areas within Rapid City. The SDGFP monitoring program conducted during 2001 and 2002 showed that fecal coliform concentrations were exceeded during all eight stormwater runoff events monitored at HAW (Krantz 2002). The data from the SD GF&P's monitoring program provides the basis for analysis of event conditions and development of the WLA for Rapid City. Two approaches were developed to evaluate the reduction of fecal coliform loadings due to stormwater runoff. The analyses for both approaches are based on statistical characteristics of rainfall events and runoff volumes, relationship between rainfall and runoff volume, and runoff volume and pollutant load. The first approach is based on SD DENR's policy that if more than 10 percent of water quality samples (with a minimum of 20 samples) exceed the criterion, the water body is assumed to be impaired. The second approach takes into consideration section 402(p) of the Clean Water Act for NPDES permits for stormwater, which requires reduction of stormwater pollution to the maximum extent practicable.

Number of Rainfall Events

Annual and seasonal (May – September) precipitation characteristics are presented in Table B1. The two key parameters for this analysis are the number of events and the mean event depth that represent May through September precipitation. Three sets of precipitation information are used to determine appropriate values for the number of events and the average event depth. Smoley (1993) did a regional analysis of precipitation data for EPA and reports that the average annual number of events for the Northwest Inland regional area is 31, and the annual average event depth is 0.37 inches (Table B1). To estimate the average number of precipitation events during May to September, the long-term average precipitation in each month collected at the Rapid City Regional Airport was used to estimate the average number of events resulting in an estimate of 20 events.

Table B1. Annual and seasonal precipitation characteristics based on regional and local data analysis.

Data Source	Total Annual Precp. (in)	May-Sept Precp. (in)	Annual Number of Events	Number of Events May-Sept	Mean Event Depth (in)
EPA Northwest Inland	11.5	7.4[1]	31	20[1]	0.37
Rapid City Regional Airport	16.47	10.59	36[1]	23[1]	-
HAW May-Sept 2001	-	8.62	-	19	0.45

1. Value is estimated

Rainfall data was collected at the HAW site during the SD GF&P monitoring program. The total precipitation recorded from May through September 2001 was 8.62 inches and the number of events was 19 with a mean event depth of 0.45 inches (Table B1).

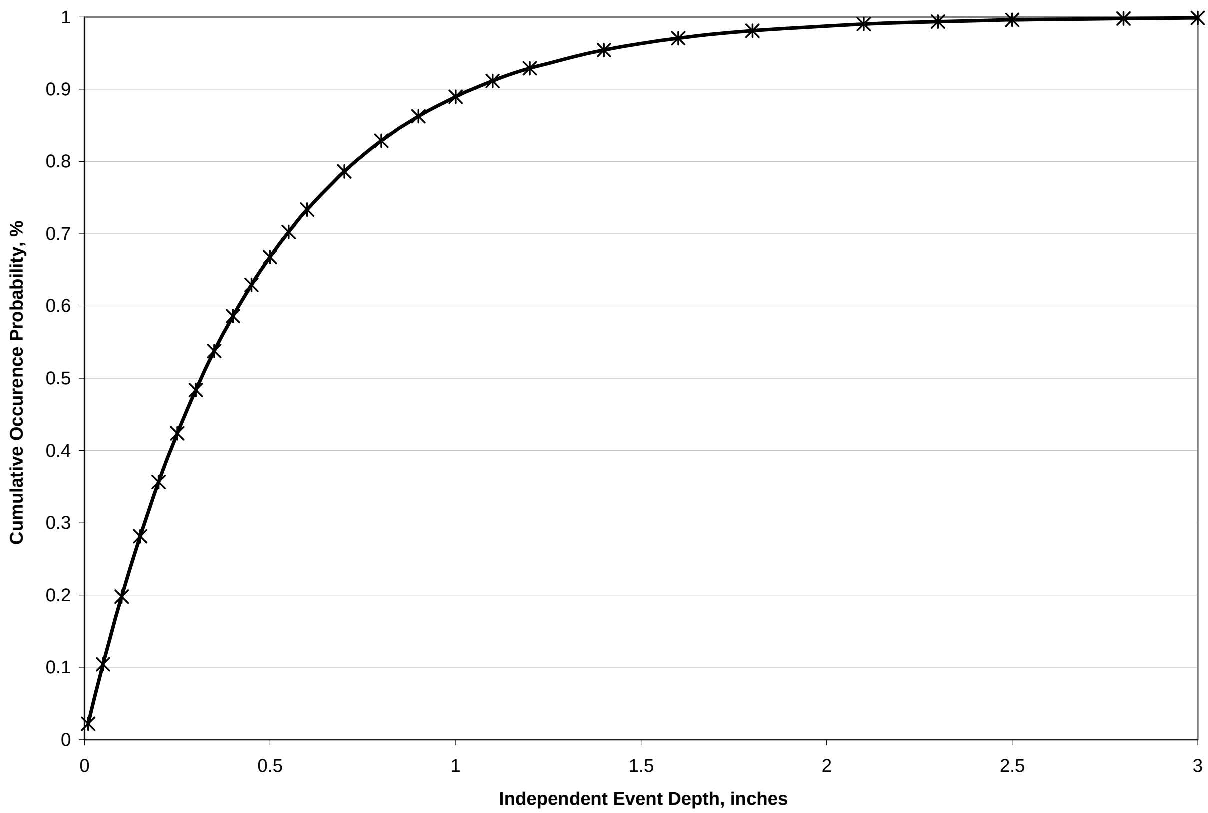


Figure B1. Cumulative rainfall distribution based on event depth at HAW monitoring site.

Using long-term precipitation data from the National Weather Service (NWS) gage at Rapid City Regional Airport (RCAP), the annual average rainfall from May to September is 10.59 inches.

The total precipitation from May through September 2001 recorded at HAW represents 81.4 percent of the long-term average for May through September, based on the NWS RCAP gage. Using the average event depth recorded at HAW (0.45 inches), the long-term average number of events from May through September is estimated to be 23. The EPA regional precipitation characteristics are generally lower than the values based on the RCAP gage and measured at HAW. This is expected due to the local influence of the Black Hills. The RCAP gage data provide a better representation of local precipitation characteristics. The precipitation data collected at HAW in 2001 represent about 80 percent of the long-term average.

Calculation Assumptions

- Each rainfall event during the May through September period causes an exceedence of water quality criteria at HAW and that there are a total of 153 days from May through September, the allowable number of events that could exceed the water quality criterion would be 15 based on 10 percent exceedence. Precipitation parameters often follow an exponential distribution following Wanielista and Yousef, (1992) and Maristany, (1992). The cumulative frequency for total precipitation from May to September is presented in Figure B1.

- Assuming that the total precipitation during May to September is distributed exponentially, and the average event depth is 0.45 inches, the number of events that must be treated can be estimated.

- Assuming that the depth of individual precipitation events is distributed exponentially the minimum event depth to be treated so that less than 10 percent of the events will not exceed the water quality criterion can be determined.

The 2001 May to September total precipitation of 8.62 inches represents a 27th percentile, the 50th percentile (long-term average) is 10.59 inches, and the 80th percentile is 12.55 inches (Figure B2). Using the average event depth of 0.45 inches, the number of precipitation events and number of events requiring treatment are estimated (Table B2). The minimum event depth requiring treatment is determined by relating event depth to the cumulative frequency of total May through September precipitation (Figure B3). The numbers of events requiring treatment and minimum treatment depth are shown in Figure B3 and summarized in Table B2. The minimum depth requiring treatment selected to represent performance standards for stormwater load reductions is based on the percent of total May to September rainfall to be treated. For average conditions, the minimum event treatment depth is 0.37 inches, and for the 80th percentile, the minimum event treatment depth is 0.49 inches.

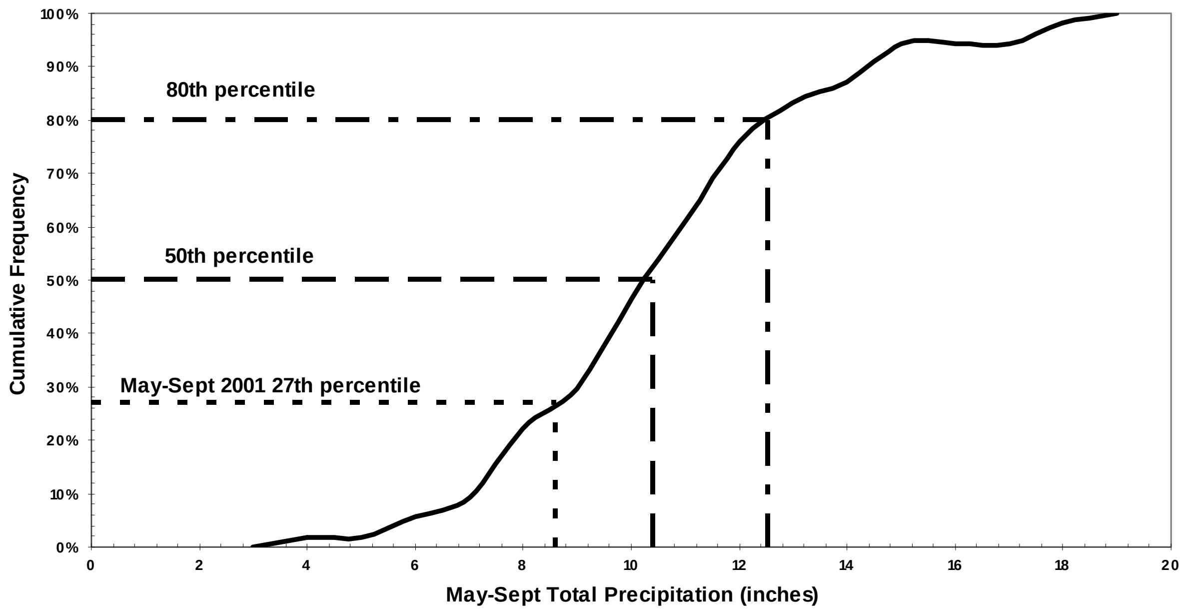


Figure B2. Cumulative frequency for total precipitation from May to September Rapid City Regional Airport.

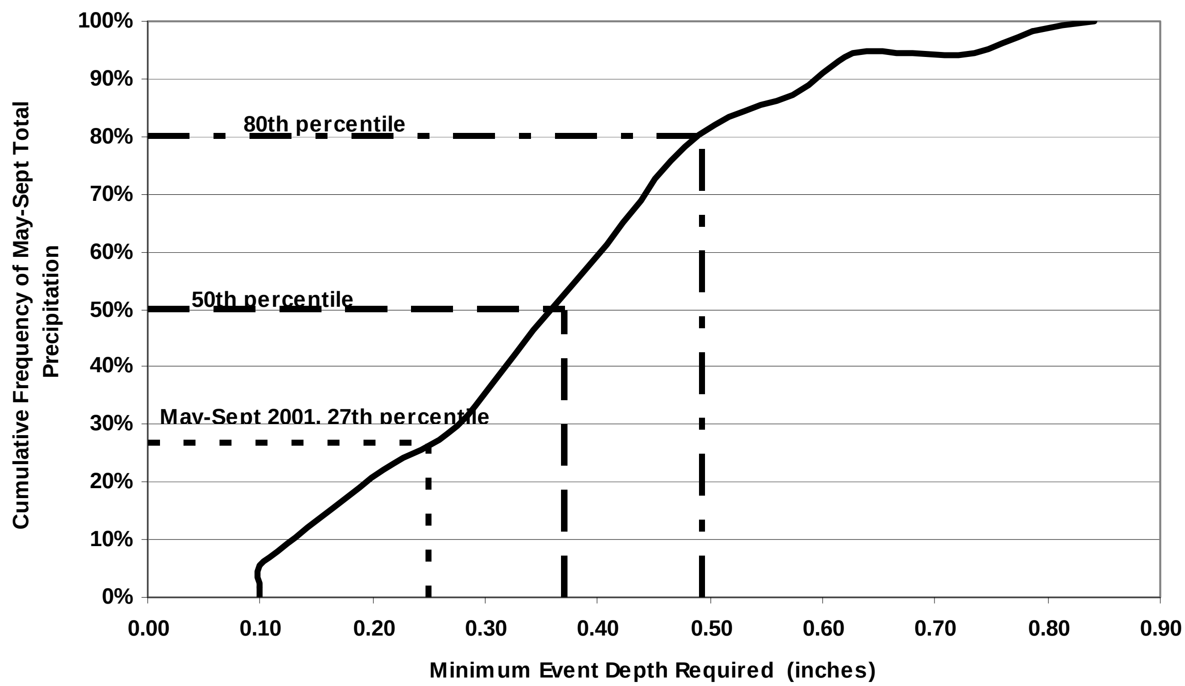


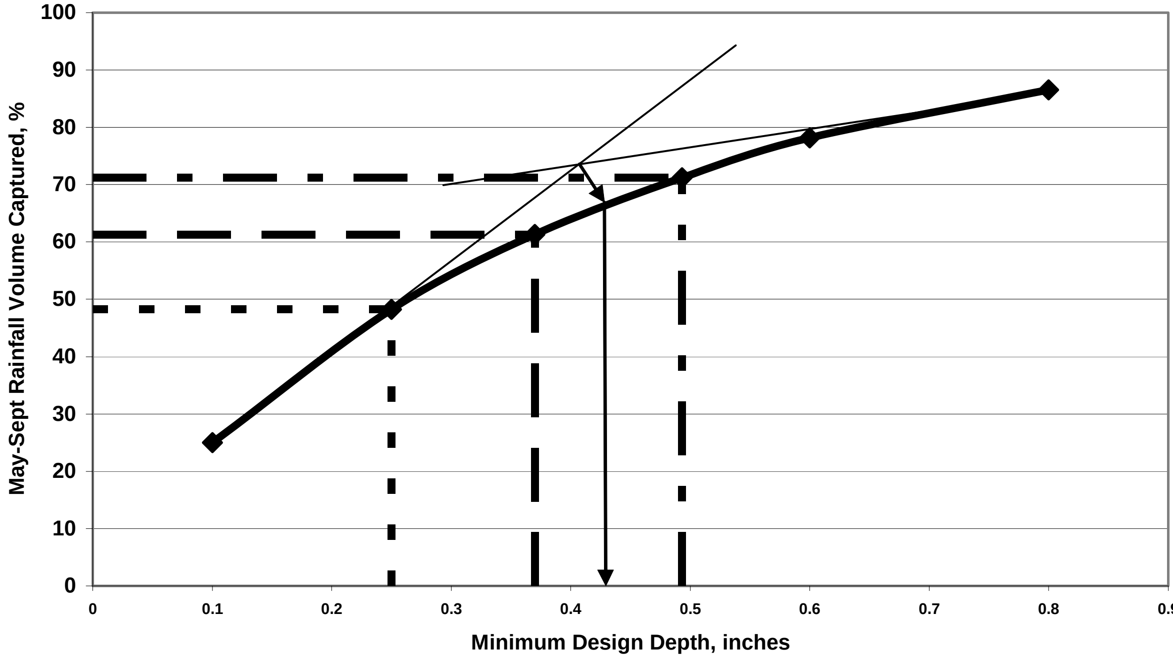
Figure 10. Minimum rainfall event depth (inches) requiring treatment to have a maximum of 10 percent of the events exceed the water quality standard based on cumulative frequency of total May through September precipitation.

Table B2. The numbers of events requiring treatment and minimum treatment depth

Data Reference	Total Number of Days May-Sept	Number of Events May-Sept	Number of Events Requiring Treatment for < 10%	Percent of Events Requiring Treatment	Minimum Event Design Depth (in)
HAW May-Sept 2001	153	19	4	21.0	0.25
RC Regional Airport	153	23	8	34.8	0.37
80th Percentile	153	28	13	46.4	0.49

Maximum Extent Practicable

It has been shown that a large percent of runoff volume is due to small rainfall events (Roesner et al., 1991 and Water Environment Federation, 1998). Thus, a significant amount of runoff volume can be captured and treated by designing for a moderate rainfall event depth. The question becomes what depth represents the maximum extent practicable. Urbonas et al. (1990), Roesner et al. (1991), Urbonas and Stahre (1993) used measured rainfall/runoff data and modeled the volume of runoff captured by stormwater BMPs for various cities in the US. They defined the maximized treatment volume as the point at which rapidly diminishing returns in the number of runoff events captured begins to occur. This point is defined as the “knee” of the curve of percent annual runoff captured versus unit storage volume (treatment volume). Resources were not available to develop this specific relationship. However, a plot of seasonal (May – September) precipitation volume designed for (captured) versus minimum design depth (rainfall event depth to use for design of BMPs) identifies the point where treatment volume is maximized (Figure B4). Based on the available precipitation data this minimum precipitation event design depth is estimated to be approximately 0.44 inches. This value falls between the minimum event design depth estimated for average and 80th percentile May to September total precipitation based on number of events needed to be treated (Figure B4).



