FECAL COLIFORM TOTAL MAXIMUM DAILY LOAD EVALUATION FOR BEAVER CREEK SEGMENT 1 IN CUSTER AND FALL RIVER COUNTIES, SOUTH DAKOTA

South Dakota Department of Environment and Natural Resources

Water Resources Assistance Program

January, 2012

Beaver Creek Segment 1 Total Maximum Daily Load

Entity ID:	SD-CH-R-BEAVER_01_USGS
Location:	HUC Code: 10120109
Size of Watershed:	61,120 acres
Water Body Type:	Stream
303(d) Listing Parameter:	Fecal Coliform Bacteria
Initial Listing Date:	2010
TMDL Priority Ranking:	2
Listed Stream Segment:	HWY 79 to confluence with Cheyenne River
Designated Use of Concern:	Limited Contact Recreation
Analytical Approach:	Load Duration Curve Framework
Target	Meet applicable water quality standards 74:51:01:51
Threshold Value	<1000 cfu/100 ml geometric mean concentration <2000 cfu/100 ml maximum single sample
Load Allocations:	
High Flow Zone LA	2.35E+13 cfu/ Day
High Flow Zone WLA	0
High Flow Zone MOS	2.45E+10 cfu/ Day
High Flow Zone TMDL	2.35E+13 cfu/ Day

Table of Contents

Table of Figures

Table of Tables

1.0 Introduction

The intent of this document is to clearly identify the components of the Total Maximum Daily Load (TMDL) submittal to support adequate public participation and facilitate the United States Environmental Protection Agency (EPA) review and approval. The TMDL was developed in accordance with Section 303(d) of the Federal Clean Water Act and guidance developed by the EPA. This TMDL document addresses the fecal coliform bacteria impairment of Segment 1 of Beaver Creek contained within South Dakota.

1.1 Watershed Characteristics

Beaver Creek drains 61,120 acres in western South Dakota (Figure 1) and discharges to the Cheyenne River in Fall River County near Buffalo Gap, South Dakota. Segment 1 occurs from Highway 79 to the Cheyenne River and is 12 miles long. This segment has a USGS gaging station located at sampling site BVC02 south of Buffalo Gap. The stream receives runoff from agricultural operations. Land use is mainly rangeland and forest land (Table 1).

Table 1: Beaver Creek watershed landuse.

Landuse	Percent
Rangeland	67.12
Forest	32.73
Residential	0.15

The impaired reach of Beaver Creek lies within Custer and Fall River Counties (Figure 2). The watershed contains the town of Buffalo Gap. Common soil associations on the uplands in the watershed include Pierre-Samsil, Pierre-Kyle, Tilford-Spearfish, Norka, Minnequa-Grummit, Nunn-Satanta, and Minnequa-Manvel-Penrose. Owanka-Haverson-Colombo is the bottomland soil association (USDA 1982; USDA 1996).

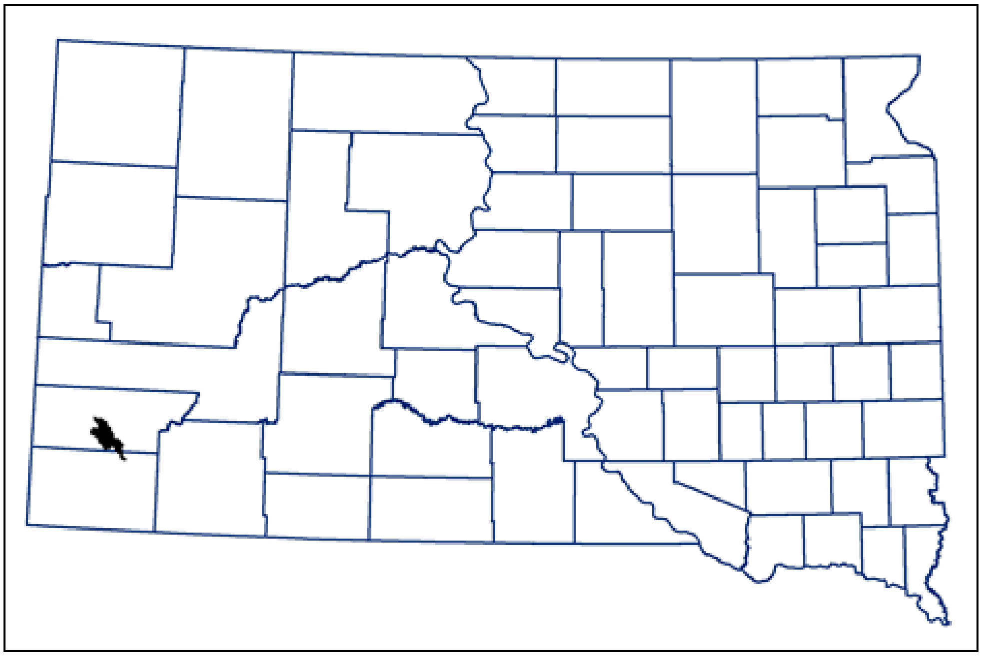

Figure 1: Location of Beaver Creek Watershed within South Dakota.

The majority of the Upper Beaver Creek Watershed is comprised of public land (Figure 2). This public land is managed by the United States Forest Service, National Park Service, and Custer State Park. The majority of the watershed in which the listed segment occurs is private except for a game production area located at BVC02, the sampling site used in the Lower Cheyenne River Watershed Assessment Project.

The average daily temperature during winter is 24 degrees F. The average daily temperature during summer is 72 degrees F. Average yearly precipitation is 15.53 inches. Over the year 75% of precipitation falls from April to September. Average yearly snow fall amounts to 32 inches (USDA 1996).

Beaver Creek was assessed as an individual portion of the Lower Cheyenne River Watershed Assessment Project, which looked at individual streams such as Beaver Creek as well as the entire drainage basin and the cumulative effects of the individual waterbodies.

In the 2010 South Dakota Integrated Report Beaver Creek Segment 1 (SD-CH-R-BEAVER_01_USGS) was listed as impaired for both limited contact recreation beneficial uses due to fecal coliform .

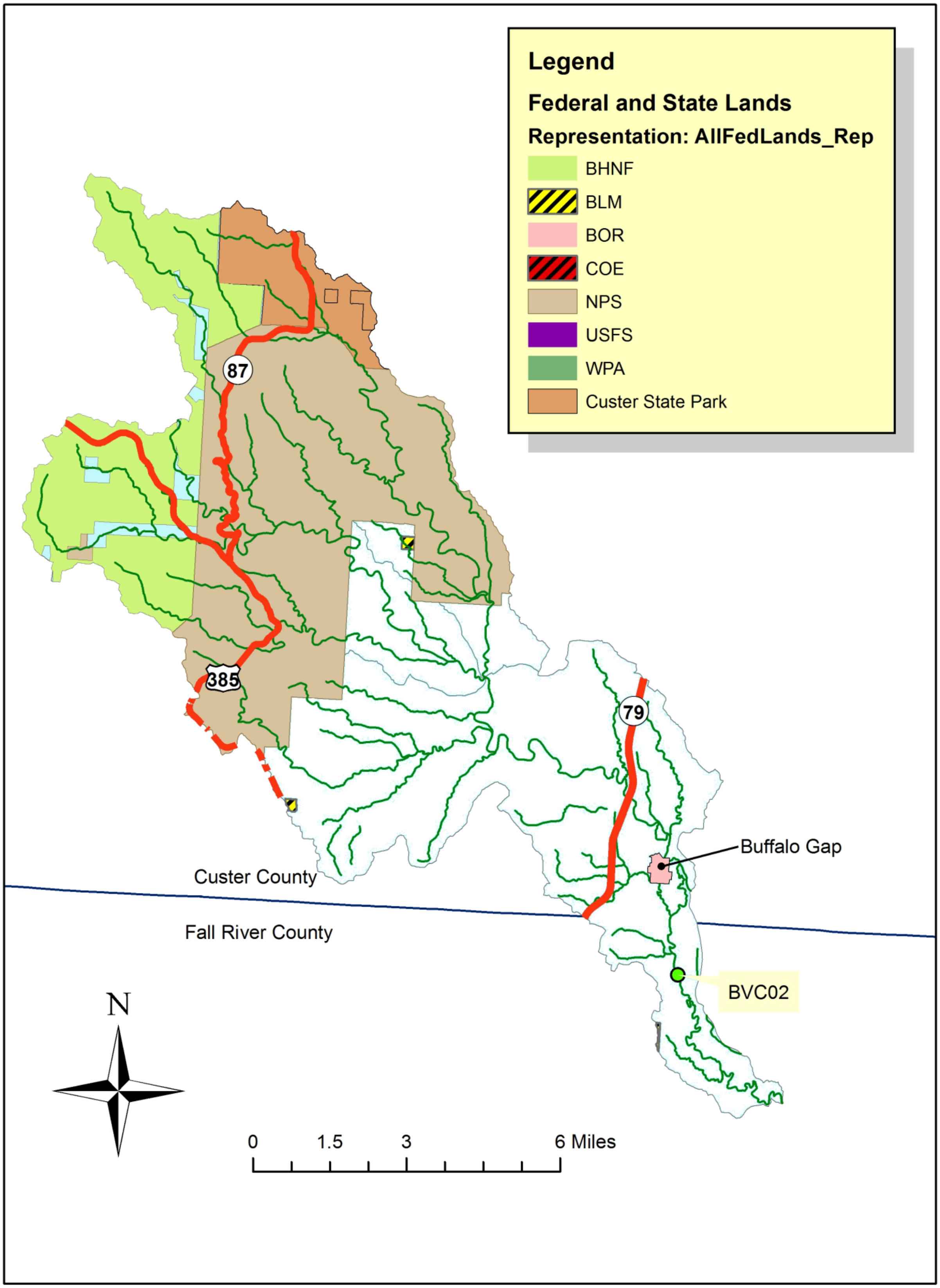

Figure 2: Beaver Creek Watershed with listed segment indicated in blue.

2.0 Water Quality Standards

Each waterbody within South Dakota is assigned beneficial uses. All waters (both lakes and streams) are designated the use of fish and wildlife propagation, recreation and stock watering. All streams are assigned the use of irrigation. Additional uses may be assigned by the state based on a beneficial use analysis of each waterbody. Water quality standards have been defined in South Dakota state statutes in support of these uses (Table 2). These standards consist of suites of numeric criteria that provide physical and chemical benchmarks from which management decisions can be developed.

Chronic standards, including geometric means and 30-day averages, are applied to a calendar month. While not explicitly described within the state water quality standards, this is the method used in the South Dakota Integrated Water Quality Report (IR) as well as in permit development.

Additional "narrative" standards that may apply can be found in the "Administrative Rules of South Dakota: Articles 74:51:01:05; 06; 08; and 09". These contain language that generally prohibits the presence of materials causing pollutants to form, visible pollutants, nuisance aquatic life, and biotic integrity.

Beaver Creek from the Cheyenne River to Highway 79 has been assigned the beneficial uses of: warm water permanent fish life propagation; limited contact recreation; irrigation; and fish, wildlife, propagation, recreation, and stock watering. Table 2 lists the criteria that must be met to support the specified beneficial uses. When multiple criteria exist for a particular parameter, the most stringent criterion is used.

The numeric TMDL target established for Beaver Creek is 1000 cfu/100 ml, which is based on the chronic standard for fecal coliform. The fecal coliform criteria for the limited contact recreation beneficial use requires that 1) no sample exceeds 2000 cfu/100 ml and 2) during a 30-day period, the geometric mean of a minimum of 5 samples collected during separate 24-hour periods must not exceed 1000 cfu/100 ml. These criteria are applicable from May 1 through September 30.

This document will use the limited contact recreation beneficial use chronic threshold value for *E. coli* of 1000 cfu/100 ml as a management goal. By using the chronic threshold of limited contact recreation there is increased confidence that acute and chronic water quality criteria for limited contact recreation will be achieved.

Table 2: State water quality standards for Beaver Creek.

Parameters	Criteria	Unit of Measure	Beneficial Use Requiring this Standard
Total ammonia nitrogen as N	Equal to or less than the result from Equation 3 in Appendix A of Surface Water Quality Standards	mg/L30 average May 1 to October 31	Warmwater Permanent Fish Life Propagation
	Equal to or less than the result from Equation 4 in Appendix A of Surface Water Quality Standards	mg/L 30 average November 1 to April 30	
	Equal to or less than the result from Equation c in Appendix A of Surface Water Quality Standards	mg/L Daily Maximum	
Dissolved Oxygen	≥5.0	mg/L	Warmwater Permanent Fish Life Propagation
Total Suspended Solids	≤90 (mean) ≤158 (single sample)	mg/L	Warmwater Permanentl Fish Life Propagation
Temperature	≤32	°C	Warmwater Permanent Fish Life Propagation
Fecal Coliform Bacteria (May 1 – Sept 30)	≤1,000 (geometric mean) ≤2,000 (single sample)	count/100 ml	Limited Contact Recreation
Escherichia coli Bacteria (May 1 – Sept 30)	≤630 (geometric mean) ≤1,178 (single sample)	count/100 ml	Limited Contact Recreation
Alkalinity (CaCO3)	≤750 (mean) ≤1,313 (single sample)	mg/L	Fish, Wildlife, Propagation, Recreation, and Stock Watering
Conductivity	≤2,500 (mean) ≤4,375 (single sample)	µmhos/cm @ 25° C	Irrigation Waters
Nitrogen, Nitrate as N	≤50 (mean) ≤88 (single sample)	mg/L	Fish, Wildlife, Propagation, Recreation, and Stock Watering
pH (standard Units	≥6.0 to ≤9.0	units	Warmwater Permanent Fish Life Propagation
Solids, Total Dissolved	≤2,500 (mean) ≤4,375 (single sample)	mg/L	Fish, Wildlife, Propagation, Recreation, and Stock Watering
Total Petroleum Hydrocarbon Oil and Grease	≤10 ≤10	mg/L mg/L	Fish, Wildlife, Propagation, Recreation, and Stock Watering
Sodium Absorption Ratio	≤10	ratio	Irrigation Waters

3.0 Significant Sources

3.1 Point Sources

There is one permitted discharge located near Buffalo Gap. This is Trout Haven Ranch and is an aquaculture facility. It does not have a fecal coliform limit and the waste load allocation for Beaver Creek is 0 cfu/day.

3.2 Nonpoint Sources

Nonpoint source fecal coliform pollution within Beaver Creek comes from primarily agricultural activities. Data from the 2009 National Agricultural Statistic Survey (NASS) and from the 2002 South Dakota Game Fish and Parks county wildlife assessment were utilized for livestock and wildlife densities, respectively. Animal density information (Table 3) was used to estimate relative source contributions of bacteria loads.