FigureB4. Seasonal (May – September) precipitation volume designed for (captured) versus minimum design depth (rainfall event depth to use for design of BMPs) to define maximum extent practicable.

Both approaches used to estimate the minimum event depth for design of BMPs result in similar values. Based on the analyses and incorporating a margin of safety, the recommended performance standard for reduction of stormwater runoff pollutant loads is to design BMPs to treat the runoff from all rainfall events less than or equal to 0.5 inches. This performance standard meets the SD DENR percent of events exceeding the water quality criterion and the clean water act requirement for reduction of stormwater pollution to the maximum extent practicable. Table B3 shows the estimated fecal coliform load based on rainfall runoff characteristics, event depth, sampled fecal coliform loading and treatment to the MEP (85 percent).

Table B3. Predicted fecal coliform load based on rainfall runoff statistical characteristics, event depth, sampled fecal coliform loading and treatment to the MEP (85 percent).

Expected Event Runoff Volume	rainfall depth inches	Cum Prob	Exceedence Prob	Runoff Vol ac-ft	Sampled Vol ac-ft	CFU Event Load CFU	Expected Event CFU Load	CFU Load Reduction	Allocated Expected CFU Load	WLA CFU/Day
	3	0.99865657	0.00134343	388	3055.571831	4.96143E+12		2.48072E+12		
2.207021454	2.8	0.997912303	0.002087697	362	2875.156055	5.47166E+12	3882501269	2.73583E+12	1941250635	
5.36085318	2.5	0.995955676	0.004044324	325	2604.532391	6.41461E+12	11628496524	3.2073E+12	5814248262	
5.63353109	2.3	0.993715102	0.006284898	299	2424.116615	7.1997E+12	15251932003	3.59985E+12	7625966001	
8.126350717	2.1	0.990233239	0.009766761	274	2243.700839	8.15339E+12	26728663130	4.07669E+12	13364331565	
19.29931641	1.8	0.981079654	0.018920346	236	1973.077175	1.00258E+13	83202482696	5.01291E+12	41601241348	
19.73616105	1.6	0.970597694	0.029402306	211	1792.661399	1.16978E+13	1.13853E+11	5.84889E+12	56926495481	
27.73129153	1.4	0.954308679	0.045691321	186	1612.245623	1.38739E+13	2.08268E+11	6.93694E+12	1.04134E+11	
38.52765541	1.2	0.928995472	0.071004528	160	1431.829847	1.67917E+13	3.88122E+11	8.39584E+12	1.94061E+11	
24.2809063	1.1	0.911485951	0.088514049	148	1341.621959	1.86445E+13	3.10235E+11	9.32223E+12	1.55117E+11	
28.29951443	1	0.889658631	0.110341369	135	1251.414071	2.08531E+13	4.31063E+11	1.04265E+13	2.15531E+11	
32.82355113	0.9	0.862448753	0.137551247	122	1161.206183	2.35196E+13	6.03687E+11	1.17598E+13	3.01844E+11	
37.85791865	0.8	0.828528994	0.171471006	110	1070.998295	2.67866E+13	8.53187E+11	1.33933E+13	4.26594E+11	
43.37920172	0.7	0.786244716	0.213755284	97	980.7904068	3.08588E+13	1.21875E+12	1.54294E+13	6.09373E+11	
49.32140353	0.6	0.733533252	0.266466748	84	890.5825188	3.60391E+13	1.76314E+12	1.80196E+13	8.81572E+11	
55.55636853	0.5	0.667823286	0.332176714	72	800.3746308	4.2793E+13	2.59003E+12	3.63741E+13	6.41895E+12	3.54E+11
130.6901809	0.3	0.483795827	0.516204173	46	619.9588548	6.45347E+13	9.87563E+12	5.48545E+13	8.39428E+12	
151.4979348	0.1	0.197816293	0.802183707	21	439.5430788	1.12209E+14	2.52725E+13	9.53774E+13	2.14816E+13	
38.97339883	0.05	0.104352911	0.895647089	15	394.4391348	1.33554E+14	1.14849E+13	1.13521E+14	9.76216E+12	
31.07248126	0.01	0.021800619	0.978199381	10	358.3559796	1.55837E+14	1.19449E+13	1.32461E+14	1.01532E+13	

Shaded = WLA based on treating 100 percent of all rainfall runoff volume to a depth of 0.5 inches and an MEP of 85 percent

APPENDIX C: Public Comments

EPA REGION VIII TMDL REVIEW

TMDL Document Info:

Document Name:	**Fecal Coliform, *E. Coli* Total Maximum Daily Load Evaluation for Lower Rapid Creek, Pennington County, South Dakota**
Submitted by:	**Cheryl Saunders, SD DENR**
Date Received:	**June 17, 2010**
Review Date:	**July 6, 2010**
Reviewer:	**Vern Berry, EPA**
Rough Draft / Public Notice / Final?	**Public Notice Draft**
Notes:	

Reviewers Final Recommendation(s) to EPA Administrator (used for final review only):

- ☐ Approve
- ☐ Partial Approval
- ☐ Disapprove
- ☐ Insufficient Information

Approval Notes to Administrator:

This document provides a standard format for EPA Region 8 to provide comments to state TMDL programs on TMDL documents submitted to EPA for either formal or informal review. All TMDL documents are evaluated against the minimum submission requirements and TMDL elements identified in the following 8 sections:

1. Problem Description
   a. TMDL Document Submittal Letter
   b. Identification of the Waterbody, Impairments, and Study Boundaries
   c. Water Quality Standards
2. Water Quality Target
3. Pollutant Source Analysis
4. TMDL Technical Analysis
   a. Data Set Description
   b. Waste Load Allocations (WLA)
   c. Load Allocations (LA)
   d. Margin of Safety (MOS)
   e. Seasonality and variations in assimilative capacity
5. Public Participation
6. Monitoring Strategy
7. Restoration Strategy
8. Daily Loading Expression

Under Section 303(d) of the Clean Water Act, waterbodies that are not attaining one or more water quality standard (WQS) are considered "impaired." When the cause of the impairment is determined to be a pollutant, a TMDL analysis is required to assess the appropriate maximum allowable pollutant loading rate. A TMDL document consists of a technical analysis conducted to: (1) assess the maximum pollutant loading rate that a waterbody is able to assimilate while maintaining water quality standards; and (2) allocate that assimilative capacity among the known sources of that pollutant**.** A well written TMDL document will describe a path forward that may be used by those who implement the TMDL recommendations to attain and maintain WQS.

Each of the following eight sections describes the factors that EPA Region 8 staff considers when reviewing TMDL documents. Also included in each section is a list of EPA's minimum submission requirements relative to that section, a brief summary of the EPA reviewer's findings, and the reviewer's comments and/or suggestions. Use of the verb "must" in the minimum submission requirements denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation. Use of the term "should" below denotes information that is generally necessary for EPA to determine if a submitted TMDL is approvable.

This review template is intended to ensure compliance with the Clean Water Act and that the reviewed documents are technically sound and the conclusions are technically defensible.

1. Problem Description

A TMDL document needs to provide a clear explanation of the problem it is intended to address. Included in that description should be a definitive portrayal of the physical boundaries to which the TMDL applies, as well as a clear description of the impairments that the TMDL intends to address and the associated pollutant(s) causing those impairments. While the existence of one or more impairment and stressor may be known, it is important that a comprehensive evaluation of the water quality be conducted prior to development of the TMDL to ensure that all water quality problems and associated stressors are identified. Typically, this step is conducted prior to the 303(d) listing of a waterbody through the monitoring and assessment program. The designated uses and water quality criteria for the waterbody should be examined against available data to provide an evaluation of the water quality relative to all applicable water quality standards. If, as part of this exercise, additional WQS problems are discovered and additional stressor pollutants are identified, consideration should be given to concurrently evaluating TMDLs for those additional pollutants. If it is determined that insufficient data is available to make such an evaluation, this should be noted in the TMDL document.

1.1 TMDL Document Submittal Letter

When a TMDL document is submitted to EPA requesting formal comments or a final review and approval, the submittal package should include a letter identifying the document being submitted and the purpose of the submission.

Minimum Submission Requirements.

☒ A TMDL submittal letter should be included with each TMDL document submitted to EPA requesting a formal review.

☒ The submittal letter should specify whether the TMDL document is being submitted for initial review and comments, public review and comments, or final review and approval.

☐ Each TMDL document submitted to EPA for final review and approval should be accompanied by a submittal letter that explicitly states that the submittal is a final TMDL submitted under Section 303(d) of the Clean Water Act for EPA review and approval. This clearly establishes the State's/Tribe's intent to submit, and EPA's duty to review, the TMDL under the statute**.** The submittal letter should contain such identifying information as the name and location of the waterbody and the pollutant(s) of concern, which matches similar identifying information in the TMDL document for which a review is being requested.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The Lower Rapid Creek bacteria TMDL was submitted to EPA for review during the public notice period via an email from Cheryl Saunders, SD DENR on June 17, 20. The email included the draft TMDL document and a public notice announcement requesting review and comment.

COMMENTS: None

1.2 Identification of the Waterbody, Impairments, and Study Boundaries

The TMDL document should provide an unambiguous description of the waterbody to which the TMDL is intended to apply and the impairments the TMDL is intended to address. The document should also clearly delineate the physical boundaries of the waterbody and the geographical extent of the watershed area studied. Any additional information needed to tie the TMDL document back to a current 303(d) listing should also be included.

Minimum Submission Requirements:

☒ The TMDL document should clearly identify the pollutant and waterbody segment(s) for which the TMDL is being established. If the TMDL document is submitted to fulfill a TMDL development requirement for a waterbody on the state's current EPA approved 303(d) list, the TMDL document submittal should clearly identify the waterbody and associated impairment(s) as they appear on the State's/Tribe's current EPA approved 303(d) list, including a full waterbody description, assessment unit/waterbody ID, and the priority ranking of the waterbody. This information is necessary to ensure that the administrative record and the national TMDL tracking database properly link the TMDL document to the 303(d) listed waterbody and impairment(s).

☒ One or more maps should be included in the TMDL document showing the general location of the waterbody and, to the maximum extent practical, any other features necessary and/or relevant to the understanding of the TMDL analysis, including but not limited to: watershed boundaries, locations of major pollutant sources, major tributaries included in the analysis, location of sampling points, location of discharge gauges, land use patterns, and the location of nearby waterbodies used to provide surrogate information or reference conditions. Clear and concise descriptions of all key features and their relationship to the waterbody and water quality data should be provided for all key and/or relevant features not represented on the map.

☐ If information is available, the waterbody segment to which the TMDL applies should be identified/geo-referenced using the National Hydrography Dataset (NHD). If the boundaries of the TMDL do not correspond to the Waterbody ID(s) (WBID), Entity_ID information or reach code (RCH_Code) information should be provided. If NHD data is not available for the waterbody, an alternative geographical referencing system that unambiguously identifies the physical boundaries to which the TMDL applies may be substituted.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: Rapid Creek is a stream located in the Black Hills of western South Dakota, and drains approximately 718 square miles in Pennington County, South Dakota. Rapid Creek flows to the Cheyenne River and ultimately to the Missouri River in the Rapid sub-basin (HUC 10120110). The focus of the TMDL document is on the lower portion of the Rapid Creek basin. The contributing drainage area of the 303(d) listed segments is approximately 126 square miles and covers 74 stream miles beginning below Canyon Lake and ending where Rapid Creek drains into the Cheyenne River. Approximately 61% of the landuse in the impaired segments is rangeland, 24% is cropland and pastureland, 7% is urban and 8% is forest and other landuses.

Three segments of lower Rapid Creek are identified on the 2008 South Dakota 303(d) Waterbody list as impaired due to elevated fecal coliform concentrations. The three listed segments are: 1) lower Rapid City to RC WWTF (SD-CH-R-RAPID_03); 2) RC WWTF to above Farmingdale SD-CH-R-RAPID_04); and 3) Above Farmingdale to mouth (SD-CH-R-RAPID_05). *Escherichia coli* is also listed as an impairment in segment SD-CH-R-RAPID_05 on the draft 2010 303(d) list. All three segments are identified as high priority for TMDL development. Data collected during the period of assessment found that portions of Rapid Creek are also impaired for total suspended solids (TSS). The TSS impairment will be addressed in a separate TMDL document.

The designated uses for the Lower Rapid Creek segments include: coldwater permanent fish life propagation waters, warmwater permanent fish life propagation waters, immersion recreation waters, limited-contact recreation waters, fish and wildlife propagation, recreation, and stock watering.

COMMENTS: None.

1.3 Water Quality Standards

TMDL documents should provide a complete description of the water quality standards for the waterbodies addressed, including a listing of the designated uses and an indication of whether the uses are being met, not being met, or not assessed. If a designated use was not assessed as part of the TMDL analysis (or not otherwise recently assessed), the documents should provide a reason for the lack of assessment (e.g., sufficient data was not available at this time to assess whether or not this designated use was being met).

Water quality criteria (WQC) are established as a component of water quality standard at levels considered necessary to protect the designated uses assigned to that waterbody. WQC identify quantifiable targets and/or qualitative water quality goals which, if attained and maintained, are intended to ensure that the designated uses for the waterbody are protected. TMDLs result in maintaining and attaining water quality standards by determining the appropriate maximum pollutant loading rate to meet water quality criteria, either directly, or through a surrogate measurable target. The TMDL document should include a description of all applicable water quality criteria for the impaired designated uses and address whether or not the criteria are being attained, not attained, or not evaluated as part of the analysis. If the criteria were not evaluated as part of the analysis, a reason should be cited (e.g., insufficient data were available to determine if this water quality criterion is being attained).

Minimum Submission Requirements:

☒ The TMDL must include a description of the applicable State/Tribal water quality standard, including the designated use(s) of the waterbody, the applicable numeric or narrative water quality criterion, and the anti-degradation policy. (40 C.F.R. §130.7(c)(1)).

☒ The purpose of a TMDL analysis is to determine the assimilative capacity of the waterbody that corresponds to the existing water quality standards for that waterbody, and to allocate that assimilative capacity between the significant sources. Therefore, <u>all TMDL documents must be written to meet the existing water quality standards</u> for that waterbody (CWA §303(d)(1)(C)).

Note: In some circumstances, the load reductions determined to be necessary by the TMDL analysis may prove to be infeasible and may possibly indicate that the existing water quality standards and/or assessment methodologies may be erroneous. However, the TMDL must still be determined based on existing water quality standards. Adjustments to water quality standards and/or assessment methodologies may be evaluated separately, from the TMDL.

☒ The TMDL document should describe the relationship between the pollutant of concern and the water quality standard the pollutant load is intended to meet. This information is necessary for EPA to evaluate whether or not attainment of the prescribed pollutant loadings will result in attainment of the water quality standard in question.

☒ If a standard includes multiple criteria for the pollutant of concern, the document should demonstrate that the TMDL value will result in attainment of all related criteria for the pollutant. For example, both acute and chronic values (if present in the WQS) should be addressed in the document, including consideration of magnitude, frequency and duration requirements.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The Lower Rapid Creek segments addressed by these TMDLs are impaired based on fecal coliform and *E. coli* concentrations that are impacting the immersion recreation beneficial uses. South Dakota has applicable numeric standards for fecal coliform and *E. coli* that may be applied to these river segments. The numeric standards being implemented in these TMDLs are: a daily maximum value of fecal coliform of 400 cfu/100mL in any one sample, and a maximum geometric mean of 200 cfu/100mL during a 30-day period, and a daily maximum value of *E. coli* of 235 cfu/100mL and a maximum geometric mean of 126 cfu/100mL. The standards for both parameters are applicable from May 1 to September 30. Discussion of additional applicable water quality standards for Lower Rapid Creek can be found on pages 6 - 9 of the TMDL document.

COMMENTS: None.

2. Water Quality Targets

TMDL analyses establish numeric targets that are used to determine whether water quality standards are being achieved. Quantified water quality targets or endpoints should be provided to evaluate each listed pollutant/water body combination addressed by the TMDL, and should represent achievement of applicable water quality standards and support of associated beneficial uses. For pollutants with numeric water quality standards, the numeric criteria are generally used as the water quality target. For pollutants with narrative standards, the narrative standard should be translated into a measurable value. At a minimum, one target is required for each pollutant/water body combination. It is generally desirable, however, to include several targets that represent achievement of the standard and support of beneficial uses (e.g., for a sediment impairment issue it may be appropriate to include a variety of targets representing water column sediment such as TSS, embeddeness, stream morphology, up-slope conditions and a measure of biota).