3.2.1 Agriculture

Manure from livestock is a potential source of fecal coliform to the stream. Livestock in the basin is predominantly beef cattle. Livestock can contribute fecal coliform bacteria directly to the stream by defecating while wading in the stream. They also can contribute by defecating while grazing on rangelands that wash off during precipitation events. Table 3 allocates the sources for bacteria production in the watershed into three primary categories. The summary is based on several assumptions. Feedlot numbers were calculated as the sum of all dairy, hog, and the NASS estimate of beef in feeding areas. All remaining livestock were assumed to be on range. Feedlots locations are shown in Figure 3.

Table 3: Fecal coliform source allocation for Beaver Creek.

Source	Percentage
Livestock on Range	94.47%
Wildlife	4.59%
Potential Human	0.27%
Feedlots	0.67%

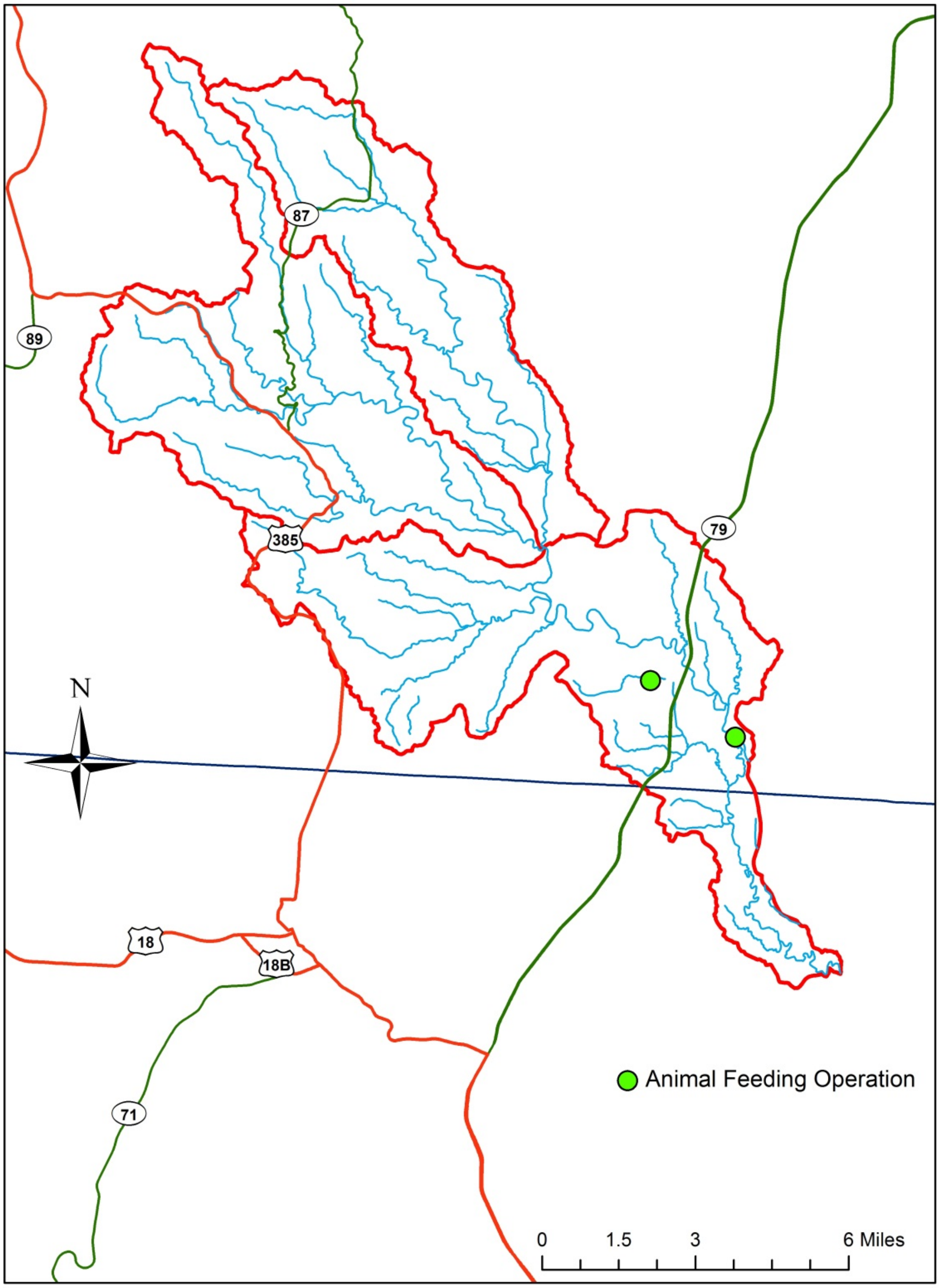

Figure 3: Animal feeding operation locations within the Beaver Creek Watershed.

3.2.2 Human

There are no municipal waste treatment facilities within the Beaver Creek watershed. Possible human fecal contribution is derived from septic tanks. Human fecal production may be estimated at 2E+09 (Bacterial Indicator Tool). When included as a total load in Table 4, human produced fecal coliform accounted for about 0.27% of all fecal coliforms produced in the watershed. These bacteria should all be delivered to a septic system, which if functioning correctly would result in no fecal coliforms entering the creek.

3.2.3 Natural background/wildlife

Wildlife within the watershed is a natural background source of fecal coliform bacteria. Wildlife population density estimates were obtained from the South Dakota Department of Game, Fish, and Parks (Table 4).

Table 4: Beaver Creek potential non-point sources.

Species	Custer (#/acre)	Fall River (#/acre)	Watershed (#/acre)	FC/animal/day	Fecal Coliform	Percent
hogs[3]	< 0.01	< 0.01	< 0.01	1.08E+10	4.90E+05	0.01%
milk cows[3]	<0.01	<0.01	<0.01	1.01E+11	2.22E+06	0.04%
cattle on range[3]	0.02	0.05	0.05	1.04E+11	4.89E+09	89.46%
cattle on feed[3]	0.02	0.05	0.02	1.04E+11	3.41E+07	0.62%
sheep[3]*	< 0.01	< 0.01	< 0.01	1.20E+10	1.52E+06	0.03%
bison[6]	< 0.01	< 0.01	< 0.01	1.04E+11	2.71E+08	4.96%
horse[3]	< 0.01	< 0.01	< 0.01	4.20E+08	7.47E+05	0.01%
human[1]	0.01	0.01	0.01	2.00E+09	1.45E+07	0.27%
All Wildlife	**Sum of All Wildlife**				2.51E+08	4.59%
deer[3]	0.01	0.01	0.01	5.00E+08	2.99E+06	
elk[6]	< 0.01	0.00	< 0.01	1.04E+11	2.26E+08	
antelope[7]	< 0.01	< 0.01	< 0.01	5.00E+08	4.66E+05	
mountain goat[7]	< 0.01	0.00	< 0.01	5.00E+08	3.09E+05	
turkey[3]	0.02	0.01	0.02	9.30E+07	1.51E+06	
mink[5]	< 0.01	< 0.01	< 0.01	1.25E+08	7.41E+04	
beaver[3]	< 0.01	< 0.01	< 0.01	2.50E+08	9.97E+04	
muskrat[5]	< 0.01	0.01	< 0.01	1.25E+08	1.04E+05	
skunk[5]	< 0.01	< 0.01	< 0.01	1.25E+08	4.10E+05	
badger[5]	< 0.01	< 0.01	< 0.01	1.25E+08	2.68E+04	
coyote[4]	< 0.01	< 0.01	< 0.01	4.09E+09	3.33E+06	
fox[4]	< 0.01	< 0.01	< 0.01	4.09E+09	2.56E+05	
raccoon[3]	< 0.01	< 0.01	< 0.01	1.25E+08	2.09E+05	
bobcat[4]	< 0.01	< 0.01	< 0.01	4.09E+09	8.25E+05	
jackrabbit[5]	< 0.01	< 0.01	< 0.01	1.25E+08	3.10E+04	
pine marten[5]	< 0.01	0.00	< 0.01	1.25E+08	5.32E+03	
mountain lion[7]	< 0.01	0.00	< 0.01	5.00E+08	1.18E+04	
cottontail rabbit[5]	< 0.01	0.01	< 0.01	1.25E+08	6.22E+05	
squirrel[5]	0.01	< 0.01	< 0.01	1.25E+08	6.01E+05	
ruffed grouse[2]	< 0.01	0.00	< 0.01	1.36E+08	2.57E+04	
partidge[2]	< 0.01	< 0.01	< 0.01	1.36E+08	1.56E+04	
sharptail grouse[2]	< 0.01	0.01	< 0.01	1.36E+08	2.49E+05	
canada goose[3]	0.00	0.0044901	< 0.01	4.90E+10	1.25E+07	

1 USEPA 2001
2 Best professional judgement based off of chickens
3 Bacteria Indicator Tool worksheet
4 Best professional judgement based off of dogs
5 Best professional judgement based off of raccoons
6 Best professional judgement based off of cattle
7 Best professional judgement based off of deer
* estimated from 2006 NASS

4.0 Technical Analysis

4.1 Data Collection Method

Data was collected during the Lower Cheyenne River Watershed Assessment Project. The collection site was BVC02 located south of Buffalo Gap along Beaver Creek Road (Figure 2). Data was collected from 2007 until 2009. Sampling attempted to obtain information on fecal coliform concentrations during event and base flow conditions. Additionally two samples were collected in 2012 at BVC02 to help augment the load duration curve.

4.2 Flow Analysis

This TMDL was developed using the Load Duration Curve (LDC) approach that results in a flow-variable target that considers the entire flow regime. The LDC is a dynamic expression of the allowable load for any given flow.

Continuous flow data was collected at USGS gaging station 06402500 from 1937 to the present. This flow data was used to create a load duration curve. To aid in interpretation and implementation of the TMDL, the LDC flow intervals were grouped into five flow zones representing high flows (0-10 percent), moist conditions (10-40 percent), mid-range flows (40-60 percent), dry conditions (60-80 percent), and low flows (80-100 percent) (USEPA 2006). The dry condition departs from the normal range of 60-90 percent due to flow conditions indicating that 60-80 percent would make a more appropriate percentile flow range. The reason for this is because the load duration curve slope changes significantly at 80 percent from the slope occurring in the dry, mid-range, and moist flow zones.

4.3 Sample Data

Sample data from the assessment project were utilized to evaluate the stream. Monthly and event based samples were collected. A total of 39 samples were available for the LDC analysis (Figure 3). Comparing flow and concentration resulted in a very weak relationship that was inadequate for use in predicting daily loads. Six of the 39 samples exceeded the acute standard (Table 4). On five dates duplicate samples were collected, out of each pair one sample was selected randomly and not included in the load duration curve analysis.

Table 5: Beaver Creek fecal coliform bacteria sample data.

Date	Fecal Coliform Bacteria (cfu/100 ml)	Average Daily Flow	Flow Zone
06/19/2007	110	0.39	Low Flows
04/24/2008	54	0.57	Low Flows
07/10/2007	230	1.9	Low Flows
08/13/2007	140	2	Low Flows
05/30/2007	510	2	Low Flows
09/16/2007	280	3.5	Dry Conditions
10/08/2007	90	3.8	Dry Conditions
08/10/2008	180	3.9	Dry Conditions
05/14/2008	76	4.2	Dry Conditions
08/03/2007	3800	5	Dry Conditions
05/19/2009	480	6.6	Dry Conditions
10/14/2008	260	7.2	Mid-range Flows
07/18/2007	2000	7.4	Mid-range Flows
10/15/2007	260	8.1	Mid-range Flows
12/09/2008	38	8.3	Mid-range Flows
11/18/2008	62	8.4	Mid-range Flows
11/20/2007	50	9.7	Moist Conditions
09/16/2008	180	9.8	Moist Conditions
02/18/2008	2	10	Moist Conditions
03/12/2008	2	10	Moist Conditions
01/15/2008	26	10	Moist Conditions
01/09/2012	12	11	Moist Conditions
01/10/2012	20	11	Moist Conditions
01/10/2012*	22	11	Moist Conditions
03/22/2009	30	11	Moist Conditions
02/08/2009	50	11	Moist Conditions
04/22/2009	74	11	Moist Conditions
02/08/2009*	78	11	Moist Conditions
01/08/2009	80	11	Moist Conditions
06/02/2008	170	11	Moist Conditions
06/17/2008	130	12	High Flows
04/16/2009	380	12	High Flows
04/16/2009*	450	12	High Flows
07/09/2008	120	14	High Flows
07/09/2008*	130	14	High Flows
08/05/2008*	11000	31	High Flows
08/05/2008	20000	31	High Flows
08/11/2008	9500	39	High Flows
07/18/2008	2000	60	High Flows
*duplicate samples			