Minimum Submission Requirements:

☒ The TMDL should identify a numeric water quality target(s) for each waterbody pollutant combination. The TMDL target is a quantitative value used to measure whether or not the applicable water quality standard is attained.

Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. Occasionally, the pollutant of concern is different from the parameter that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as a numerical dissolved oxygen criterion). In such cases, the TMDL should explain the linkage between the pollutant(s) of concern, and express the quantitative relationship between the TMDL target *and pollutant of concern. In all cases, TMDL targets must represent the attainment of current water quality standards.*

☐ When a numeric TMDL target is established to ensure the attainment of a narrative water quality criterion, the numeric target, the methodology used to determine the numeric target, and the link between the pollutant of concern and the narrative water quality criterion should all be described in the TMDL document. Any additional information supporting the numeric target and linkage should also be included in the document.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The water quality targets for these TMDLs are based on the numeric water quality standards for fecal coliform and *E. coli* established to protect the immersion recreation beneficial uses for the three Lower Rapid Creek segments. The fecal coliform daily maximum value is ≤ 400 cfu/100mL in any one sample, and the maximum geometric mean is ≤ 200 cfu/100mL during a 30-day period. The *E. coli daily* maximum value is 235 cfu/100mL and the maximum geometric mean is 126 cfu/100mL. The *E. coli* targets are only applicable to the furthest downstream segment of Rapid Creek (SD-CH-R-RAPID_05). The standards for both parameters are applicable from May 1 to September 30.

COMMENTS: None.

3. Pollutant Source Analysis

A TMDL analysis is conducted when a pollutant load is known or suspected to be exceeding the loading capacity of the waterbody. Logically then, a TMDL analysis should consider all sources of the pollutant of concern in some manner. The detail provided in the source assessment step drives the rigor of the pollutant load allocation. In other words, it is only possible to specifically allocate quantifiable loads or load reductions to each significant source (or source category) when the relative load contribution from each source has been estimated. Therefore, the pollutant load from each significant source (or source category) should be identified and quantified to the maximum practical extent. This may be accomplished using site-specific monitoring data, modeling, or application of other assessment techniques. If insufficient time or resources are available to accomplish this step, a phased/adaptive management approach may be appropriate. The approach should be clearly defined in the document.

Minimum Submission Requirements:

☒ The TMDL should include an identification of all potentially significant point and non-point sources of the pollutant of concern, including the geographical location of the source(s) and the quantity of the loading, e.g., lbs/per day. This information is necessary for EPA to evaluate the WLA, LA and MOS components of the TMDL.

☒ The level of detail provided in the source assessment should be commensurate with the nature of the watershed and the nature of the pollutant being studied. Where it is possible to separate natural background from non-point sources, the TMDL should include a description of both the natural background loads and the non-point source loads.

☒ Natural background loads should not be assumed to be the difference between the sum of known and quantified anthropogenic sources and the existing *in situ* loads (e.g. measured in stream) unless it can be demonstrated that all significant anthropogenic sources of the pollutant of concern have been identified, characterized, and properly quantified.

☒ The sampling data relied upon to discover, characterize, and quantify the pollutant sources should be included in the document (e.g. a data appendix) along with a description of how the data were analyzed to characterize and quantify the pollutant sources. A discussion of the known deficiencies and/or gaps in the data set and their potential implications should also be included.

Recommendation:
☐ Approve ☒ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The TMDL document identifies the land use in the lower portion of the watershed as predominately agricultural consisting of rangeland (61 percent) cropland and pasture land (24 percent), urban (7 percent), and forest and other land uses (8 percent). The specific landuse breakdown for each segment is included in Table 8 of the TMDL.

The City of Rapid City is located in the upper most segment (SD-CH-R-RAPID_03, TMDL Figure 2) of the Creek. This segment flows through Rapid City (population ~ 67,000) and is impacted by stormwater runoff contributing fecal coliform and *E. coli* loading to Rapid Creek. Rapid City has an approved Municipal Separate Storm Sewer Systems (MS4) stormwater permit (Permit # SDR41A007) which was issued in 2003 by SD DENR.

Rapid City also has a wastewater treatment facility (RC WWTF) that discharges into Rapid Creek between monitoring stations ASTP and BSTP (Figure 2). Rapid City was issued a discharge permit (Permit # SD-0023574) in 2001 by SD DENR. As part of their permit, fecal coliform bacteria are routinely sampled three times per week from May 1st through September 30th each year. This permit will be updated to include monitoring *E. coli* bacteria. However, beginning in 2009, the RC WWTF began sampling *E. coli* bacteria as part of their routine sampling to monitor and track *E. coli* concentrations in their effluent.

Based on review of available information and communication with state and local authorities, the primary non-point sources of fecal coliform and by default *E. coli* bacteria within the Lower Rapid Creek watershed include agricultural runoff, wildlife, and human sources. Using the best available information, potential loadings were estimated based on total production potential for each source and landuse using the EPA's Bacterial Indicator Tool (BIT) based on the density and distribution of animals (livestock and wildlife) and failing septic systems in the watershed (US EPA, 2000). The BIT does not have *E. coli* specific production values incorporated into its reference tables. However, in this watershed, *E. coli* concentrations were significantly related to fecal coliform bacteria concentrations; therefore, fecal coliform bacteria were used as a surrogate for *E. coli* production potential. Thus, fecal coliform production sources and percentages were applied to *E. coli* bacteria sources and percentages and interpreted as bacterial loading.

COMMENTS: It is not clear how the results from the BIT model were used in the TMDL. From the written description it appears that the model can include point sources, but there is no mention of including the RC WWTP in the model. Was there any calibration using the monitoring data from the watershed with the BIT model or were results from the model just used to provide additional information on potential source contributions? The last paragraph in Section 4.4 mentions watershed wide bacterial production based on a percentage from each of the main sources – what percent of the total production comes from the RC WWTP? Is all of the "urban" bacterial production coming from the RC MS4?

SD DENR Response:

The following was added to the Significant Sources section (Section 4.4) of the report.

Comment: It is not clear how the results from the BIT model were used in the TMDL.

Response:

BIT model results were used to provide additional information on potential source contributions based on land use. These data may be used to identify which landuse types have the highest potential to contribute bacterial load based on animal numbers and total bacterial production.

Comment: From the written description it appears that the model can include point sources, but there is no mention of including the RC WWTP in the model.

Response:

Point sources (RC MS4 and RC WWTP) were calculated separately and included in the overall bacterial production calculation in Table 8. The model estimates septic failures and cattle in the stream which are considered non-point source loads not point source "permitted" facilities.

Comment: Was there any calibration using the monitoring data from the watershed with the BIT model or were results from the model just used to provide additional information on potential source contributions?

Response:

Non-point source BIT calibration consisted of using the best available and most reliable animal numbers directly from reputable sources. Data sources included agricultural and livestock numbers from NASS 2009, wildlife numbers from SD GF&P, septic numbers from the City if Rapid City and Pennington County. BIT point source calibration consisted of using the WLA developed and calculated from measured rainfall, rainfall depth, MEP estimates and measured water quality data for the Rapid City stormwater MS4 and by using the WLA developed from the permitted bacterial effluent limit for the Rapid City WWTP based on South Dakota water quality standards and plant design flows. These data were used along with Best Professional Judgment (BPJ) to reliably estimate the total bacterial production in the Lower Rapid Creek watershed.

The BIT model was used to provide additional information on potential source contributions based on landuse.

Comment: The last paragraph in Section 4.4 mentions watershed wide bacterial production based on a percentage from each of the main sources – what percent of the total production comes from the RC WWTP?

Response:

As a portion of total watershed production, point source bacterial production loadings were a small percentage with Rapid City MS4 and Rapid City WWTP each contributing approximately 0.01 percent of the total bacterial production in Lower Rapid Creek (Table 8).

Comment: Is all of the "urban" bacterial production coming from the RC MS4?

Response:

No, in segment SD-CH-R-RAPID_03, 89.8 percent of the bacterial production comes from storm water and build up areas; however, on a watershed basis, urban use contributes 43.8 percent of the bacterial production (Table 8).

4. TMDL Technical Analysis

TMDL determinations should be supported by a robust data set and an appropriate level of technical analysis**.** This applies to **all** of the components of a TMDL document. It is vitally important that the technical basis for **all** conclusions be articulated in a manner that is easily understandable and readily apparent to the reader.

A TMDL analysis determines the maximum pollutant loading rate that may be allowed to a waterbody without violating water quality standards. The TMDL analysis should demonstrate an understanding of the relationship between the rate of pollutant loading into the waterbody and the resultant water quality impacts. This stressor → response relationship between the pollutant and impairment and between the selected targets, sources, TMDLs, and load allocations needs to be clearly articulated and supported by an appropriate level of technical analysis. Every effort should be made to be as detailed as possible, and to base all conclusions on the best available scientific principles.

The pollutant loading allocation is at the heart of the TMDL analysis. TMDLs apportion responsibility for taking actions by allocating the available assimilative capacity among the various point, non-point, and natural pollutant sources. Allocations may be expressed in a variety of ways, such as by individual discharger, by tributary watershed, by source or land use category, by land parcel, or other appropriate scale or division of responsibility.

The pollutant loading allocation that will result in achievement of the water quality target is expressed in the form of the standard TMDL equation:

$$TMDL = \sum LAs + \sum WLAs + MOS$$

Where:

TMDL = Total Pollutant Loading Capacity of the waterbody

LAs = Pollutant Load Allocations

WLAs = Pollutant Wasteload Allocations

MOS = The portion of the Load Capacity allocated to the Margin of safety.

Minimum Submission Requirements:

☒ A TMDL must identify the loading capacity of a waterbody for the applicable pollutant, taking into consideration temporal variations in that capacity. EPA regulations define loading capacity as the greatest amount of a pollutant that a water can receive without violating water quality standards (40 C.F.R. §130.2(f)).

☒ The total loading capacity of the waterbody should be clearly demonstrated to equate back to the pollutant load allocations through a balanced TMDL equation. In instances where numerous LA, WLA and seasonal TMDL capacities make expression in the form of an equation cumbersome, a table may be substituted as long as it is clear that the total TMDL capacity equates to the sum of the allocations.

☒ The TMDL document should describe the methodology and technical analysis used to establish and quantify the cause-and-effect relationship between the numeric target and the identified pollutant sources. In many instances, this method will be a water quality model.

☒ It is necessary for EPA staff to be aware of any assumptions used in the technical analysis to understand and evaluate the methodology used to derive the TMDL value and associated loading allocations. Therefore, the

TMDL document should contain a description of any important assumptions (including the basis for those assumptions) made in developing the TMDL, including but not limited to:

(1) the spatial extent of the watershed in which the impaired waterbody is located and the spatial extent of the TMDL technical analysis;
(2) the distribution of land use in the watershed (e.g., urban, forested, agriculture);
(3) a presentation of relevant information affecting the characterization of the pollutant of concern and its allocation to sources such as population characteristics, wildlife resources, industrial activities etc…;
(4) present and future growth trends, if taken into consideration in determining the TMDL and preparing the TMDL document (e.g., the TMDL could include the design capacity of an existing or planned wastewater treatment facility);
(5) an explanation and analytical basis for expressing the TMDL through surrogate measures, if applicable. Surrogate measures are parameters such as percent fines and turbidity for sediment impairments; chlorophyll *a* and phosphorus loadings for excess algae; length of riparian buffer; or number of acres of best management practices.

☒ The TMDL document should contain documentation supporting the TMDL analysis, including an inventory of the data set used, a description of the methodology used to analyze the data, a discussion of strengths and weaknesses in the analytical process, and the results from any water quality modeling used. This information is necessary for EPA to review the loading capacity determination, and the associated load, wasteload, and margin of safety allocations.

☒ TMDLs must take critical conditions (e.g., steam flow, loading, and water quality parameters, seasonality, etc…) into account as part of the analysis of loading capacity (40 C.F.R. §130.7(c)(1)). TMDLs should define applicable critical conditions and describe the approach used to determine both point and non-point source loadings under such critical conditions. In particular, the document should discuss the approach used to compute and allocate non-point source loadings, e.g., meteorological conditions and land use distribution.

☐ Where both non-point sources and NPDES permitted point sources are included in the TMDL loading allocation, and attainment of the TMDL target depends on reductions in the non-point source loads, the TMDL document must include a demonstration that non-point source loading reductions needed to implement the load allocations are actually practicable [40 CFR 130.2(i) and 122.44(d)].

Recommendation:
☐ Approve ☒ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The technical analysis should describe the cause and effect relationship between the identified pollutant sources, the numeric targets, and achievement of water quality standards. It should also include a description of the analytical processes used, results from water quality modeling, assumptions and other pertinent information. The technical analysis for the Lower Rapid Creek TMDL describes how the fecal coliform loads were derived in order to meet the applicable water quality standards for the 303(d) impaired stream segments.

The South Dakota Department of Environment and Natural Resources (SD DENR) have collected fecal coliform bacteria samples at various locations along Lower Rapid Creek since 1967. *E. coli* bacteria sampling was initiated in the summer of 2000 at WQM 19 (DENR 460910) near Farmingdale, SD. Average daily discharge data from these sites were used with SD DENR WQM and assessment water quality data to develop segment specific load duration curves for analysis. Flow data from monitoring site 06414000 at Rapid City were compared to the limited flow data available at 06416000 below Hawthorn Ditch (HAW). Discharge was similar enough to use flows from 06414000 at Rapid City to supplement and expand flow range at 06416000 below Hawthorn Ditch. Stream flows at the other two USGS monitoring sites in Rapid Creek had long-term data sets with segment SD-CHR-RAPID_04 having 28 years and segment SD-CH-R-RAPID_05 having 49 years.

Recreational beneficial use standards are applicable only from May through September (recreation season). Only discharge data collected during the recreation season from each stream segment were used to develop the flow duration curves. Recreational season discharge dates ranged from 1950 through 2008 for segment SD-CH-R-RAPID_03, 1981 through 2009 for segment SD-CH-R-RAPID_04, and 1960 through 2009 for segment SD-CH-RRAPID_05.

The TMDLs were developed using the Load Duration Curve (LDC) approach, resulting in a flow-variable target that considers the entire flow regime within the recreational season (May 1st – September 30th). The LDC is a dynamic expression of the allowable load for any given day within the recreation season. To aid in interpretation and implementation of the TMDL, the LDC flow intervals were grouped into five flow zones: high flows (0–10%), moist conditions (10–40%), mid-range flows (40–60%), dry conditions (60–90%), and low flows (90–100%) according to EPA's *An Approach for Using Load Duration Curves in the Development of TMDLs* (US EPA, 2006). Flow zones were adjusted based on the number of data points (instantaneous samples) within the each standard LDC flow interval. This was done when the numbers of data points in the regular flow zones were less than two to increase the total number of observed samples for comparison. This procedure was only used in segment SD-CH-RRAPID_03 to increase the high and low flow zones by 5% to increase the number of data points within these zones.

The LDCs shown in Figures 4 - 6 and Figure 8 in the TMDL document, represent dynamic expressions of parameter-specific TMDLs for each impaired segment of Lower Rapid Creek that are based on the daily maximum fecal coliform bacteria, *E. coli* bacteria, resulting in a unique maximum daily load that corresponds to a measured average daily flow. The curves include the individual data points shown as triangle and diamond symbols as well as a dashed line that represents an approximate geometric mean values within each flow zone. Using this approach, the resulting loading capacities were derived for each listed segment, for each of the flow zones, and are shown in Tables 16 – 22 of the TMDL document.

To ensure that all applicable water quality standards are met, TMDL loads were set according to the criterion (either acute or chronic) that required the greatest load reduction percentage by flow zone for each of the three listed segments of lower Rapid Creek. The TMDL loading capacities in all three segments are based on the acute criterion (400 CFU/100 mL). These loads, when met, will attain compliance with all applicable water quality standards for fecal coliform and *E. coli* bacteria.

COMMENTS: Lower Rapid Creek, as a "blended" water with both point source and non-point source contributions in two of the listed segments, needs to include a demonstration of reasonable assurance in the TMDL. The TMDL document must include a demonstration that non-point source loading reductions in segments SD-CH-R-RAPID_03 and SD-CH-R-RAPID_04, which are needed to implement the load allocations, are actually practicable. We recommend adding a reasonable assurance description that includes: an analysis of the technical feasibility of achieving non-point source load reductions through BMP control implementation; and a description of existing BMP implementation underway as well as current and future plans to ensure BMP implementation. When the NPDES permits are reissued for the Rapid City MS4 and WWTP, the State permit and non-point source programs should assess the progress in non-point source load reduction (see 40 CFR Section 122.44(d)). As part of the reasonable assurance demonstration we also recommend a statement indicating the likelihood that the non-point source controls needed to achieve the specified load reductions will get implemented in those two segments, and the estimated length of time it will take to achieve the non-point source reductions.