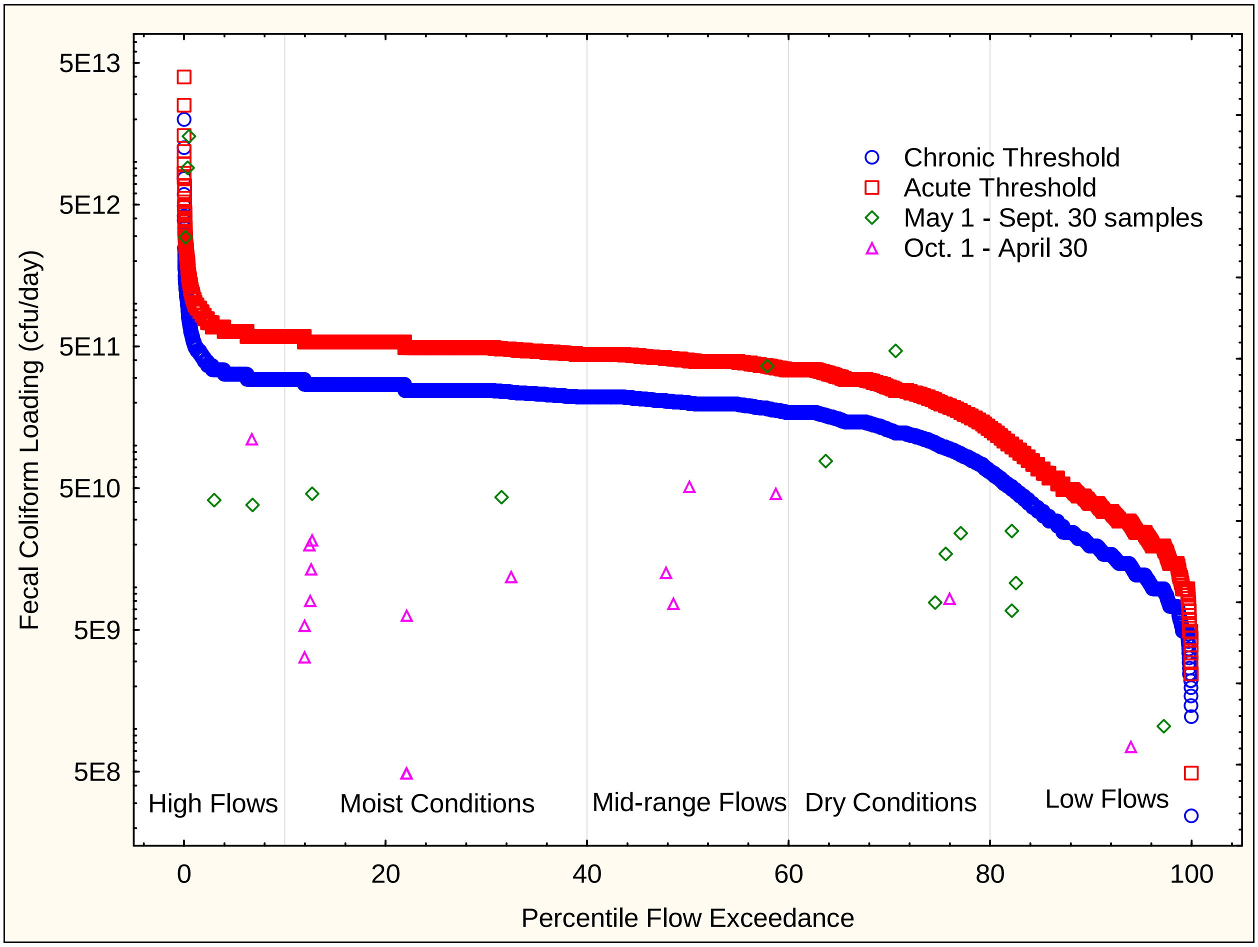

Figure 4: Beaver Creek load duration curve depicting chronic and acute threshold exceedances.

5.0 TMDL and Allocations

5.0.1 High Flows (<10% exceedance)

The high flow zone is composed of the highest 10% of flows that occurred in Beaver Creek. There were six samples representing this zone of which three exceeded the acute threshold. The 95 percentile concentration of all samples in the zone was used to calculate the current load from which reductions were calculated. A load reduction of 94% will be needed to fully support designated beneficial uses to the chronic water quality standard.

Table 6 depicts an example of a TMDL for a flow of 31 cfs (95 percentile flow in this zone) within the high flow zone regime. Higher and lower flows within this zone may acceptably carry higher or lower loads as long as the concentration does not exceed the state standard.

While the 2000 cfu/100ml goal may have made an acceptable goal, the chronic threshold of 1000 cfu/100ml was chosen for the TMDL. By using the 1000 cfu/100ml threshold, assurance is provided that the acute water quality standard will not be exceeded and chronic violations will be avoided.

Table 6: TMDL summary table for high flow conditions.

	Flow Zone (expressed as CFU/day)	
	High Flows	
	≥ 12 cfs	
LA	2.35E+13	Remaining load after deducting WLA and MOS from TMDL
WLA	0	
MOS	2.45E+10	
TMDL @1000 cfu/100 ml	2.35E+13	Standard multiplied by 95^{th} % flow for zone
Current Load	4.23E+14	95^{th} Percentile of observed fecal coliform bacteria load for each zone multiplied by 95% flow for zone
Load Reduction	94%	Reduction required to reduce the current load to the load at the standard

5.0.2 Moist Conditions (10% to 40% exceedance)

Moist condition flows are characterized by above average moisture conditions in the watershed. Flows in this regime are generated by precipitation and snowmelt events. The moist condition flows extend from approximately 12 cfs down to 9 cfs. Table 7 depicts an example of a TMDL for a flow of 12 cfs (95 percentile flow in this zone) within the moist condition regime. Higher and lower flows within this zone may acceptably carry higher or lower loads as long as the concentration does not exceed the state standard.

None of the twelve samples representing this flow zone exceeded either the acute or the chronic threshold. No load reduction is needed to meet water quality standards within the moist condition flow zone.

Table 7: TMDL summary table for moist conditions.

	Flow Zone (expressed as CFU/day)	
	Moist Conditions 9 – 12 cfs	
LA	3.50E+12	Remaining load after deducting WLA and MOS from TMDL
WLA	0	
MOS	2.45E+10	
TMDL @1000 cfu/100 ml	3.52E+12	Standard multiplied by 95^{th} % flow for zone
Current Load	5.32E+11	95^{th} Percentile of observed fecal coliform bacteria load for each zone multiplied by 95% flow for zone
Load Reduction	0%	Reduction required to reduce the current load to the load at the standard

5.0.3 Midrange Flows (40% to 60% exceedance)

The midrange flows extend from approximately nine cfs down to seven cfs. One sample out of five exceeded the acute threshold. A load reduction of 27% will be needed to fully support designated beneficial uses to the chronic water quality standard. Table 8 depicts an example of a TMDL for a flow of 9 cfs (95 percentile flow in this zone) within the midrange flow zone regime. Higher and lower flows within this zone may acceptably carry higher or lower loads as long as the concentration does not exceed the state standard.

Table 8: TMDL summary table for mid-range flows.

	Flow Zone (expressed as CFU/day)	
	Mid-range Flows	
	7 - 9 cfs	
LA	1.95E+12	Remaining load after deducting WLA and MOS from TMDL
WLA	0	
MOS	2.94E+10	
TMDL @1000 cfu/100 ml	1.98E+12	Standard multiplied by 95^{th} % flow for zone
Current Load	2.70E+12	95^{th} Percentile of observed fecal coliform bacteria load for each zone multiplied by 95% flow for zone
Load Reduction	27%	Reduction required to reduce the current load to the load at the standard

5.0.4 Dry Conditions (60% to 80% exceedance)

Dry condition flows extend from approximately 7 cfs down to 2.7 cfs. One of the 6 samples exceeded the acute threshold. A load reduction of 53% is needed to meet the chronic threshold. Table 9 depicts an example of a TMDL for a flow of 7 cfs (95 percentile zone in this zone) within the dry condition regime. Higher and lower flows within this zone may acceptably carry higher or lower loads as long as the concentration does not exceed the state standard.

Table 9: TMDL summary table for dry conditions.

	Flow Zone (expressed as CFU/day)	
	Dry Conditions	
	2.7 – 7 cfs	
LA	1.14E+12	Remaining load after deducting WLA and MOS from TMDL
WLA	0	
MOS	6.12E+10	
TMDL @1000 cfu/100 ml	1.20E+12	Standard multiplied by 95th % flow for zone
Current Load	2.58E+12	95th Percentile of observed fecal coliform bacteria load for each zone multiplied by 95% flow for zone
Load Reduction	53%	Reduction required to reduce the current load to the load at the standard

5.0.5 Low Flow Conditions (80% to 100% exceedance)

The low flow conditions zone include discharges from 2.7 cfs down to 0 cfs. None of the five samples within this flow zone exceeded the chronic threshold. No reduction is necessary to meet water quality standards (Table 10).

Table 10: TMDL summary table for low flow conditions.