SD DENR Response:

The following Section (11.0) was added to the report.

Reasonable assurance means a demonstration that the wasteload and load allocations will be realized through regulatory or voluntary actions. Rapid Creek segments SD-CH-R-RAPID_03 and SD-CH-R-RAPID_04 are impaired by both point and non-point sources and that these TMDLs have been developed for wasteload allocations may reflect anticipated or expected reductions of pathogen indicators from other sources if those anticipated or expected reductions are supported by a reasonable assurance that they will occur (CFR 40-130.2g).

Reasonable assurance of the TMDL established for segment SD-CH-R-RAPID_03 and SD-CH-R-RAPID_04 in Lower Rapid Creek will require a comprehensive approach that addresses:

- regulated stormwater and wastewater discharges under MS4 and NPDES permits
- non-point source pollution outside MS4 area
- existing and potential future sources
- regulatory and voluntary approaches

There is reasonable assurance that the goals of these TMDLs established for Lower Rapid Creek can be met with proper planning between state and local regulatory agencies, organizations and stakeholders, BMP implementation, and access to adequate financial resources.

The TMDL wasteload allocation (WLA) for segment SD-CH-R-RAPID_03 is from the Rapid City stormwater discharge that is regulated through the Rapid City MS4 permit; while the WLA for segment SD-CH-R-RAPID_04 is from the Rapid City WWTP which is regulated by the Rapid City NPDES permit.

Point Sources

Rapid City has adopted City Ordinance NO. 5355, 5356 and 5357 dealing with stormwater runoff and has installed two stormwater detention/infiltration ponds along Rapid Creek to control TSS and bacteria concentrations in segment SD-CH-R-RAPID_03. The Rapid City WWTP located in segment SD-CH-R-RAPID_04 continues to operate in compliance with their NPDES permit and has been upgrading their treatment system with new technology to improve plant efficiencies and water quality in Lower Rapid Creek.

Stormwater MS4

- Construct additional stormwater ponds along Rapid Creek
- Construct stormwater wetlands near stormwater outfalls
- Construct linear wetlands along drainage basins
- Continue stormwater monitoring and modeling
- Continue pet clean-up/education: Education programs for pet owners can improve water quality of runoff from urban areas.

Rapid City WWTP

- Continue scheduled sewer repair
- Continue upgrading treatment system as new technologies become available
- Extend ultra-violet effluent treatment from the recreation season (May through September) to year round to help reduce fecal coliform/*E. coli* concentrations in Rapid Creek which may decrease or control possible sediment source bacterial re-suspension during higher event flows.

Previous and continued commitment and support from local governments (City of Rapid City) to permit compliance, facility improvement, and improving water quality provide a reasonable assurance that future efforts in point source reduction and control will continue towards achieving TMDL targets and improved water quality in Lower Rapid Creek watershed.

Non-point Source

The City of Rapid City and Pennington County have adopted On-Site Wastewater Treatment Ordinances regulating septic systems within Rapid City and Pennington County, Ordinance NO. 4083 and 34-08, respectively. These ordinances require periodic inspections of on-site treatment systems throughout the

Lower Rapid Creek watershed and if deficiencies are found require timely mitigation. When fully implemented, these ordinances should reduce fecal coliform and *E. coli* concentrations in segments SD-CH-R-RAPID_03, SD-CH-R-RAPID_04, and SD-CH-R-RAPID_05 of Lower Rapid Creek.

There are many active watershed groups that provide watershed stewardship and have vested interest in the Lower Rapid Creek watershed. These include the City of Rapid City, Rapid Valley Water District, Pennington County, South Dakota GFP, Pennington County Conservation District, Natural Resource Conservation Service, Black Hills Fly Fishers, Cheyenne River Watershed Partnership, South Dakota School of Mines and Technology, and the United States Geological Survey. These groups have supported the Lower Rapid Creek Assessment Project with comments, technical and/or financial support and are eager to plan and support an upcoming implementation project.

The City of Rapid City and Pennington County are committed to reducing non-point source bacterial concentrations in Lower Rapid Creek by enacting on-site wastewater treatment ordinances requiring inspections and mitigation. The past and present support of from local governments and the substantial number of active watershed groups that support an implementation project in Lower Rapid Creek provides reasonable assurance that future efforts in non-point source reduction achieving TMDL targets and improved water quality in Lower Rapid Creek watershed.

Reasonable assurance for non-point sources by segment in Lower Rapid Creek will be accomplished through methods and projects outlined in Section 12.0 Restoration Strategy but are not exhaustive.

4.1 Data Set Description

TMDL documents should include a thorough description and summary of all available water quality data that are relevant to the water quality assessment and TMDL analysis. An inventory of the data used for the TMDL analysis should be provided to document, for the record, the data used in decision making. This also provides the reader with the opportunity to independently review the data. The TMDL analysis should make use of all readily available data for the waterbody under analysis unless the TMDL writer determines that the data are not relevant or appropriate. For relevant data that were known but rejected, an explanation of why the data were not utilized should be provided (e.g., samples exceeded holding times, data collected prior to a specific date were not considered timely, etc…).

Minimum Submission Requirements:

☒ TMDL documents should include a thorough description and summary of all available water quality data that are relevant to the water quality assessment and TMDL analysis such that the water quality impairments are clearly defined and linked to the impaired beneficial uses and appropriate water quality criteria.

☒ The TMDL document submitted should be accompanied by the data set utilized during the TMDL analysis. If possible, it is preferred that the data set be provided in an electronic format and referenced in the document. If electronic submission of the data is not possible, the data set may be included as an appendix to the document.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The Lower Rapid Creek TMDL data description and summary are included mostly in the Technical Analysis section of the document, and the full data set is in Appendix A of the TMDL. The South Dakota Department of Environment and Natural Resources (SD DENR) have collected fecal coliform bacteria samples at various locations along Lower Rapid Creek from 1967 to present. *E. coli* bacteria sampling was initiated in the summer of 2000 at WQM 19 (DENR 460910) near Farmingdale, SD. The data set also includes the flow record on the Lower Rapid Creek that was used to create the load duration curve for the three segments included in this TMDL.

COMMENTS: None.

4.2 Waste Load Allocations (WLA):

Waste Load Allocations represent point source pollutant loads to the waterbody. Point source loads are typically better understood and more easily monitored and quantified than non-point source loads. Whenever practical, each point source should be given a separate waste load allocation. All NPDES permitted dischargers that discharge the pollutant under analysis directly to the waterbody should be identified and given separate waste load allocations. The finalized WLAs are required to be incorporated into future NPDES permit renewals.

Minimum Submission Requirements:

☒ EPA regulations require that a TMDL include WLAs for all significant and/or NPDES permitted point sources of the pollutant. TMDLs must identify the portion of the loading capacity allocated to individual existing and/or future point source(s) (40 C.F.R. §130.2(h), 40 C.F.R. §130.2(i)). In some cases, WLAs may cover more than one discharger, e.g., if the source is contained within a general permit. If no allocations are to be made to point sources, then the TMDL should include a value of zero for the WLA.

☒ All NPDES permitted dischargers given WLA as part of the TMDL should be identified in the TMDL, including the specific NPDES permit numbers, their geographical locations, and their associated waste load allocations.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The City of Rapid City is located in the upper portion of the study area approximately between monitoring sites ABCL and the coldwater/warmwater fisheries change in Rapid Creek S15 T1N R8E (segment SD-CH-R-RAPID_03). This segment flows through Rapid City (population ~ 67,000) and is impacted by stormwater runoff contributing fecal coliform and *E. coli* loading to Rapid Creek. Rapid City has an approved Municipal Separate Storm Sewer Systems (MS4) stormwater permit (Permit # SDR41A007) which was issued in 2003 by SD DENR. The WLA for segment SD-CHR-RAPID_03 is stormwater discharge from the MS4. The WLA for fecal coliform was calculated by SDSM&T personnel and approved by SD DENR Surface Water Quality Program (SWQP) staff. The WLA allocation was derived by treating all runoff to a depth of 0.5 inches based on the exponential distribution of all rainfall events and treatment to
the maximum extent practicable. Based on these calculations, best management practices would treat 85 percent of all runoff occurring in Rapid City. Details on the MS4 WLA can be found in Appendix B of the TMDL.

Rapid City has a wastewater treatment facility (RC WWTF) that discharges into Rapid Creek between ASTP and BSTP (segment SD-CH-R-RAPID_04)). Rapid City was issued a discharge permit (Permit # SD-0023574) in 2001 by SD DENR. As part of their permit, fecal coliform bacteria are routinely sampled three times per week from May 1st through September 30th each year. This permit will be updated to include monitoring *E. coli* bacteria. The fecal coliform WLA for the RC WWTF was calculated to be 2.27E+11 CFU/day derived from a design flow of 15 million gallons per day and a discharge limit of 400 cfu/100mL. The RC WWTF has a continuous discharge so the WLA is applicable throughout the entire flow regime during the recreation season May 1 – September 30.

The lowest segment, SD-CH-R-RAPID_05, has no point source discharges.

COMMENTS: Section 4.1.2 says: "This permit will be updated to include monitoring *E. coli* bacteria." The permit should also be updated to include *E. coli* effluent limitations to ensure that the water quality standards will be met during the recreation season.

SD DENR Response:

The following was added to the Point Sources section (Section 4.1.2) of the report.

> Rapid City has a wastewater treatment facility (RC WWTF) that discharges into Rapid Creek between monitoring sites ASTP and BSTP (Figure 2). Rapid City was issued a discharge permit (Permit # SD-0023574) in 2001 by SD DENR. As part of their permit, fecal coliform bacteria are routinely sampled three times per week from May 1st through September 30th each year. This permit will be updated to include monitoring *E. coli* bacteria. The permit will also be updated to include *E. coli* bacteria effluent limitations to ensure that the water quality standards will be met during the recreation season. Beginning in 2009, the RC WWTF began sampling *E. coli* bacteria as part of their routine sampling to monitor and track *E. coli* concentrations in their effluent

4.3 Load Allocations (LA):

Load allocations include the non-point source, natural, and background loads. These types of loads are typically more difficult to quantify than point source loads, and may include a significant degree of uncertainty. Often it is necessary to group these loads into larger categories and estimate the loading rates based on limited monitoring data and/or modeling results. The background load represents a composite of all upstream pollutant loads into the waterbody. In addition to the upstream non-point and upstream natural load, the background load often includes upstream point source loads that are not given specific waste load allocations in this particular TMDL analysis. In instances where non-point source loading rates are particularly difficult to quantify, a performance-based allocation approach, in which a detailed monitoring plan and adaptive management strategy are employed for the application of BMPs, may be appropriate.

Minimum Submission Requirements:

☒ EPA regulations require that TMDL expressions include LAs which identify the portion of the loading capacity attributed to non-point sources and to natural background. Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. §130.2(g)). Load allocations may be included for both existing and future non-point source loads. Where possible, load allocations should be described separately for natural background and non-point sources.

☒ Load allocations assigned to natural background loads should not be assumed to be the difference between the sum of known and quantified anthropogenic sources and the existing *in situ* loads (e.g., measured in stream) unless it can be demonstrated that all significant anthropogenic sources of the pollutant of concern have been identified and given proper load or waste load allocations.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: In segment SD-CH-R-RAPID_03, the fecal coliform data indicates a steady increase in the coliform concentrations from late spring to midsummer during base flow conditions. Possible non-point sources of fecal coliform loading during base flow conditions in this segment include wildlife, domestic animals, septic systems and potential leaking sewers. Landuse below the HAW monitoring site gradually transitions from urban to agricultural cropland, pastureland, rangeland, with some rural development and increasing numbers of septic systems. Load allocation sources based on production potentials by landuse type comprised livestock and manure management on agricultural and pastureland/rangeland. Based on

LDC TMDL analysis, current LAs will need to be reduced by approximately 78 percent to meet the TMDL developed for this segment of Rapid Creek in the high flow zone.

In segment SD-CH-R-RAPID_04, load allocations will require a significant load reduction in the high and moist flow zones. Based on recent data, the TMDL specifies a 95 percent reduction in the fecal coliform loading in the high flow zone and 84 percent in the moist flow zone with the remaining flow zones meeting TMDL standards based on the acute criteria. Most of the landuse in this segment is agricultural (mostly pastureland/rangeland and cropland) which make up approximately 92 percent of the landuse. Possible non-point sources of excess fecal coliform loading during high flow conditions in this segment include riparian area grazing by livestock, manure application to pastureland/rangeland and cropland, intensive grazing and over-wintering livestock in the riparian zone. Another potential source of increased fecal coliform loading in this segment of Rapid Creek is failing septic systems. Based on public input and information from local agencies, the largest numbers of suspected failing septic systems exist in this segment and are presumed to be located above the WQM monitoring site below the RC WWTF. Septic systems by definition are considered non-point source load and thus are wholly part of the load allocation portion of the TMDL. An estimated 27 percent reduction from failing septic systems is necessary to achieve the overall load reduction needed to help meet the TMDL set for this segment of Rapid Creek.

Landuse in segment SD-CH-R-RAPID_05 is similar to segment SD-CH-R-RAPID_04 in that most of the landuse is agricultural (pastureland/rangeland) and comprises 98 percent of all landuse. TMDL specifies an 80 percent reduction in fecal coliform loading for the high flow zone and a 74 percent load reduction in the moist flow zone. Sources of excess fecal coliform loading during high flow conditions in this segment are similar to segment SD-CH-R-RAPID_04 and include runoff from riparian area grazing, manure application to pastureland/rangeland, wintering livestock in and around the riparian zone, and intensive grazing practices. It is assumed that a significant portion of the local load reductions necessary to meet water quality standards in segment SD-CH-R-RAPID_05 will be achieved through BMP reductions in fecal coliform realized in upstream segment SD-CH-R-RAPID_04.

Flow zones requiring reductions to meet flow zone-specific *E. coli* bacteria TMDLs were identical to flow zones based on fecal coliform bacteria for this stream segment (SD-CH-RRAPID_05). *E. coli* loads in the high flow zone were estimated using regression analysis between *E. coli* and fecal coliform bacteria and applying the regression equation to fecal coliform concentrations in the high flow zone to predict *E. coli* concentrations and ultimately loading in the high flow zone.

A significant uncertainty for this segment is the persistence of fecal coliform in the stream and bank sediments. From October through April, fecal coliform discharges from the RC WWTF are un-regulated. If fecal coliform can survive in various microhabitats within stream sediment, they are subject to re-suspension during high-flow/event conditions in spring and early summer.

COMMENTS: If fecal coliform and other bacterial indicators are surviving within stream sediment due to un-regulated discharge from the RC WWTP during the recreation off season (i.e., Oct – April), then we suggest that a research project be initiated to investigate this potential source and make recommendations for controls, such as off season treatment, as necessary.

The WLA description for Segment 03 mentions that stormwater BMPs should be designed to treat all runoff up to 0.5 inches. We recognize that the focus of the stormwater WLA calculations were based on the need to treat the runoff, however, as part of the stormwater permit modifications and implementation plan we suggest looking at BMPs that will reduce runoff in addition to treatment designs. Also, the approach used in the TMDL to allocate a single WLA to all MS4 stormwater sources, without understanding which outfalls or landuse types (e.g., residential, commercial, industrial) contribute larger loads, will present additional challenges during implementation when prioritizing implementation resources. The following web sites and documents are by no means the only resources available, but may provide a beginning point for implementation design:

http://www.epa.gov/owow/tmdl/pdf/tmdl-sw_permits11172008.pdf
http://www.epa.gov/owow/nps/lid/
http://www.epa.gov/ne/npdes/stormwater/assets/pdfs/IncorporatingLID.pdf
http://www.lowimpactdevelopment.org/

SD DENR Response:

COMMENTS: If fecal coliform and other bacterial indicators are surviving within stream sediment due to un-regulated discharge from the RC WWTP during the recreation off season (i.e., Oct – April), then we suggest that a research project be initiated to investigate this potential source and make recommendations for controls, such as off season treatment, as necessary.

Response:

Added the list to study pathogens in sediments (see below).

Within segment SD-CH-R-RAPID_04, BMPs that reduce fecal coliform/*E. coli* loads should include but are not limited to:

- relocation or implementation of stormwater runoff treatment systems from critical concentrated livestock feeding areas adjacent to Rapid Creek,
- implement management practices to improve and protect the riparian buffer zone through grazing management practices with off-stream watering and residential zoning,
- continued implementation of the septic system inspection program within one-mile of Rapid City limits to document the condition of existing septic tank systems, identify failing systems and develop a mechanism/program to repair or replace failing systems
- investigate the survival, longevity and decay rate of pathogens in the sediments of Rapid Creek over extended periods of time.

and

The following was/is in Section 12.0 about further study.

The Rapid City WWTF NPDES permit allows discharge of high concentrations of fecal coliform from October through April. There is limited knowledge on the survival of fecal coliform bacteria and associated pathogens in the stream and bank sediments. With survival, these pathogens are subject to re-suspension with high flows or other channel disturbances in spring and summer. As part of an implementation plan, it would be beneficial to supply funds to investigate the survival, longevity and decay rate of pathogens in the sediments of Rapid Creek over extended periods of time.

Comment: The WLA description for Segment 03 mentions that stormwater BMPs should be designed to treat all runoff up to 0.5 inches. We recognize that the focus of the stormwater WLA calculations were based on the need to treat the runoff, however, as part of the stormwater permit modifications and implementation plan we suggest looking at BMPs that will reduce runoff in addition to treatment designs.

Response:

The critical area within segment SD-CH-R-RAPID_03 is treatment of stormwater runoff from the highly impervious commercial area of Rapid City, representing segment SD-CH-R-RAPID_03. BMPs that reduce fecal coliform/*E. coli* loads and control stormwater runoff should include but are not limited to:

- continue development and implementation of a stormwater management program with BMPs designed to treat runoff from rainfall events up to 0.5 inch, however, as part of the stormwater permit modifications and implementation plan consider looking at BMPs that will treat reduce runoff in addition to just targeting treatment designs.
- implementation of low impact development techniques, especially for future development,
- continued implementation of the septic system inspection program within one-mile of Rapid City limits to document the condition of existing septic tank systems, identify failing systems and develop a mechanism/program to repair or replace failing systems, and,
- phase in inspections for on-site wastewater treatment systems within Pennington County as per county ordinance # 34-08 adopted 2010, especially along the riparian zones of Rapid Creek.

Comment: Also, the approach used in the TMDL to allocate a single WLA to all MS4 stormwater sources, without understanding which outfalls or landuse types (e.g., residential, commercial, industrial) contribute larger loads, will present additional challenges during implementation when prioritizing implementation resources. The following web sites and documents are by no means the only resources available, but may provide a beginning point for implementation:

Response:

The following sentences were added to Section 12.0 as requested.

> The TMDL to allocate a single WLA to all MS4 stormwater sources, without understanding which outfalls or landuse types (e.g., residential, commercial, industrial) contribute larger loads, will present additional challenges during implementation when prioritizing implementation resources. The following web sites and documents are by no means the only resources available, but may provide a beginning point for implementation:
>
> http://www.epa.gov/owow/tmdl/pdf/tmdl-sw_permits11172008.pdf
> http://www.epa.gov/owow/nps/lid/
> http://www.epa.gov/ne/npdes/stormwater/assets/pdfs/IncorporatingLID.pdf
> http://www.lowimpactdevelopment.org/
>
> The City of Rapid City may want to fund as part of the implementation project, a SWMM model for Rapid City.

4.4 Margin of Safety (MOS):

Natural systems are inherently complex. Any mathematical relationship used to quantify the stressor → response relationship between pollutant loading rates and the resultant water quality impacts, no matter how rigorous, will include some level of uncertainty and error. To compensate for this uncertainty and ensure water quality standards will be attained, a margin of safety is required as a component of each TMDL. The MOS may take the form of a explicit load allocation (e.g., 10 lbs/day), or may be implicitly built into the TMDL analysis through the use of conservative assumptions and values for the various factors that determine the TMDL pollutant load → water quality effect relationship. Whether explicit or implicit, the MOS should be supported by an appropriate level of discussion that addresses the level of uncertainty in the various components of the TMDL technical analysis, the assumptions used in that analysis, and the relative effect of those assumptions on the final TMDL. The discussion should demonstrate that the MOS used is sufficient to ensure that the water quality standards would be attained if the TMDL pollutant loading rates are met. In cases where there is substantial uncertainty regarding the linkage between the proposed allocations and achievement of water quality standards, it may be necessary to employ a phased or adaptive management approach (e.g., establish a monitoring plan to determine if the proposed allocations are, in fact, leading to the desired water quality improvements).

Minimum Submission Requirements:

☒ TMDLs must include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)). EPA's 1991 TMDL Guidance explains that the MOS may be implicit (i.e., incorporated into the TMDL through conservative assumptions in the analysis) or explicit (i.e., expressed in the TMDL as loadings set aside for the MOS).

- ☐ If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS should be identified and described. The document should discuss why the assumptions are considered conservative and the effect of the assumption on the final TMDL value determined.
- ☒ If the MOS is explicit, the loading set aside for the MOS should be identified. The document should discuss how the explicit MOS chosen is related to the uncertainty and/or potential error in the linkage analysis between the WQS, the TMDL target, and the TMDL loading rate.
- ☐ If, rather than an explicit or implicit MOS, the TMDL relies upon a phased approach to deal with large and/or unquantifiable uncertainties in the linkage analysis, the document should include a description of the planned phases for the TMDL as well as a monitoring plan and adaptive management strategy.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The Lower Rapid Creek TMDLs include explicit MOSs for each segment derived by calculating the difference between the loading capacity at the mid-point of each of the five flow zones and the loading capacity at the minimum flow in each zone. The explicit MOS values are included in Tables 15 - 22 of the TMDL.

COMMENTS: None.

4.5 Seasonality and variations in assimilative capacity:

The TMDL relationship is a factor of both the loading rate of the pollutant to the waterbody and the amount of pollutant the waterbody can assimilate and still attain water quality standards. Water quality standards often vary based on seasonal considerations. Therefore, it is appropriate that the TMDL analysis consider seasonal variations, such as critical flow periods (high flow, low flow), when establishing TMDLs, targets, and allocations.

Minimum Submission Requirements:

☒ The statute and regulations require that a TMDL be established with consideration of seasonal variations. The TMDL must describe the method chosen for including seasonal variability as a factor. (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)).

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: By using the load duration curve approach to develop the TMDL allocations seasonal variability in fecal coliform loads are taken into account. Highest steam flows typically occur during late spring, and the lowest stream flows occur during the winter months.

COMMENTS: None.

5. Public Participation

EPA regulations require that the establishment of TMDLs be conducted in a process open to the public, and that the public be afforded an opportunity to participate. To meaningfully participate in the TMDL process it is necessary that stakeholders, including members of the general public, be able to understand the problem and the proposed solution. TMDL documents should include language that explains the issues to the general public in understandable terms, as well as provides additional detailed technical information for the scientific community. Notifications or solicitations for comments regarding the TMDL should be made available to the general public, widely circulated, and clearly identify the product as a TMDL and the fact that it will be submitted to EPA for review. When the final TMDL is submitted to EPA for approval, a copy of the comments received by the state and the state responses to those comments should be included with the document.

Minimum Submission Requirements:

☒ The TMDL must include a description of the public participation process used during the development of the TMDL (40 C.F.R. §130.7(c)(1)(ii)).

☐ TMDLs submitted to EPA for review and approval should include a summary of significant comments and the State's/Tribe's responses to those comments.

Recommendation:

☐ Approve ☒ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The State's submittal includes a summary of the public participation process that has occurred which describes the ways the public has been given an opportunity to be involved in the TMDL development process so far. In particular, the State has encouraged participation through public meetings in the watershed, and a website was developed and maintained throughout the project. The TMDL has been available for a 30-day public notice period prior to finalization.

COMMENTS: The Public Participation section (Section 9.0) includes a list of public meetings and presentations to various stakeholder groups. However, the summary does not mention the previous TMDL public notices or other events between 2004 and the present. The section also does not include any summary of significant comments received throughout the process, and the State's response to significant comments received. This section should be updated to reflect public participation up to the present.

SD DENR Response:

The following was added to the Public Participation section (Section 9.0) of this report.

> From 2004 through 2006, the City of Rapid City and Pennington County held many public meetings to develop an On-Site Wastewater Disposal and Treatment Ordinance. By March 2006 Ordinance NO. 4083 was approved and added to Chapter 13.09 to the Rapid City Municipal Code. This Ordinance allows the City of Rapid City to regulate and inspect on-site wastewater systems inside a one-mile buffer around

Rapid City Rapid City limits and the airport. Inspections in within these areas began in 2007. An additional (>30) public and committee meetings (public informational, clean water committee, planning commission, and county commission meetings) were held by the County to further develop the Pennington County On-Site Wastewater Treatment Ordinance. County ordinance 34-08 was approved and adopted in July 2010. The basis for these ordinances were partially due to the results from the Rapid Creek Fecal Coliform/*E. coli* Report and TMDL and Rapid Creek being listed on the 303(d) list as impaired for fecal coliform. Assessment and TMDL data were used to emphasize the need for these ordinances as adaptive and proactive BMP measures to help reduce point and non-point source bacterial loading to Rapid Creek.

In 2007, the original document was revised to include updated SD DENR WQM data sets and re-formatted for informal submittal to US EPA for review. The report and TMDL was submitted to US EPA in January 2008 with comments received in February 2008. After reviewing US EPA responses, SD DENR pulled the document from the submittal process due to significant alterations required to restructure the document to conform to US EPA comments and updated submittal requirements. The current document was significantly updated and modified in 2008 and 2009 and incorporates all US EPA informal comments originally received in 2008.

In 2009, Rapid Creek TMDL data, sampling and analysis methodologies, and results were presented and discussed at multiple meetings with interested parties (SD DENR, Hill City, SDSM&T; Pennington County, US Forest Service, RESPEC Consulting Services, City of Rapid City and interested stakeholders) during design and development of the Spring Creek Implementation Project.

Meetings in 2010 with South Dakota School of Mines and Technology (SDSM&T) and the City of Rapid City on WLAs assigned to Rapid City in segment SD-CH-R-RAPID_03 of the Rapid Creek TMDL have resulted in SDSM&T entering into an agreement (contracts) with the City of Rapid City to study and model three urban watersheds within Rapid City to determine fecal coliform and *E. coli* loading to Rapid Creek with varying degrees of urbanized development and runoff. Data will be used help assess the impact stormwater and development has on bacterial loading in Rapid Creek and the MS4 permit over the next five years.

All comments and public input from meetings, written, or personal communications regarding the Rapid Creek report and TMDL results including current US EPA comments were addressed and incorporated in the current document. Specific responses to US EPA specific comments are attached in Appendix C.

6. Monitoring Strategy

TMDLs may have significant uncertainty associated with the selection of appropriate numeric targets and estimates of source loadings and assimilative capacity. In these cases, a phased TMDL approach may be necessary. For Phased TMDLs, it is EPA's expectation that a monitoring plan will be included as a component of the TMDL document to articulate the means by which the TMDL will be evaluated in the field, and to provide for future supplemental data that will address any uncertainties that may exist when the document is prepared.

Minimum Submission Requirements:

☒ When a TMDL involves both NPDES permitted point source(s) and non-point source(s) allocations, and attainment of the TMDL target depends on reductions in the non-point source loads, the TMDL document should include a monitoring plan that describes the additional data to be collected to determine if the load reductions provided for in the TMDL are occurring.

☒ Under certain circumstances, a phased TMDL approach may be utilized when limited existing data are relied upon to develop a TMDL, and the State believes that the use of additional data or data based on better analytical techniques would likely increase the accuracy of the TMDL load calculation and merit development of a second phase TMDL. EPA recommends that a phased TMDL document or its implementation plan include a monitoring plan and a scheduled timeframe for revision of the TMDL. These elements would not be an intrinsic part of the TMDL and would not be approved by EPA, but may be necessary to support a rationale for approving the TMDL. http://www.epa.gov/owow/tmdl/tmdl_clarification_letter.pdf

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: Lower Rapid Creek will continue to be monitored through SD DENR's ambient water quality monitoring stations on Rapid Creek. Existing and future WQM monitoring sites will be sampled on a monthly basis. SD DENR is in the process of adding a monthly ambient WQM site and installing a permanent stage recorder at the Hawthorn monitoring site in Rapid City to monitor water quality and stream flows in the recently modified segment SD-CH-R-RAPID_03 in Rapid Creek. During the recreation season bacterial monitoring should be increased to collect at least 5 samples per month to assess the geometric mean criterion. Additional monitoring and evaluation efforts should be targeted toward designed urban and rural BMPs to document the effectiveness of implemented BMPs. Monitoring locations should be based on the location and type of BMPs installed. Post-implementation monitoring will be necessary to assure the TMDL has been reached and maintenance of the beneficial use occurs.

COMMENTS: None.

7. Restoration Strategy

The overall purpose of the TMDL analysis is to determine what actions are necessary to ensure that the pollutant load in a waterbody does not result in water quality impairment. Adding additional detail regarding the proposed approach for the restoration of water quality <u>is not</u> currently a regulatory requirement, but is considered a value added component of a TMDL document. During the TMDL analytical process, information is often gained that may serve to point restoration efforts in the right direction and help ensure that resources are spent in the most efficient manner possible. For example, watershed models used to analyze the linkage between the pollutant loading rates and resultant water quality impacts might also be used to conduct "what if" scenarios to help direct BMP installations to locations that provide the greatest pollutant reductions. Once a TMDL has been written and approved, it is often the responsibility of other water quality programs to see that it is implemented. The level of quality and detail provided in the restoration strategy will greatly influence the future success in achieving the needed pollutant load reductions.

Minimum Submission Requirements:

☒ EPA is not required to and does not approve TMDL implementation plans. However, in cases where a WLA is dependent upon the achievement of a LA, "reasonable assurance" is required to demonstrate the necessary LA called for in the document is practicable). A discussion of the BMPs (or other load reduction measures) that are to be relied upon to achieve the LA(s), and programs and funding sources that will be relied upon to implement the load reductions called for in the document, may be included in the implementation/restoration section of the TMDL document to support a demonstration of "reasonable assurance".

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The Restoration Strategy section of the TMDL document says that there's broad support to begin an implementation project within the lower Cheyenne River watershed. Rapid Creek is part of the Cheyenne River watershed and could be included in a larger, basin-wide implementation project. Major entities that should be involved in planning, funding and supporting this project as it pertains to Rapid

Creek are the West Dakota Water Development District, Pennington County, Pennington County Conservation District, the City of Rapid City, Cheyenne River Partnership and the Natural Resource Conservation Service. Funds to implement watershed water quality improvements can be obtained through the SD DENR.

COMMENTS: As noted above in the Technical Analysis comments, the TMDL needs to include a demonstration of reasonable assurance that the non-point source load allocations are achievable and that they will be implemented within a reasonable period of time.

SD DENR Response:
A reasonable assurance section (Section 11) was added to the report reasonable assurance.

8. Daily Loading Expression

The goal of a TMDL analysis is to determine what actions are necessary to attain and maintain WQS. The appropriate averaging period that corresponds to this goal will vary depending on the pollutant and the nature of the waterbody under analysis. When selecting an appropriate averaging period for a TMDL analysis, primary concern should be given to the nature of the pollutant in question and the achievement of the underlying WQS. However, recent federal appeals court decisions have pointed out that the title TMDL implies a “daily” loading rate. While the most appropriate averaging period to be used for developing a TMDL analysis may vary according to the pollutant, a daily loading rate can provide a more practical indication of whether or not the overall needed load reductions are being achieved. When limited monitoring resources are available, a daily loading target that takes into account the natural variability of the system can serve as a useful indicator for whether or not the overall load reductions are likely to be met. Therefore, a daily expression of the required pollutant loading rate is a required element in all TMDLs, in addition to any other load averaging periods that may have been used to conduct the TMDL analysis. The level of effort spent to develop the daily load indicator should be based on the overall utility it can provide as an indicator for the total load reductions needed.

Minimum Submission Requirements:

☒ The document should include an expression of the TMDL in terms of a daily load. However, the TMDL may also be expressed in temporal terms other than daily (e.g., an annual or monthly load). If the document expresses the TMDL in additional “non-daily” terms the document should explain why it is appropriate or advantageous to express the TMDL in the additional unit of measurement chosen.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The Lower Rapid Creek fecal coliform and *E. coli* TMDLs include daily loads expressed as colonies per day. The daily TMDL loads are included in TMDL Section of the TMDL document.

COMMENTS: None.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
1595 Wynkoop Street
DENVER, CO 80202-1129
Phone 800-227-8917
http://www.epa.gov/region08

SEP 2 8 2010

RECEIVED
OCT 5 2010
DEPT. OF ENVIRONMENT AND NATURAL RESOURCES, SECRETARY'S OFFICE

Ref: 8EPR-EP

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

Re: TMDL Approvals
Lower Rapid Creek; Pathogens; SD-CH-R-RAPID_03; SD-CH-R-RAPID_04; SD-CH-R-RAPID_05

Dear Mr. ~~Pirner~~ Steve:

We have completed our review of the total maximum daily loads (TMDLs) as submitted by your office for the waterbodies listed in the enclosure to this letter. In accordance with the Clean Water Act (33 U.S.C. 1251 *et. seq.*), we approve all aspects of the TMDLs as developed for the water quality limited waterbodies as described in Section 303(d)(1). Based on our review, we feel the separate elements of the TMDLs listed in the enclosed table adequately address the pollutants of concern as given in the table, taking into consideration seasonal variation and a margin of safety.