	Flow Zone (expressed as CFU/day)	
	Low Flows 0 - 2.7 cfs	
LA	1.21E+11	Remaining load after deducting WLA and MOS from TMDL
WLA	0	
MOS	1.96E+10	
TMDL @1000 cfu/100 ml	1.41E+11	Standard multiplied by 95th % flow for zone
Current Load	5.30E+10	95th Percentile of observed fecal coliform bacteria load for each zone multiplied by 95% flow for zone
Load Reduction	0%	Reduction required to reduce the current load to the load at the standard

5.1 Load Allocations (LAs)

Approximately 67% of the landuse in the watershed is rangeland. The majority of the TMDL load has been allocated to these nonpoint source loads in the following load allocations. A 94% reduction in fecal coliform bacteria from anthropogenic sources (livestock) is required in the high flow zone to fully attain the current chronic water quality standards. No reduction is necessary within the moist condition flow zone. A 27% reduction in fecal coliform bacteria is required in the midrange flow zone to fully attain current chronic water quality standards. A 53% reduction in fecal coliform bacteria is required in the dry conditions zone to fully attain current chronic water quality standards. No reduction is needed in the low flow zone to meet water quality standards. Reducing sample concentrations below 1000 cfu/100 ml provides assurance that both acute and chronic standards will be met.

5.2 Wasteload Allocations (WLAs)

There are no point source discharges of fecal coliform within the Beaver Creek Watershed. One point source discharger has a TSS limit in its permit but does not need a fecal coliform discharge permit. This is an aquaculture facility and continuously discharges into Beaver Creek.

6.0 Margin of Safety (MOS) and Seasonality

6.1 Margin of Safety

An explicit MOS identified using a duration curve framework is basically unallocated assimilative capacity intended to account for uncertainty (e.g., loads from tributary streams, effectiveness of controls, etc). An explicit MOS was calculated as the difference between the loading capacity at the mid-point of each of the flow zones and the loading capacity at the minimum flow in each zone. A substantial MOS is provided using this method, because the loading capacity is typically much less at the minimum flow of a zone as compared to the mid-point. Because the allocations are a direct function of flow, accounting for potential flow variability is an appropriate way to address the MOS.

6.2 Seasonality

The impairments to Beaver Creek are most severe during summer (Figure 5). During this time period the creek is most likely to experience higher temperatures (encouraging livestock use of the stream) and peak recreational use of the waters. Typically, livestock are allowed to graze along the streams during the summer months. Combined with the peak in bacteria sources, high-intensity rainstorm events are common during the summer and produce a significant amount of fecal coliform loading due to bacterial wash-off from the watershed.

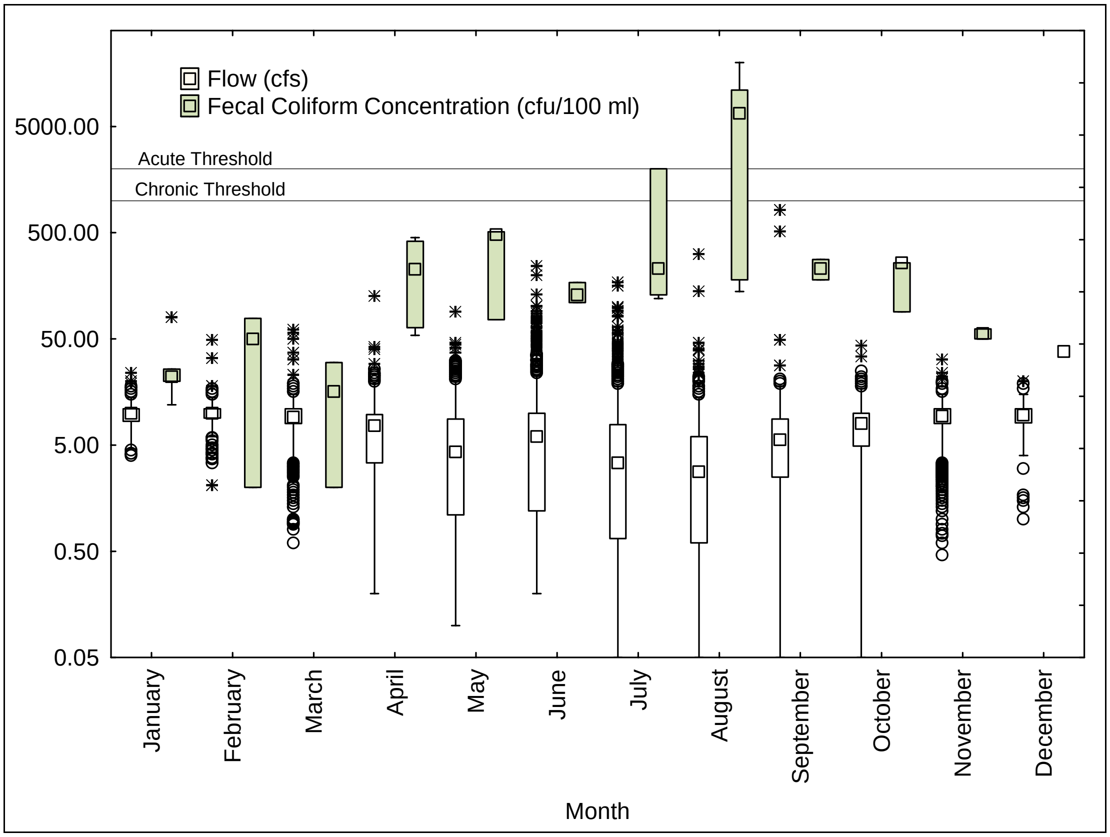

Figure 5: Monthly fecal coliform concentration and flow for Beaver Creek.

7.0 Public Participation

During the Lower Cheyenne River Watershed Assessment efforts to gain public education, review and comment were sought from local groups within the watershed on the conclusions drawn from the assessment. In addition there was a 30-day public notice period for public review and comment. The findings from these public meetings and comments were taken into consideration in the development of TMDLs generated by the assessment. The public notice was published in the Rapid City Journal, Hot Springs Star, and Custer County Chronicle. The document was also made available through the SD DENR's website.

8.0 Monitoring Strategy

The Department may adjust the load and/or wasteload allocations in this TMDL to account for new information or circumstances that are developed or come to light during the implementation of the TMDL and a review of the new information or circumstances indicate that such adjustments are appropriate. Adjustment of the load and waste load allocation will only be made following an opportunity for public participation. New information generated during TMDL implementation may include, among other things, monitoring data, BMP effectiveness information and land use information. The Department 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. The Department will notify EPA of any adjustments to this TMDL within 30 days of their adoption.

9.0 Restoration Strategy

Implementation strategies will be similar to McCutcheon (2010). Exclusion of livestock from the stream and rangeland management is recommended in reducing fecal coliform loading to the stream. Livestock exclusion can be achieved by fencing the stream off and providing off-stream watering sources. Rangeland management includes rotational grazing and reducing the intensity as well as duration of grazing. Rangeland management will improve range health resulting in increased water infiltration and decreased runoff. Combined livestock exclusion and rangeland management will likely result in sufficient reductions in fecal coliform loading to attain water quality standards.

10.0 Literature Cited

Huxoll, Cory. 2002. South Dakota Game Fish and Parks; South Dakota Game Report No. 2003-11; 2002 Annual Report County Wildlife Assessments with a summary of the 1991-2002 Assessments.

McCutcheon, C.M. 2010. Fecal Coliform Total Maximum Daily Load for the Cheyenne River, Pennington County, South Dakota. RESPEC Consulting and Services Topical Report RSI-2120.

SDDENR (South Dakota Department of Environment and Natural Resources). 2010. The 2010 South Dakota Integrated Report for Surface Water Quality Assessment Pierre, SD.