Thank you for submitting these TMDLs for our review and approval. If you have any questions, the most knowledgeable person on my staff is Vern Berry and he may be reached at 303-312-6234.

Sincerely,

Carol L. Campbell

Carol L. Campbell
Assistant Regional Administrator
Office of Ecosystems Protection
and Remediation

Enclosures

ENCLOSURE 1: APPROVED TMDLs

Fecal Coliform, Escherichia coli Bacteria Total Maximum Daily Loads (TMDLs) for Lower Rapid Creek, Pennington County, South Dakota (SD DENR, September 2010)

4	Pollutant TMDLs completed.
4	Causes addressed from the 2010 303(d) list.
	Determinations that no pollutant TMDL needed.

Submitted: 9/7/2010

Segment: Lower Rapid Creek - from above Farmingdale to mouth

303(d) ID: SD-CH-R-RAPID 05

Parameter/Pollutant (303(d) list cause): E. COLI - 227

Water Quality Targets: < = 126 cfu/100 mL 30-day geometric mean; < = 235 cfu/100mL single sample maximum

Allocation*	Value	Units	Permits
WLA	0	CFU/DAY	
MOS	2.6E+11	CFU/DAY	
LA	5.3E+11	CFU/DAY	
TMDL	7.9E+11	CFU/DAY	

Notes: The loads shown represent the loads during the moist flow regime as defined by the load duration curve for lower Rapid Creek, segment 05 (see Figure 6 of the TMDL). The moist range flows are when significant differences occur between the existing loads and the target loads, and represent the flow regime that is most likely to be targeted for BMP implementation.

Parameter/Pollutant (303(d) list cause): FECAL COLIFORM - 259

Water Quality Targets: < = 200 cfu/100 mL 30-day geometric mean; < = 400 cfu/100mL single sample maximum

Allocation*	Value	Units	Permits
WLA	0	CFU/DAY	
TMDL	13.4E+11	CFU/DAY	
MOS	4.4E+11	CFU/DAY	
LA	9.0E+11	CFU/DAY	

Notes: The loads shown represent the loads during the moist flow regime as defined by the load duration curve for lower Rapid Creek, segment 05 (see Figure 6 of the TMDL). The moist range flows are when significant differences occur between the existing loads and the target loads, and represent the flow regime that is most likely to be targeted for BMP implementation.

Date Submitted: 9/7/2010

Segment: Lower Rapid Creek - from lower Rapid City to RC WWTF

303(d) ID: SD-CH-R-RAPID 03

Parameter/Pollutant (303(d) list cause): FECAL COLIFORM - 259

Water Quality Targets: < = 200 cfu/100 mL 30-day geometric mean; < = 400 cfu/100mL single sample maximum

Allocation*	Value	Units	Permits
TMDL	13.5E+11	CFU/DAY	
MOS	2.5E+11	CFU/DAY	
WLA	3.5E+11	CFU/DAY	SDR41A007
LA	7.5E+11	CFU/DAY	

Notes: The loads shown represent the loads during the moist flow regime as defined by the load duration curve for lower Rapid Creek, segment 03 (see Figure 4 of the TMDL). The moist range flows are when significant differences occur between the existing loads and the target loads, and represent the flow regime that is most likely to be targeted for BMP implementation.

Date Submitted: 9/7/2010

Segment: Lower Rapid Creek - from RC WWTF to above Farmingdale

303(d) ID: SD-CH-R-RAPID 04

Parameter/Pollutant (303(d) list cause): FECAL COLIFORM - 259

Water Quality Targets: <= 200 cfu/100 mL 30-day geometric mean; <= 400 cfu/100mL single sample maximum

Allocation*	Value	Units	Permits
LA	12.3E+11	CFU/DAY	
WLA	2.3E+11	CFU/DAY	SD0023574
TMDL	21.5E+11	CFU/DAY	
MOS	6.9E+11	CFU/DAY	

Notes: The loads shown represent the loads during the moist flow regime as defined by the load duration curve for lower Rapid Creek, segment 04 (see Figure 5 of the TMDL). The moist range flows are when significant differences occur between the existing loads and the target loads, and represent the flow regime that is most likely to be targeted for BMP implementation.

* LA = Load Allocation, WLA = Wasteload Allocation, MOS = Margin of Safety, TMDL = sum(WLAs) + sum(LAs) + MOS

ENCLOSURE 2

EPA REGION VIII TMDL REVIEW

TMDL Document Info:

Document Name:	**Fecal Coliform, *Escherichia coli* Bacteria Total Maximum Daily Loads (TMDLs) for Lower Rapid Creek, Pennington County, South Dakota**
Submitted by:	**Cheryl Saunders, SD DENR**
Date Received:	**September 7, 2010**
Review Date:	**September 27, 2010**
Reviewer:	**Vern Berry, EPA**
Rough Draft / Public Notice / Final?	**Final**
Notes:	

Reviewers Final Recommendation(s) to EPA Administrator (used for final review only):

☒ Approve
☐ Partial Approval
☐ Disapprove
☐ Insufficient Information

Approval Notes to Administrator:

This document provides a standard format for EPA Region 8 to provide comments to state TMDL programs on TMDL documents submitted to EPA for either formal or informal review. All TMDL documents are evaluated against the minimum submission requirements and TMDL elements identified in the following 8 sections:

1. Problem Description
   1.1.. TMDL Document Submittal Letter
   1.2. Identification of the Waterbody, Impairments, and Study Boundaries
   1.3. Water Quality Standards
2. Water Quality Target
3. Pollutant Source Analysis
4. TMDL Technical Analysis
   4.1. Data Set Description
   4.2. Waste Load Allocations (WLA)
   4.3. Load Allocations (LA)
   4.4. Margin of Safety (MOS)
   4.5. Seasonality and variations in assimilative capacity
5. Public Participation
6. Monitoring Strategy
7. Restoration Strategy
8. Daily Loading Expression

Under Section 303(d) of the Clean Water Act, waterbodies that are not attaining one or more water quality standard (WQS) are considered "impaired." When the cause of the impairment is determined to be a pollutant, a TMDL analysis is required to assess the appropriate maximum allowable pollutant loading rate.

A TMDL document consists of a technical analysis conducted to: (1) assess the maximum pollutant loading rate that a waterbody is able to assimilate while maintaining water quality standards; and (2) allocate that assimilative capacity among the known sources of that pollutant. A well written TMDL document will describe a path forward that may be used by those who implement the TMDL recommendations to attain and maintain WQS.

Each of the following eight sections describes the factors that EPA Region 8 staff considers when reviewing TMDL documents. Also included in each section is a list of EPA's minimum submission requirements relative to that section, a brief summary of the EPA reviewer's findings, and the reviewer's comments and/or suggestions. Use of the verb "must" in the minimum submission requirements denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation. Use of the term "should" below denotes information that is generally necessary for EPA to determine if a submitted TMDL is approvable.

This review template is intended to ensure compliance with the Clean Water Act and that the reviewed documents are technically sound and the conclusions are technically defensible.

1. Problem Description

A TMDL document needs to provide a clear explanation of the problem it is intended to address. Included in that description should be a definitive portrayal of the physical boundaries to which the TMDL applies, as well as a clear description of the impairments that the TMDL intends to address and the associated pollutant(s) causing those impairments. While the existence of one or more impairment and stressor may be known, it is important that a comprehensive evaluation of the water quality be conducted prior to development of the TMDL to ensure that all water quality problems and associated stressors are identified. Typically, this step is conducted prior to the 303(d) listing of a waterbody through the monitoring and assessment program. The designated uses and water quality criteria for the waterbody should be examined against available data to provide an evaluation of the water quality relative to all applicable water quality standards. If, as part of this exercise, additional WQS problems are discovered and additional stressor pollutants are identified, consideration should be given to concurrently evaluating TMDLs for those additional pollutants. If it is determined that insufficient data is available to make such an evaluation, this should be noted in the TMDL document.

1.1 TMDL Document Submittal Letter

When a TMDL document is submitted to EPA requesting formal comments or a final review and approval, the submittal package should include a letter identifying the document being submitted and the purpose of the submission.

Minimum Submission Requirements.

☒ A TMDL submittal letter should be included with each TMDL document submitted to EPA requesting a formal review.

☒ The submittal letter should specify whether the TMDL document is being submitted for initial review and comments, public review and comments, or final review and approval.

☒ Each TMDL document submitted to EPA for final review and approval should be accompanied by a submittal letter that explicitly states that the submittal is a final TMDL submitted under Section 303(d) of the Clean Water Act for EPA review and approval. This clearly establishes the State's/Tribe's intent to submit, and EPA's duty to review, the TMDL under the statute. The submittal letter should contain such identifying information as the name and location of the waterbody and the pollutant(s) of concern, which matches similar identifying information in the TMDL document for which a review is being requested.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The final Lower Rapid Creek bacteria TMDL was submitted to EPA for review and approval via an email from Rich Hanson, SD DENR on September 7, 2010. The email included the final TMDL document and a letter requesting approval of the TMDL.

COMMENTS: None

1.2 Identification of the Waterbody, Impairments, and Study Boundaries

The TMDL document should provide an unambiguous description of the waterbody to which the TMDL is intended to apply and the impairments the TMDL is intended to address. The document should also clearly delineate the physical boundaries of the waterbody and the geographical extent of the watershed area studied. Any additional information needed to tie the TMDL document back to a current 303(d) listing should also be included.

Minimum Submission Requirements:

☒ The TMDL document should clearly identify the pollutant and waterbody segment(s) for which the TMDL is being established. If the TMDL document is submitted to fulfill a TMDL development requirement for a waterbody on the state's current EPA approved 303(d) list, the TMDL document submittal should clearly identify the waterbody and associated impairment(s) as they appear on the State's/Tribe's current EPA approved 303(d) list, including a full waterbody description, assessment unit/waterbody ID, and the priority ranking of the waterbody. This information is necessary to ensure that the administrative record and the national TMDL tracking database properly link the TMDL document to the 303(d) listed waterbody and impairment(s).

☒ One or more maps should be included in the TMDL document showing the general location of the waterbody and, to the maximum extent practical, any other features necessary and/or relevant to the understanding of the TMDL analysis, including but not limited to: watershed boundaries, locations of major pollutant sources, major tributaries included in the analysis, location of sampling points, location of discharge gauges, land use patterns, and the location of nearby waterbodies used to provide surrogate information or reference conditions. Clear and concise descriptions of all key features and their relationship to the waterbody and water quality data should be provided for all key and/or relevant features not represented on the map.

☐ If information is available, the waterbody segment to which the TMDL applies should be identified/geo-referenced using the National Hydrography Dataset (NHD). If the boundaries of the TMDL do not correspond to the Waterbody ID(s) (WBID), Entity_ID information or reach code (RCH_Code) information should be provided. If NHD data is not available for the waterbody, an alternative geographical referencing system that unambiguously identifies the physical boundaries to which the TMDL applies may be substituted.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: Rapid Creek is a stream located in the Black Hills of western South Dakota, and drains approximately 718 square miles in Pennington County, South Dakota. Rapid Creek flows to the Cheyenne River and ultimately to the Missouri River in the Rapid sub-basin (HUC 10120110). The focus of the TMDL document is on the lower portion of the Rapid Creek basin. The contributing drainage area of the 303(d) listed segments is approximately 126 square miles and covers 74 stream miles beginning below Canyon Lake and ending where Rapid Creek drains into the Cheyenne River.

Three segments of lower Rapid Creek are identified on the 2008 South Dakota 303(d) waterbody list as impaired due to elevated fecal coliform concentrations. The three listed segments are: 1) Rapid Creek from lower Rapid City to the Rapid City wastewater treatment facility (RC WWTF) (18.97 miles; SD-CH-R-

RAPID_03); 2) Rapid Creek from the RC WWTF to above Farmingdale (29.84 miles; SD-CH-R-RAPID_04); and 3) Rapid Creek from above Farmingdale to mouth (27.39 miles; SD-CH-R-RAPID_05). *Escherichia coli* are also listed as impairments in segment SD-CH-R-RAPID_05 on the 2010 303(d) list. All three segments are identified as high priority for TMDL development. Data collected during the period of assessment found that portions of Rapid Creek are also impaired for total suspended solids (TSS). The TSS impairment will be addressed in a separate TMDL document.

The designated uses for the Lower Rapid Creek segments include: coldwater permanent fish life propagation waters, warmwater permanent fish life propagation waters, immersion recreation waters, limited-contact recreation waters, fish and wildlife propagation, recreation, and stock watering.

COMMENTS: None.

1.3 Water Quality Standards

TMDL documents should provide a complete description of the water quality standards for the waterbodies addressed, including a listing of the designated uses and an indication of whether the uses are being met, not being met, or not assessed. If a designated use was not assessed as part of the TMDL analysis (or not otherwise recently assessed), the documents should provide a reason for the lack of assessment (e.g., sufficient data was not available at this time to assess whether or not this designated use was being met).

Water quality criteria (WQC) are established as a component of water quality standard at levels considered necessary to protect the designated uses assigned to that waterbody. WQC identify quantifiable targets and/or qualitative water quality goals which, if attained and maintained, are intended to ensure that the designated uses for the waterbody are protected. TMDLs result in maintaining and attaining water quality standards by determining the appropriate maximum pollutant loading rate to meet water quality criteria, either directly, or through a surrogate measurable target. The TMDL document should include a description of all applicable water quality criteria for the impaired designated uses and address whether or not the criteria are being attained, not attained, or not evaluated as part of the analysis. If the criteria were not evaluated as part of the analysis, a reason should be cited (e.g., insufficient data were available to determine if this water quality criterion is being attained).

Minimum Submission Requirements:

☒ The TMDL must include a description of the applicable State/Tribal water quality standard, including the designated use(s) of the waterbody, the applicable numeric or narrative water quality criterion, and the anti-degradation policy. (40 C.F.R. §130.7(c)(1)).

☒ The purpose of a TMDL analysis is to determine the assimilative capacity of the waterbody that corresponds to the existing water quality standards for that waterbody, and to allocate that assimilative capacity between the significant sources. Therefore, <u>all TMDL documents must be written to meet the existing water quality standards</u> for that waterbody (CWA §303(d)(1)(C)).

Note: In some circumstances, the load reductions determined to be necessary by the TMDL analysis may prove to be infeasible and may possibly indicate that the existing water quality standards and/or assessment methodologies may be erroneous. However, the TMDL must still be determined based on existing water quality standards. Adjustments to water quality standards and/or assessment methodologies may be evaluated separately, from the TMDL.

☒ The TMDL document should describe the relationship between the pollutant of concern and the water quality standard the pollutant load is intended to meet. This information is necessary for EPA to evaluate whether or not attainment of the prescribed pollutant loadings will result in attainment of the water quality standard in question.

☒ If a standard includes multiple criteria for the pollutant of concern, the document should demonstrate that the TMDL value will result in attainment of all related criteria for the pollutant. For example, both acute and chronic values (if present in the WQS) should be addressed in the document, including consideration of magnitude, frequency and duration requirements.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The Lower Rapid Creek segments addressed by these TMDLs are impaired based on fecal coliform and *E. coli* concentrations that are impacting the immersion recreation beneficial uses. South Dakota has applicable numeric standards for fecal coliform and *E. coli* that may be applied to these river segments. The numeric standards being implemented in these TMDLs are: a daily maximum value of fecal coliform of 400 cfu/100mL in any one sample, and a maximum geometric mean of 200 cfu/100mL during a 30-day period, and a daily maximum value of *E. coli* of 235 cfu/100mL and a maximum geometric mean of 126 cfu/100mL. The standards for both parameters are applicable from May 1 to September 30. Discussion of additional applicable water quality standards for Lower Rapid Creek can be found on pages 6 - 9 of the TMDL document.

COMMENTS: None.

2. Water Quality Targets

TMDL analyses establish numeric targets that are used to determine whether water quality standards are being achieved. Quantified water quality targets or endpoints should be provided to evaluate each listed pollutant/water body combination addressed by the TMDL, and should represent achievement of applicable water quality standards and support of associated beneficial uses. For pollutants with numeric water quality standards, the numeric criteria are generally used as the water quality target. For pollutants with narrative standards, the narrative standard should be translated into a measurable value. At a minimum, one target is required for each pollutant/water body combination. It is generally desirable, however, to include several targets that represent achievement of the standard and support of beneficial uses (e.g., for a sediment impairment issue it may be appropriate to include a variety of targets representing water column sediment such as TSS, embeddeness, stream morphology, up-slope conditions and a measure of biota).