USDA (United States Department of Agriculture). 1996. Soil Survey of Custer and Pennington Counties, Prairie Parts, South Dakota.

USDA (United States Department of Agriculture). 1982. Soil Survey of Fall River County, South Dakota.

USEPA (U.S. Environmental Protection Agency). 2006. An Approach for Using Load Duration Curves in Developing TMDLs. U.S. Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2001. Protocol for Developing Pathogen TMDLs. EPA 841-R-00-002. Office of Water 4503F0, United States Environmental Protection Agency, Washington D.C. 132 pp.

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

SEP 26 2012

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 Approval
Beaver Creek Segment 1, Fecal Coliform
SD-CH-R-BEAVER_01_USGS

Dear Mr. Pirner:

We have completed our review of the total maximum daily load as submitted by your office for the waterbody 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 TMDL referenced above as developed for the water quality limited waterbody as described in Section 303(d)(1). Based on our review, we feel the separate elements of the TMDL as listed in the enclosed table adequately address the pollutant of concern as given in the table, taking into consideration seasonal variation and a margin of safety.

Thank you for submitting the TMDL for our review and approval. If you have any questions, the most knowledgeable person on my staff is Bonnie Lavelle and she may be reached at 303-312-6579.

Sincerely,

Howard M. Cantor, for
Assistant Regional Administrator
Office of Ecosystems Protection
and Remediation

Enclosures

ENCLOSURE 1: APPROVED TMDLs

FECAL COLIFORM TOTAL MAXIMUM DAILY LOAD EVALUATION FOR BEAVER CREEK SEGMENT 1 IN CUSTER AND FALL RIVER COUNTIES, SOUTH DAKOTA

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

Submitted: 8/2/2012

Segment: Beaver Creek Segment 1 from Wyoming border to the confluence with Cheyenne River

303(d) ID: SD-CH-R-BEAVER 01 USGS

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

Water Quality Targets: <1000 cfu/100 ml geometric mean concentration; <2000 cfu/100 ml maximum single sample

Allocation*	Value	Units	Permits
WLA	0	CFU/DAY	
LA	2.35E+13	CFU/DAY	
TMDL	2.35E+13	CFU/DAY	
MOS	2.45E+10	CFU/DAY	

Notes:

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

ENCLOSURE 2: EPA REGION 8 TMDL REVIEW

TMDL Document Info:

Document Name:	**Fecal Coliform Total Maximum Daily Load Evaluation for Beaver Creek Segment 1 in Custer and Fall River Counties, South Dakota**
Submitted by:	**South Dakota Department of Environment and Natural Resources**
Date Received:	**August 2, 2012**
Review Date:	**September 20, 2012**
Reviewer:	**Vern Berry, Bonnie Lavelle, EPA**
Rough Draft / Public Notice / Final Draft?	**Final**
Notes:	

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

☒ Approve
☐ Partial Approval
☐ Disapprove
☐ Insufficient Information

Approval Notes to Administrator: Based on the review presented below, I recommend approval of the TMDL submitted in this document.

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 ☐ N/A

Summary:
The final version of the fecal coliform TMDL for Beaver Creek Segment 1 was transmitted to EPA via email on August 2, 2012 with a submittal letter requesting final EPA review and approval.

Comments: *No comments.*

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:

Physical Setting and Listing History*:*

Beaver Creek begins in the Black Hills of South Dakota and flows southeast to its mouth at the confluence with the Cheyenne River. On its way to the Cheyenne River, Beaver Creek flows through Custer and Fall River Counties and drains 61,120 acres in western South Dakota. The HUC Code for Beaver Creek is 10120109 and is part of the Middle Cheyenne-Spring watershed.

The portion of Beaver Creek listed as impaired (SD-CH-R-BEAVER_01_USGS) is approximately 12 miles long from west of South Dakota Highway 79 to the confluence with the Cheyenne River. Land use within the Beaver Creek watershed is mainly rangeland (67%) and forest (33%). Less than 1% of the land in the watershed is developed. The impaired segment of Beaver Creek receives runoff from agricultural operations.

Chapter 74:51:03:01 of the South Dakota Administrative Rules assigns all streams in South Dakota the beneficial uses of:

> *Beneficial use Classification 9: Fish and wildlife propagation, recreation, and stock watering waters*
> *Beneficial Use Classification 10: Irrigation waters*

Chapter 74:51:03:07 of the South Dakota Administrative Rules assigns the following additional beneficial use classifications to Beaver Creek near Buffalo Gap, South Dakota:

> *Beneficial Use Classification 4: Warmwater permanent fish life propagation waters*
> *Beneficial Use Classification 8: Limited contact recreation waters*

Beaver Creek was included in the Lower Cheyenne Watershed Assessment. This assessment was designed to compile and evaluate data for fecal coliform and total suspended solids as well as identify loading sources and feasible restoration recommendations. Beaver Creek, SD-CH-R-BEAVER_01_USGS, was first listed as impaired for fecal coliform on the 2010 303(d) list.

***Impairment status**:*
The 2010 South Dakota Integrated Report for Surface Water Quality Assessment identifies Beaver Creek segment SD-CH-R-BEAVER_01_USGS as not supporting the following beneficial uses:

Stream Segment	*Data Source*	*Beneficial Use Not Supported*	*Cause*	*Priority*
Beaver Creek SD-CH-R-BEAVER_01_USGS	*DENR USGS*	*Classification 8 Limited Contact Recreation*	*Fecal Coliform*	*2*

Comments: *No comments.*

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, all TMDL documents must be written to meet the existing water quality standards 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:
A description of the applicable State water quality standards, including the designated use(s) of Beaver Creek and the applicable numeric water quality criteria are included in several places in the TMDL document.

Section 2.0, Water Quality Standards, (page 8) describes the beneficial uses that have been assigned to Beaver Creek. These are:

- *Beneficial Use Classification 9: Fish and wildlife propagation, recreation, and stock watering waters*
- *Beneficial Use Classification 10: Irrigation waters*
- *Beneficial Use Classification 4: Warmwater permanent fish life propagation waters*
- *Beneficial Use Classification 8: Limited contact recreation waters*

Table 2, State Water Quality Standards for Beaver Creek (page 9) summarizes the Water Quality Criteria for Beaver Creek. These criteria must be met to support the assigned beneficial uses.

Section 1.1, Watershed Characteristics, (page 5) states that the portion of Beaver Creek, segment SD-CH-R-BEAVER_01_USGS, was listed as impaired in the 2010 Integrated Report and the cause was fecal coliform bacteria.

Section 2.0, Water Quality Standards, (page 9) describes the fecal coliform water quality criteria that support the limited contact recreational uses:

1. *Single sample maximum of ≤ 2000 cfu/100ml;*
2. *30-day, geometric mean. based on a minimum of 5 samples obtained during separate 24-hour periods, of ≤ 1000 cfu/100ml; and*
3. *These criteria only apply during the period May 1 – September 30.*

This section also states that the TMDL target is based on the chronic standard for fecal coliform of ≤ 1000 cfu/100ml to support the limited contact recreational use.

Comments: *No comments.*

2.0 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:
Section 2.0, Water Quality Standards (page 9), identifies the water quality target based on the chronic standard for fecal coliform that supports the limited contact recreation beneficial use. This target is: fecal coliform ≤ 1000 cfu/100mL.

Load duration curves are developed in Section 3.0, Technical Analysis (pages 14-16) and Figure 4, Load Duration Curve (LDC) for Beaver Creek monitoring location BVC02. Load duration curves are presented for both the Acute and Chronic water quality criteria for fecal coliform that supports the limited contact recreation use.

Comments: *No comments.*

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**:*
Section 3.0, Significant Sources beginning on page 9, provides the pollutant source analysis for the listed segment of Beaver Creek. There is one permitted point source within the Beaver Creek watershed for Trout Haven Ranch, an aquaculture facility located near Buffalo Gap. The permit for this facility does not have a fecal coliform limit.

Nonpoint sources of fecal coliform are primarily agricultural (manure from livestock) with contributions from septic systems and natural background/wildlife. Livestock in the watershed are predominantly beef cattle. Homes in the watershed have septic systems which have the potential to contribute fecal coliform bacteria to the impaired segment of Beaver Creek.

The number of livestock and wildlife animals per acre within the watershed was estimated based on the results of the 2009 National Agricultural Statistic Survey (NASS) and the 2002 South Dakota Game Fish and Parks county wildlife assessment. Estimates of the amount of fecal coliform per animal per day were combined with the estimated number of animals per acre to arrive at an estimated daily load of fecal coliform in cfu of fecal coliform per acre per day for each species. Table 4, "Beaver Creek potential non-point sources" on page 13 summarizes these estimates.

The TMDL document also presents a percentage contribution of fecal coliform in the watershed for 4 primary categories. Table 3,"Fecal coliform source allocation for Beaver Creek" on page 10 presents these estimates:

- *Livestock on Range are estimated to contribute 94.47% of the fecal coliform,*
- *Human sources are estimated to contribute 0.27% of the fecal coliform,*
- *Wildlife is estimated to contribute 4.59% of the fecal coliform, and*
- *Feedlots are estimated to contribute 0.67% of the fecal coliform.*

These estimates may not reflect the percentage contribution of fecal coliform that reaches Beaver Creek. Land use, cover, distance from the stream precipitation and other factors affect the amount that reaches the stream. It is likely that fecal matter deposited on land away from the stream will only contribute fecal matter during runoff events. Additionally, some of the fecal matter from livestock and wildlife may be deposited directly into the stream.

The geographic locations of the feedlots are shown in Figure 3 on page 10. The numbers of livestock within these facilities is likely to vary seasonally with livestock likely not occurring within the feedlot during the growing season. It is common practice of livestock producers within western South Dakota to place livestock on range during the summer and to place livestock on feed during the winter months. Given the low numbers of livestock feedlots within this watershed and the likely lack of livestock within the facilities during summer months it is likely that implementation will focus on BMPs designed to reduce fecal coliform loading from rangeland.

Comments: *No comments.*

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:
Section 3.0, "Technical Analysis" describes the collection of data used to support this TMDL. Water quality samples and flow data was collected at one location along the impaired segment:

- *BVC02, located approximately 3 miles south of the town of Buffalo Gap along Beaver Creek Road*

Water samples were collected from this location from 2007 to 2009, and two additional samples were collected in January 2012. Table 5, "Beaver Creek fecal coliform bacteria sample data" (page 15) provides date of sample collection and fecal coliform concentrations for each sampling event.

Section 4.2, "Flow Analysis" (page 14) states that flow data was collected at USGS gaging station 06402500 from 1937 to present. This gaging station is co-located with sampling site BVC02 south of Buffalo Gap.

The water quality data and the flow data were used to develop the load duration curve for the impaired segment of Beaver Creek. The load duration curve was divided into five flow zones as described in the document.

***Comments**: No comments.*

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 Beaver Creek TMDL data description and summary are included mostly in the Technical Analysis section of the document. The recent water quality monitoring was conducted during the period from 2007 to 2009, and two additional samples were collected in January 2012. Monthly and event* *based samples were collected during this period resulting in a total of 39 fecal coliform samples. The data set also includes the flow record on Beaver Creek, from 1937 to present, that was use to develop a load duration curve.*

***Comments**: No comments.*

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**:*
There is one permitted point source within the Beaver Creek watershed for Trout Haven Ranch, an aquaculture facility located near Buffalo Gap. The permit for this facility does not have a fecal coliform limit. The TMDL establishes a waste load allocation of 0 for all flow zones.

***Comments**: No comments.*

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**:*

This TMDL was developed using the Load Duration Curve (LDC) approach. The chronic water quality criterion for fecal coliform that supports the limited contact recreation use was used as the water quality target. Separate summary tables of the TMDL calculations are presented for each of the flow zones: high flow, moist, mid-range flows, dry, and low flow.

The Load Allocation is discussed in Section 5.1, "Load Allocation" (page 22). Approximately 67% of the watershed is comprised of rangeland agricultural use. Fecal coliform loading is attributed to these sources. The following load allocations are made:

- *2.35E+13 cfu/day during high flow conditions (≥12 cfs); a 94% reduction is needed;*
- *3.50E+12 cfu/day during moist conditions(9-12 cfs); a 0% reduction is needed;*
- *1.95E+12 cfu/day during mid-range conditions(7-9 cfs); a 27% reduction is needed;*
- *1.14E+12 cfu/day during dry conditions(2.7-7cfs); a 53% reduction is needed;*
- *1.21E+11 cfu/day during low flow conditions (0-2.7 cfs); a 0% reduction is needed.*

***Comments**: No comments.*

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:

Section 6.0, "Margin of Safety" (page 22) states that an explicit MOS is included in the TMDL. The MOS is the quantitative difference between the loading capacity at the mid-point of each of the flow zones and the loading capacity at the minimum flow in each zone on the LDC. A substantial MOS is provided using this method because the loading capacity is typically much less at the minimum flow.

The MOS is as follows:

- *2.45E+10 cfu/day during high flow conditions(≥12 cfs);*
- *2.45E+10 cfu/day during moist conditions (9-12 cfs);*
- *2.94 E+10 cfu/day during mid-range conditions(7-9 cfs);*
- *6.12E+10 cfu/day during dry conditions(2.7-7 cfs);*
- *1.96E+10 cfu/day during low flow conditions (0-2.7 cfs).*

Comments: *No comments.*

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. The highest stream flows typically occur during late spring, and the lowest stream flows typically occur during the winter months. The TMDL also considers seasonality because the fecal coliform criteria are in effect from May 1 to September 30, as defined by the recreation season in South Dakota.*

Comments: *No comments.*

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 Public Participation section of the TMDL document describes the public participation process that has occurred during the development of the TMDL. In particular, the State has encouraged participation through public board meetings in the watershed and a website was developed and maintained throughout the project. This TMDL was also available for a 30-day public notice period prior to finalization.*

Comments: *No comments.*

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: *Beaver Creek should continue to be monitored as part of the Cheyenne River implementation project. Post-implementation monitoring will be necessary to assure the TMDL targets have been achieved and maintenance of the beneficial use occurs.*

Comments: *No comments.*

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: *Section 9.0, Restoration Strategy (page 24), says that the implementation activities for Beaver Creek will be similar to those identified in the Cheyenne River TMDL document and will focus on exclusion of livestock from the stream and rangeland management.*

Given the low numbers of livestock feedlots within this watershed and the likely lack of livestock within the facilities during summer months it is likely that implementation will focus on BMPs designed to reduce fecal coliform loading from rangeland.

Comments: *No comments.*

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 Beaver Creek fecal coliform TMDL includes daily loads expressed as colonies per day. The daily TMDL loads are included in TMDL and Allocations section of the TMDL document.*

Comments: *No comments.*