Minimum Submission Requirements:

☒ The TMDL should identify a numeric water quality target(s) for each waterbody pollutant combination. The TMDL target is a quantitative value used to measure whether or not the applicable water quality standard is attained.

Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. Occasionally, the pollutant of concern is different from the parameter that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as a numerical dissolved oxygen criterion). In such cases, the TMDL should explain the linkage between the pollutant(s) of concern, and express the quantitative relationship between the TMDL target and pollutant of concern. In all cases, TMDL targets must represent the attainment of current water quality standards.

☐ When a numeric TMDL target is established to ensure the attainment of a narrative water quality criterion, the numeric target, the methodology used to determine the numeric target, and the link between the pollutant of concern and the narrative water quality criterion should all be described in the TMDL document. Any additional information supporting the numeric target and linkage should also be included in the document.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The water quality targets for these TMDLs are based on the numeric water quality standards for fecal coliform and *E. coli* established to protect the immersion recreation beneficial uses for the three Lower Rapid Creek segments. The fecal coliform targets are: daily maximum value of ≤ 400 cfu/100mL in any one sample, and maximum geometric mean of ≤ 200 cfu/100mL during a 30-day period. The *E. coli* targets are: daily maximum value of ≤ 235 cfu/100mL, and maximum geometric mean of ≤ 126 cfu/100mL. The *E. coli* targets are only applicable to the furthest downstream segment of Rapid Creek (SD-CH-R-RAPID_05). The standards for both parameters are applicable from May 1 to September 30.

COMMENTS: None.

3. Pollutant Source Analysis

A TMDL analysis is conducted when a pollutant load is known or suspected to be exceeding the loading capacity of the waterbody. Logically then, a TMDL analysis should consider all sources of the pollutant of concern in some manner. The detail provided in the source assessment step drives the rigor of the pollutant load allocation. In other words, it is only possible to specifically allocate quantifiable loads or load reductions to each significant source (or source category) when the relative load contribution from each source has been estimated. Therefore, the pollutant load from each significant source (or source category) should be identified and quantified to the maximum practical extent. This may be accomplished using site-specific monitoring data, modeling, or application of other assessment techniques. If insufficient time or resources are available to accomplish this step, a phased/adaptive management approach may be appropriate. The approach should be clearly defined in the document.

Minimum Submission Requirements:

☒ The TMDL should include an identification of all potentially significant point and nonpoint sources of the pollutant of concern, including the geographical location of the source(s) and the quantity of the loading, e.g., lbs/per day. This information is necessary for EPA to evaluate the WLA, LA and MOS components of the TMDL.

☒ The level of detail provided in the source assessment should be commensurate with the nature of the watershed and the nature of the pollutant being studied. Where it is possible to separate natural background from nonpoint sources, the TMDL should include a description of both the natural background loads and the nonpoint source loads.

☒ Natural background loads should not be assumed to be the difference between the sum of known and quantified anthropogenic sources and the existing *in situ* loads (e.g. measured in stream) unless it can be demonstrated that all significant anthropogenic sources of the pollutant of concern have been identified, characterized, and properly quantified.

☒ The sampling data relied upon to discover, characterize, and quantify the pollutant sources should be included in the document (e.g. a data appendix) along with a description of how the data were analyzed to characterize and quantify the pollutant sources. A discussion of the known deficiencies and/or gaps in the data set and their potential implications should also be included.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The TMDL document identifies the land use in the lower portion of the watershed as predominately agricultural. Approximately 61percent of the landuse in the impaired segments is rangeland, 24 percent is cropland and pastureland, 7 percent is urban and 8 percent is forest and other landuses. The specific landuse breakdown for each segment is included in Table 8 of the TMDL.

The City of Rapid City is located in the upper most segment (SD-CH-R-RAPID_03, TMDL Figure 2) of the Creek. This segment flows through Rapid City (population ~ 67,000) and is impacted by stormwater runoff contributing fecal coliform and *E. coli* loading to Rapid Creek. Rapid City has an approved Municipal Separate Storm Sewer Systems (MS4) stormwater permit (Permit number SDR41A007) which was issued in 2003 by SD DENR.

Rapid City also has a wastewater treatment facility (RC WWTF) that discharges into Rapid Creek between monitoring stations ASTP and BSTP (see TMDL Figure 2). Rapid City was issued a discharge permit (Permit number SD-0023574) in 2001 by SD DENR. As part of their permit, fecal coliform bacteria are routinely sampled three times per week from May 1st through September 30th each year. This permit will be updated to include monitoring and effluent limitations for *E. coli* bacteria. Beginning in 2009, the RC WWTF began sampling *E. coli* bacteria as part of their routine sampling to monitor and track *E. coli* concentrations in their effluent.

Based on review of available information and communication with state and local authorities, the primary nonpoint sources of fecal coliform and by default *E. coli* bacteria within the Lower Rapid Creek watershed include agricultural runoff, wildlife, and human sources. Using the best available information, potential loadings were estimated based on total production potential for each source and landuse using the EPA's Bacterial Indicator Tool (BIT) based on the density and distribution of animals (livestock and wildlife) and failing septic systems in the watershed (US EPA, 2000). The BIT does not have *E. coli* specific production values incorporated into its reference tables. However, in this watershed, *E. coli* concentrations were significantly related to fecal coliform bacteria concentrations; therefore, fecal coliform bacteria were used as a surrogate for *E. coli* production potential. Thus, fecal coliform production sources and percentages were applied to *E. coli* bacteria sources and percentages and interpreted as bacterial loading.

COMMENTS: None.

4. TMDL Technical Analysis

TMDL determinations should be supported by a robust data set and an appropriate level of technical analysis. This applies to **all** of the components of a TMDL document. It is vitally important that the technical basis for **all** conclusions be articulated in a manner that is easily understandable and readily apparent to the reader.

A TMDL analysis determines the maximum pollutant loading rate that may be allowed to a waterbody without violating water quality standards. The TMDL analysis should demonstrate an understanding of the relationship between the rate of pollutant loading into the waterbody and the resultant water quality impacts. This stressor → response relationship between the pollutant and impairment and between the selected targets, sources, TMDLs, and load allocations needs to be clearly articulated and supported by an appropriate level of technical analysis. Every effort should be made to be as detailed as possible, and to base all conclusions on the best available scientific principles.

The pollutant loading allocation is at the heart of the TMDL analysis. TMDLs apportion responsibility for taking actions by allocating the available assimilative capacity among the various point, nonpoint, and natural pollutant sources. Allocations may be expressed in a variety of ways, such as by individual discharger, by tributary watershed, by source or land use category, by land parcel, or other appropriate scale or division of responsibility.

The pollutant loading allocation that will result in achievement of the water quality target is expressed in the form of the standard TMDL equation:

$$TMDL = \sum LAs + \sum WLAs + MOS$$

Where:

TMDL = Total Pollutant Loading Capacity of the waterbody

LAs = Pollutant Load Allocations

WLAs = Pollutant Wasteload Allocations

MOS = The portion of the Load Capacity allocated to the Margin of safety.

Minimum Submission Requirements:

☒ A TMDL must identify the loading capacity of a waterbody for the applicable pollutant, taking into consideration temporal variations in that capacity. EPA regulations define loading capacity as the greatest amount of a pollutant that a water can receive without violating water quality standards (40 C.F.R. §130.2(f)).

☒ The total loading capacity of the waterbody should be clearly demonstrated to equate back to the pollutant load allocations through a balanced TMDL equation. In instances where numerous LA, WLA and seasonal TMDL capacities make expression in the form of an equation cumbersome, a table may be substituted as long as it is clear that the total TMDL capacity equates to the sum of the allocations.

☒ The TMDL document should describe the methodology and technical analysis used to establish and quantify the cause-and-effect relationship between the numeric target and the identified pollutant sources. In many instances, this method will be a water quality model.

☒ It is necessary for EPA staff to be aware of any assumptions used in the technical analysis to understand and evaluate the methodology used to derive the TMDL value and associated loading allocations. Therefore, the TMDL document should contain a description of any important assumptions (including the basis for those assumptions) made in developing the TMDL, including but not limited to:

(1) the spatial extent of the watershed in which the impaired waterbody is located and the spatial extent of the TMDL technical analysis;
(2) the distribution of land use in the watershed (e.g., urban, forested, agriculture);
(3) a presentation of relevant information affecting the characterization of the pollutant of concern and its allocation to sources such as population characteristics, wildlife resources, industrial activities etc…;
(4) present and future growth trends, if taken into consideration in determining the TMDL and preparing the TMDL document (e.g., the TMDL could include the design capacity of an existing or planned wastewater treatment facility);
(5) an explanation and analytical basis for expressing the TMDL through surrogate measures, if applicable. Surrogate measures are parameters such as percent fines and turbidity for sediment impairments; chlorophyll *a* and phosphorus loadings for excess algae; length of riparian buffer; or number of acres of best management practices.

☒ The TMDL document should contain documentation supporting the TMDL analysis, including an inventory of the data set used, a description of the methodology used to analyze the data, a discussion of strengths and weaknesses in the analytical process, and the results from any water quality modeling used. This information is necessary for EPA to review the loading capacity determination, and the associated load, wasteload, and margin of safety allocations.

☒ TMDLs must take critical conditions (e.g., steam flow, loading, and water quality parameters, seasonality, etc…) into account as part of the analysis of loading capacity (40 C.F.R. §130.7(c)(1)). TMDLs should define applicable critical conditions and describe the approach used to determine both point and nonpoint source loadings under such critical conditions. In particular, the document should discuss the approach used to compute and allocate nonpoint source loadings, e.g., meteorological conditions and land use distribution.

☒ Where both nonpoint sources and NPDES permitted point sources are included in the TMDL loading allocation, and attainment of the TMDL target depends on reductions in the nonpoint source loads, the TMDL document must include a demonstration that nonpoint source loading reductions needed to implement the load allocations are actually practicable [40 CFR 130.2(i) and 122.44(d)].

Recommendation:

☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The technical analysis should describe the cause and effect relationship between the identified pollutant sources, the numeric targets, and achievement of water quality standards. It should also include a description of the analytical processes used, results from water quality modeling, assumptions and other pertinent information. The technical analysis for the Lower Rapid Creek TMDL describes how the fecal coliform loads were derived in order to meet the applicable water quality standards for the 303(d) impaired stream segments.

The South Dakota Department of Environment and Natural Resources (SD DENR) have collected fecal coliform bacteria samples at various locations along Lower Rapid Creek since 1967. *E. coli* bacteria sampling was initiated in the summer of 2000 at WQM 19 (DENR 460910) near Farmingdale, SD. Average daily discharge data from these sites were used with SD DENR WQM and assessment water quality data to develop segment specific load duration curves for analysis. Flow data from monitoring site 06414000 at Rapid City were compared to the limited flow data available at 06416000 below Hawthorn Ditch (HAW). Discharge was similar enough to use flows from 06414000 at Rapid City to supplement and expand flow range at 06416000 below Hawthorn Ditch. Stream flows at the other two USGS monitoring sites in Rapid Creek had long-term data sets with segment SD-CHR-RAPID_04 having 28 years and segment SD-CH-R-RAPID_05 having 49 years.

Recreational beneficial use standards are applicable only from May through September (recreation season). Only discharge data collected during the recreation season from each stream segment were used to develop the flow duration curves. Recreational season discharge dates ranged from 1950 through 2008 for segment SD-CH-R-RAPID_03, 1981 through 2009 for segment SD-CH-R-RAPID_04, and 1960 through 2009 for segment SD-CH-RRAPID_05.

The TMDLs were developed using the Load Duration Curve (LDC) approach, resulting in a flow-variable target that considers the entire flow regime within the recreational season (May 1st – September 30th). The LDC is a dynamic expression of the allowable load for any given day within the recreation season. To aid in interpretation and implementation of the TMDL, the LDC flow intervals were grouped into five flow zones: high flows (0–10%), moist conditions (10–40%), mid-range flows (40–60%), dry conditions (60–90%), and low flows (90–100%) according to EPA's *An Approach for Using Load Duration Curves in the Development of TMDLs* (US EPA, 2006). Flow zones were adjusted based on the number of data points (instantaneous samples) within the each standard LDC flow interval. This was done when the numbers of data points in the regular flow zones were less than two to increase the total number of observed samples for comparison. This procedure was only used in segment SD-CH-RRAPID_03 to increase the high and low flow zones by 5% to increase the number of data points within these zones.

The LDCs shown in Figures 4 - 6 and Figure 8 in the TMDL document, represent dynamic expressions of parameter-specific TMDLs for each impaired segment of Lower Rapid Creek that are based on the daily maximum fecal coliform bacteria, *E. coli* bacteria, resulting in a unique maximum daily load that corresponds to a measured average daily flow. The curves include the individual data points shown as triangle and diamond symbols as well as a dashed line that represents an approximate geometric mean values within each flow zone. Using this approach, the resulting loading capacities were derived for each listed segment, for each of the flow zones, and are shown in Tables 16 – 22 of the TMDL document.

To ensure that all applicable water quality standards are met, TMDL loads were set according to the criterion (either acute or chronic) that required the greatest load reduction percentage by flow zone for each of the three listed segments of lower Rapid Creek. The TMDL loading capacities in all three segments are based on the acute criterion (400 CFU/100 mL). These loads, when met, will attain compliance with all applicable water quality standards for fecal coliform and *E. coli* bacteria.

Section 11.0 of the TMDL document addresses reasonable assurance to ensure that the controls necessary to reduce bacteria loading in segments SD-CH-RRAPID_03 and SD-CH-RRAPID_04 will be implemented for both point sources and nonpoint sources. Also, Section 12.0 of the TMDL document includes information on planned restoration activities in the watershed.

COMMENTS: None.

4.1 Data Set Description

TMDL documents should include a thorough description and summary of all available water quality data that are relevant to the water quality assessment and TMDL analysis. An inventory of the data used for the TMDL analysis should be provided to document, for the record, the data used in decision making. This also provides the reader with the opportunity to independently review the data. The TMDL analysis should make use of all readily available data for the waterbody under analysis unless the TMDL writer determines that the data are not relevant or appropriate. For relevant data that were known but rejected, an explanation of why the data were not utilized should be provided (e.g., samples exceeded holding times, data collected prior to a specific date were not considered timely, etc…).

Minimum Submission Requirements:

☒ TMDL documents should include a thorough description and summary of all available water quality data that are relevant to the water quality assessment and TMDL analysis such that the water quality impairments are clearly defined and linked to the impaired beneficial uses and appropriate water quality criteria.

☒ The TMDL document submitted should be accompanied by the data set utilized during the TMDL analysis. If possible, it is preferred that the data set be provided in an electronic format and referenced in the document. If electronic submission of the data is not possible, the data set may be included as an appendix to the document.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The Lower Rapid Creek TMDL data description and summary are included mostly in the Technical Analysis section of the document, and the full data set is in Appendix A of the TMDL. The South Dakota Department of Environment and Natural Resources (SD DENR) have collected fecal coliform bacteria samples at various locations along Lower Rapid Creek from 1967 to present. *E. coli* bacteria sampling was initiated in the summer of 2000 at WQM 19 (DENR 460910) near Farmingdale, SD. The data set also includes the flow record on the Lower Rapid Creek that was used to create the load duration curve for the three segments included in this TMDL.

COMMENTS: None.

4.2 Waste Load Allocations (WLA):

Waste Load Allocations represent point source pollutant loads to the waterbody. Point source loads are typically better understood and more easily monitored and quantified than nonpoint source loads. Whenever practical, each point source should be given a separate waste load allocation. All NPDES permitted dischargers that discharge the pollutant under analysis directly to the waterbody should be identified and given separate waste load allocations. The finalized WLAs are required to be incorporated into future NPDES permit renewals.

Minimum Submission Requirements:

☒ EPA regulations require that a TMDL include WLAs for all significant and/or NPDES permitted point sources of the pollutant. TMDLs must identify the portion of the loading capacity allocated to individual existing and/or future point source(s) (40 C.F.R. §130.2(h), 40 C.F.R. §130.2(i)). In some cases, WLAs may cover more than one discharger, e.g., if the source is contained within a general permit. If no allocations are to be made to point sources, then the TMDL should include a value of zero for the WLA.

☒ All NPDES permitted dischargers given WLA as part of the TMDL should be identified in the TMDL, including the specific NPDES permit numbers, their geographical locations, and their associated waste load allocations.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The City of Rapid City is located in the upper portion of the study area approximately between monitoring sites ABCL and the coldwater/warmwater fisheries change in Rapid Creek S15 T1N R8E (segment SD-CH-R-RAPID_03). This segment flows through Rapid City (population ~ 67,000) and is impacted by stormwater runoff contributing fecal coliform and *E. coli* loading to Rapid Creek. Rapid City has an approved Municipal Separate Storm Sewer Systems (MS4) stormwater permit (Permit # SDR41A007) which was issued in 2003 by SD DENR. The WLA for segment SD-CHR-RAPID_03 is stormwater discharge from the MS4. The WLA for fecal coliform was calculated by South Dakota School of Mines & Technology personnel and approved by SD DENR Surface Water Quality Program (SWQP) staff. The WLA allocation was derived by treating all runoff to a depth of 0.5 inches based on the exponential distribution of all rainfall events and treatment to the maximum extent practicable. Based on these calculations, best management practices would treat 85 percent of all runoff occurring in Rapid City. Details on the MS4 WLA can be found in Appendix B of the TMDL document.

Rapid City has a wastewater treatment facility (RC WWTF) that discharges into Rapid Creek between ASTP and BSTP (segment SD-CH-R-RAPID_04)). Rapid City was issued a discharge permit (Permit # SD-0023574) in 2001 by SD DENR. As part of their permit, fecal coliform bacteria are routinely sampled three times per week from May 1st through September 30th each year. This permit will be updated to include monitoring and effluent limitations for *E. coli* bacteria. The fecal coliform WLA for the RC WWTF was calculated to be 2.27E+11 cfu/day derived from a design flow of 15 million gallons per day and a discharge limit of 400 cfu/100mL. The RC WWTF has a continuous discharge so the WLA is applicable throughout the entire flow regime during the recreation season May 1 – September 30.

The lowest segment, SD-CH-R-RAPID_05, has no point source discharges.

COMMENTS: None.

4.3 Load Allocations (LA):

Load allocations include the nonpoint source, natural, and background loads. These types of loads are typically more difficult to quantify than point source loads, and may include a significant degree of uncertainty. Often it is necessary to group these loads into larger categories and estimate the loading rates based on limited monitoring data and/or modeling results. The background load represents a composite of all upstream pollutant loads into the waterbody. In addition to the upstream nonpoint and upstream natural load, the background load often includes upstream point source loads that are not given specific waste load allocations in this particular TMDL analysis. In instances where nonpoint source loading rates are particularly difficult to quantify, a performance-based allocation approach, in which a detailed monitoring plan and adaptive management strategy are employed for the application of BMPs, may be appropriate.

Minimum Submission Requirements:

☒ EPA regulations require that TMDL expressions include LAs which identify the portion of the loading capacity attributed to nonpoint sources and to natural background. Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. §130.2(g)). Load allocations may be included for both existing and future nonpoint source loads. Where possible, load allocations should be described separately for natural background and nonpoint sources.

☒ Load allocations assigned to natural background loads should not be assumed to be the difference between the sum of known and quantified anthropogenic sources and the existing *in situ* loads (e.g., measured in stream) unless it can be demonstrated that all significant anthropogenic sources of the pollutant of concern have been identified and given proper load or waste load allocations.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: In segment SD-CH-R-RAPID_03, the fecal coliform data indicates a steady increase in the coliform concentrations from late spring to midsummer during base flow conditions. Possible nonpoint sources of fecal coliform loading during base flow conditions in this segment include wildlife, domestic animals, septic systems and potential leaking sewers. Landuse below the HAW monitoring site gradually transitions from urban to agricultural cropland, pastureland, rangeland, with some rural development and increasing numbers of septic systems. Load allocation sources based on production potentials by landuse type comprised livestock and manure management on agricultural and pastureland/rangeland. Based on LDC TMDL analysis, current LAs will need to be reduced by approximately 78 percent to meet the TMDL developed for this segment of Rapid Creek in the high flow zone.

In segment SD-CH-R-RAPID_04, load allocations will require a significant load reduction in the high and moist flow zones. Based on recent data, the TMDL specifies a 95 percent reduction in the fecal coliform loading in the high flow zone and 84 percent in the moist flow zone with the remaining flow zones meeting TMDL standards based on the acute criteria. Most of the landuse in this segment is agricultural (mostly pastureland/rangeland and cropland) which make up approximately 92 percent of the landuse. Possible nonpoint sources of excess fecal coliform loading during high flow conditions in this segment include riparian area grazing by livestock, manure application to pastureland/rangeland and cropland, intensive grazing and over-wintering livestock in the riparian zone. Another potential source of increased fecal coliform loading in this segment of Rapid Creek is failing septic systems. Based on public input and information from local agencies, the largest numbers of suspected failing septic systems exist in this segment and are presumed to be located above the WQM monitoring site below the RC WWTF. Septic systems by definition are considered non-point source load and thus are wholly part of the load allocation portion of the TMDL. An estimated 27 percent reduction from failing septic systems is necessary to achieve the overall load reduction needed to help meet the TMDL set for this segment of Rapid Creek.

Landuse in segment SD-CH-R-RAPID_05 is similar to segment SD-CH-R-RAPID_04 in that most of the landuse is agricultural (pastureland/rangeland) and comprises 98 percent of all landuse. TMDL specifies an 80 percent reduction in fecal coliform loading for the high flow zone and a 74 percent load reduction in the moist flow zone. Sources of excess fecal coliform loading during high flow conditions in this segment are similar to segment SD-CH-R-RAPID_04 and include runoff from riparian area grazing, manure application to pastureland/rangeland, wintering livestock in and around the riparian zone, and intensive grazing practices. It is assumed that a significant portion of the local load reductions necessary to meet water quality standards in segment SD-CH-R-RAPID_05 will be achieved through BMP reductions in fecal coliform realized in upstream segment SD-CH-R-RAPID_04.

Flow zones requiring reductions to meet flow zone-specific *E. coli* bacteria TMDLs were identical to flow zones based on fecal coliform bacteria for this stream segment (SD-CH-RRAPID_05). *E. coli* loads in the high flow zone were estimated using regression analysis between *E. coli* and fecal coliform bacteria and applying the regression equation to fecal coliform concentrations in the high flow zone to predict *E. coli* concentrations and ultimately loading in the high flow zone.

A significant uncertainty for this segment is the persistence of fecal coliform in the stream and bank sediments. From October through April, fecal coliform discharges from the RC WWTF are un-regulated. If fecal coliform can survive in various microhabitats within stream sediment, they are subject to re-suspension during high-flow/event conditions in spring and early summer.

COMMENTS: None.

4.4 Margin of Safety (MOS):

Natural systems are inherently complex. Any mathematical relationship used to quantify the stressor → response relationship between pollutant loading rates and the resultant water quality impacts, no matter how rigorous, will include some level of uncertainty and error. To compensate for this uncertainty and ensure water quality standards will be attained, a margin of safety is required as a component of each TMDL. The MOS may take the form of a explicit load allocation (e.g., 10 lbs/day), or may be implicitly built into the TMDL analysis through the use of conservative assumptions and values for the various factors that determine the TMDL pollutant load → water quality effect relationship. Whether explicit or implicit, the MOS should be supported by an appropriate level of discussion that addresses the level of uncertainty in the various components of the TMDL technical analysis, the assumptions used in that analysis, and the relative effect of those assumptions on the final TMDL. The discussion should demonstrate that the MOS used is sufficient to ensure that the water quality standards would be attained if the TMDL pollutant loading rates are met. In cases where there is substantial uncertainty regarding the linkage between the proposed allocations and achievement of water quality standards, it may be necessary to employ a phased or adaptive management approach (e.g., establish a monitoring plan to determine if the proposed allocations are, in fact, leading to the desired water quality improvements).

Minimum Submission Requirements:

☒ TMDLs must include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)). EPA's 1991 TMDL Guidance explains that the MOS may be implicit (i.e., incorporated into the TMDL through conservative assumptions in the analysis) or explicit (i.e., expressed in the TMDL as loadings set aside for the MOS).

- ☐ If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS should be identified and described. The document should discuss why the assumptions are considered conservative and the effect of the assumption on the final TMDL value determined.
- ☒ If the MOS is explicit, the loading set aside for the MOS should be identified. The document should discuss how the explicit MOS chosen is related to the uncertainty and/or potential error in the linkage analysis between the WQS, the TMDL target, and the TMDL loading rate.
- ☐ If, rather than an explicit or implicit MOS, the TMDL relies upon a phased approach to deal with large and/or unquantifiable uncertainties in the linkage analysis, the document should include a description of the planned phases for the TMDL as well as a monitoring plan and adaptive management strategy.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The Lower Rapid Creek TMDLs include explicit MOSs for each segment derived by calculating the difference between the loading capacity at the mid-point of each of the five flow zones and the loading capacity at the minimum flow in each zone. The explicit MOS values are included in Tables 15 - 22 of the TMDL.

COMMENTS: None.

4.5 Seasonality and variations in assimilative capacity:

The TMDL relationship is a factor of both the loading rate of the pollutant to the waterbody and the amount of pollutant the waterbody can assimilate and still attain water quality standards. Water quality standards often vary based on seasonal considerations. Therefore, it is appropriate that the TMDL analysis consider seasonal variations, such as critical flow periods (high flow, low flow), when establishing TMDLs, targets, and allocations.

Minimum Submission Requirements:

☒ The statute and regulations require that a TMDL be established with consideration of seasonal variations. The TMDL must describe the method chosen for including seasonal variability as a factor. (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)).

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: By using the load duration curve approach to develop the TMDL allocations seasonal variability in fecal coliform loads are taken into account. Highest steam flows typically occur during late spring, and the lowest stream flows occur during the winter months.

COMMENTS: None.

5. Public Participation

EPA regulations require that the establishment of TMDLs be conducted in a process open to the public, and that the public be afforded an opportunity to participate. To meaningfully participate in the TMDL process it is necessary that stakeholders, including members of the general public, be able to understand the problem and the proposed solution. TMDL documents should include language that explains the issues to the general public in understandable terms, as well as provides additional detailed technical information for the scientific community. Notifications or solicitations for comments regarding the TMDL should be made available to the general public, widely circulated, and clearly identify the product as a TMDL and the fact that it will be submitted to EPA for review. When the final TMDL is submitted to EPA for approval, a copy of the comments received by the state and the state responses to those comments should be included with the document.

Minimum Submission Requirements:
☒ The TMDL must include a description of the public participation process used during the development of the TMDL (40 C.F.R. §130.7(c)(1)(ii)).

☒ TMDLs submitted to EPA for review and approval should include a summary of significant comments and the State's/Tribe's responses to those comments.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The State's submittal includes a summary of the public participation process that has occurred which describes the ways the public has been given an opportunity to be involved in the TMDL development process so far. In particular, the State has encouraged participation through public meetings in the watershed, and a website was developed and maintained throughout the project. The TMDL has been available for a 30-day public notice period prior to finalization.

COMMENTS: None.

6. Monitoring Strategy

TMDLs may have significant uncertainty associated with the selection of appropriate numeric targets and estimates of source loadings and assimilative capacity. In these cases, a phased TMDL approach may be necessary. For Phased TMDLs, it is EPA's expectation that a monitoring plan will be included as a component of the TMDL document to articulate the means by which the TMDL will be evaluated in the field, and to provide for future supplemental data that will address any uncertainties that may exist when the document is prepared.

Minimum Submission Requirements:

☒ When a TMDL involves both NPDES permitted point source(s) and nonpoint source(s) allocations, and attainment of the TMDL target depends on reductions in the nonpoint source loads, the TMDL document should include a monitoring plan that describes the additional data to be collected to determine if the load reductions provided for in the TMDL are occurring.

☒ Under certain circumstances, a phased TMDL approach may be utilized when limited existing data are relied upon to develop a TMDL, and the State believes that the use of additional data or data based on better analytical techniques would likely increase the accuracy of the TMDL load calculation and merit development of a second phase TMDL. EPA recommends that a phased TMDL document or its implementation plan include a monitoring plan and a scheduled timeframe for revision of the TMDL. These elements would not be an intrinsic part of the TMDL and would not be approved by EPA, but may be necessary to support a rationale for approving the TMDL. http://www.epa.gov/owow/tmdl/tmdl_clarification_letter.pdf

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: Lower Rapid Creek will continue to be monitored through SD DENR's ambient water quality monitoring stations on Rapid Creek. Existing and future WQM monitoring sites will be sampled on a monthly basis. SD DENR is in the process of adding a monthly ambient WQM site and installing a permanent stage recorder at the Hawthorn monitoring site in Rapid City to monitor water quality and stream flows in the recently modified segment SD-CH-R-RAPID_03 in Rapid Creek. During the recreation season bacterial monitoring should be increased to collect at least 5 samples per month to assess the geometric mean criterion. Additional monitoring and evaluation efforts should be targeted toward designed urban and rural BMPs to document the effectiveness of implemented BMPs. Monitoring locations should be based on the location and type of BMPs installed. Post-implementation monitoring will be necessary to assure the TMDL has been reached and maintenance of the beneficial use occurs.

COMMENTS: None.

7. Restoration Strategy

The overall purpose of the TMDL analysis is to determine what actions are necessary to ensure that the pollutant load in a waterbody does not result in water quality impairment. Adding additional detail regarding the proposed approach for the restoration of water quality is not currently a regulatory requirement, but is considered a value added component of a TMDL document. During the TMDL analytical process, information is often gained that may serve to point restoration efforts in the right direction and help ensure that resources are spent in the most efficient manner possible. For example, watershed models used to analyze the linkage between the pollutant loading rates and resultant water quality impacts might also be used to conduct "what if" scenarios to help direct BMP installations to locations that provide the greatest pollutant reductions. Once a TMDL has been written and approved, it is often the responsibility of other water quality programs to see that it is implemented. The level of quality and detail provided in the restoration strategy will greatly influence the future success in achieving the needed pollutant load reductions.

Minimum Submission Requirements:

☒ EPA is not required to and does not approve TMDL implementation plans. However, in cases where a WLA is dependent upon the achievement of a LA, "reasonable assurance" is required to demonstrate the necessary LA called for in the document is practicable). A discussion of the BMPs (or other load reduction measures) that are to be relied upon to achieve the LA(s), and programs and funding sources that will be relied upon to implement the load reductions called for in the document, may be included in the implementation/restoration section of the TMDL document to support a demonstration of "reasonable assurance".

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The Restoration Strategy section of the TMDL document says that there's broad support to begin an implementation project within the lower Cheyenne River watershed. Rapid Creek is part of the Cheyenne River watershed and could be included in a larger, basin-wide implementation project. Major entities that should be involved in planning, funding and supporting this project as it pertains to Rapid Creek are the West Dakota Water Development District, Pennington County, Pennington County Conservation District, the City of Rapid City, Cheyenne River Partnership and the Natural Resource Conservation Service. Funds to implement watershed water quality improvements can be obtained through the SD DENR. In 2010 the Pennington County Conservation District has expressed interest in sponsoring a Lower Rapid Creek Implementation Project. Restoration strategy recommendations are included in Section 12.0 of the TMDL document, and reasonable assurance is addressed in Section 11.0.

COMMENTS: None.

8. Daily Loading Expression

The goal of a TMDL analysis is to determine what actions are necessary to attain and maintain WQS. The appropriate averaging period that corresponds to this goal will vary depending on the pollutant and the nature of the waterbody under analysis. When selecting an appropriate averaging period for a TMDL analysis, primary concern should be given to the nature of the pollutant in question and the achievement of the underlying WQS. However, recent federal appeals court decisions have pointed out that the title TMDL implies a "daily" loading rate. While the most appropriate averaging period to be used for developing a TMDL analysis may vary according to the pollutant, a daily loading rate can provide a more practical indication of whether or not the overall needed load reductions are being achieved. When limited monitoring resources are available, a daily loading target that takes into account the natural variability of the system can serve as a useful indicator for whether or not the overall load reductions are likely to be met. Therefore, a daily expression of the required pollutant loading rate is a required element in all TMDLs, in addition to any other load averaging periods that may have been used to conduct the TMDL analysis. The level of effort spent to develop the daily load indicator should be based on the overall utility it can provide as an indicator for the total load reductions needed.

Minimum Submission Requirements:

☒ The document should include an expression of the TMDL in terms of a daily load. However, the TMDL may also be expressed in temporal terms other than daily (e.g., an annual or monthly load). If the document expresses the TMDL in additional "non-daily" terms the document should explain why it is appropriate or advantageous to express the TMDL in the additional unit of measurement chosen.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The Lower Rapid Creek fecal coliform and *E. coli* TMDLs include daily loads expressed as colonies per day. The daily TMDL loads are included in TMDL Section of the TMDL document.

COMMENTS: None.