ESHERICHIA COLI TOTAL MAXIMUM DAILY LOAD EVALUATION OF THE BIG SIOUX RIVER SEGMENT 1 CODINGTON, GRANT, DAY, AND ROBERTS COUNTIES, SOUTH DAKOTA

South Dakota Department of
Environment and Natural Resources

Protecting South Dakota's Tomorrow ... Today

SOUTH DAKOTA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

JANUARY, 2012

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E. coli Total Maximum Daily Load Summary

Entity ID:	SD-BS-R-BIG_SIOUX_01
Location:	HUC Code: 10170201
Size of Watershed:	170,000 acres
Water body Type:	River/Stream
303(d) Listing Parameter:	*E. coli*
Initial Listing date:	2010 IR
TMDL Priority Ranking:	1
Listed Stream Miles:	31 miles
Designated Use of Concern:	Limited Contact Recreation
Analytical Approach:	Load Duration Curve Framework
Target:	Meet applicable water quality standards 74:51:01:55
Indicators:	*E. coli*
Threshold Value:	<630 CFU/100mL geometric mean concentration with maximum single sample concentrations of <1178 CFU/100mL
High Flow Zone LA:	$4.5E^{13}$ CFU/day
High Flow Zone WLA:	0 CFU/day
High Flow Zone MOS:	$4.9E^{13}$ CFU/day
High Flow Zone TMDL:	$9.4E^{13}$ CFU/day

1.0 Introduction

The intent of this document is to clearly identify the components of the TMDL submittal to support adequate public participation and facilitate 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 EPA. This TMDL document addresses the *E. coli* impairment of the Big Sioux River, SD-BS-R-BIG_SIOUX_01. Segment 1 of the Big Sioux River is listed in the 2010 South Dakota Integrated Report (SDDENR 2010) as impaired in regard to dissolved oxygen and *E. coli* bacteria. This document deals specifically with the *E. coli* impairment.

Segment 1 of the Big Sioux River was listed as impaired in regard to *E. coli* based on routine monitoring data collected from 2001 to 2009. South Dakota criteria for determining support status state that if over 20 samples are collected, the water body will be listed as impaired if 10% or more of the samples exceed the daily maximum criterion (SDDENR 2010). Additional sampling in 2010 and 2011 confirmed the impairment and the water body will be listed in the 2012 SD Integrated Report.

1.1 Watershed Characteristics

Segment 1 of the Big Sioux River drains approximately 170,000 acres of Codington, Grant, Day, and Roberts counties in South Dakota. This segment is defined as extending from Lake Kampeska at Watertown, SD upstream to Section 28, T121N, R52W in Grant County. Contributing drainage areas upstream constitute the headwaters of the river.

The boundary of the watershed is somewhat undefined as a result of rising water levels in previously closed drainages in Northeastern SD. Lakes that do not have a recorded history of discharging have reached elevations that are nearing, or have begun to contribute to the upper reaches of the basin. For the purposes of this report, the USGS Hydrologic Unit Code (HUC) 12 boundaries (Figure 1) will be utilized to provide a reproducible level of consistency. The HUC 8 boundary includes an area of over 700,000 potential acres. The nature of the intermittent and incomplete hydrologic connection significantly limits this drainage areas contribution of water and pollutants to the river.

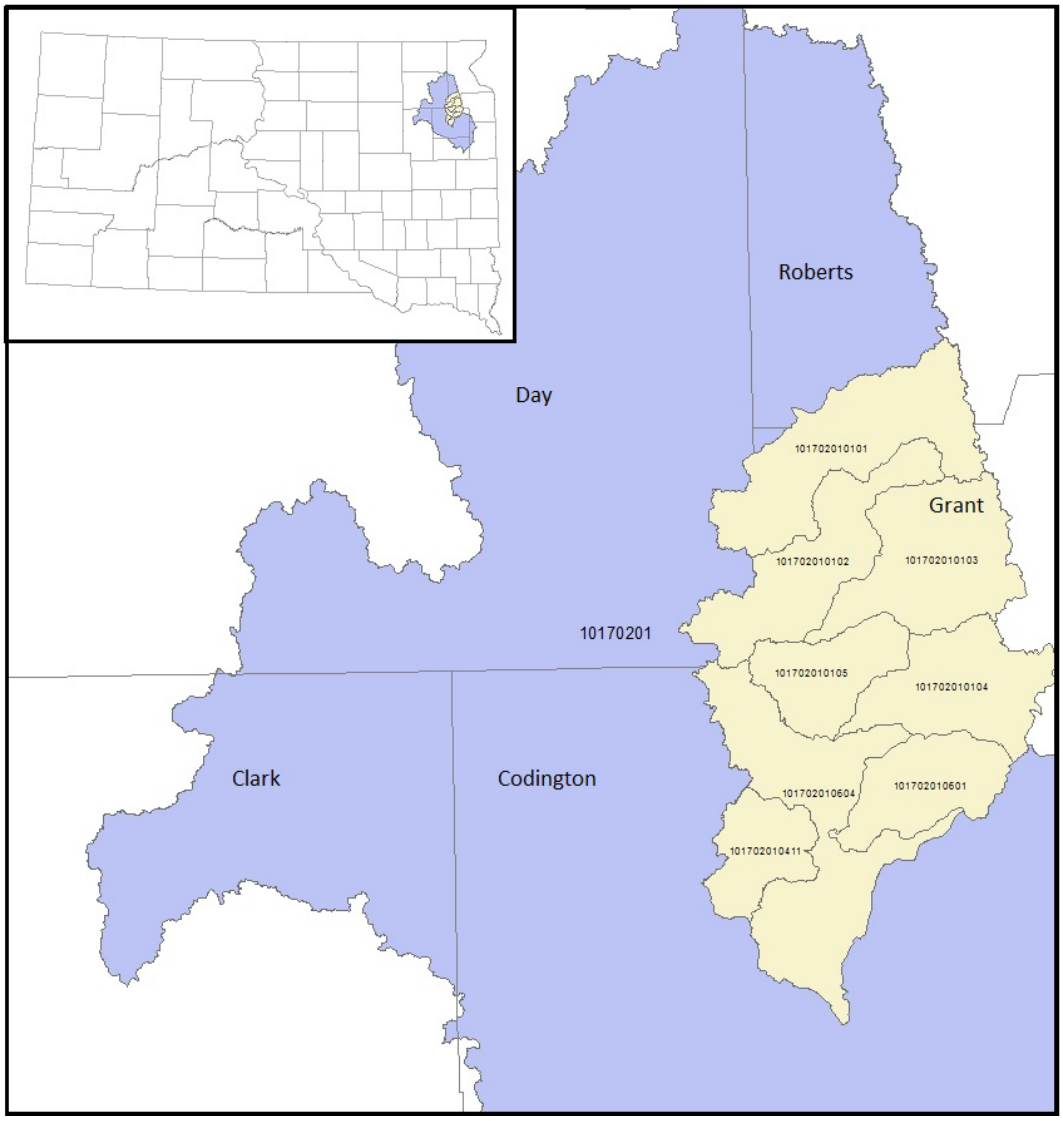

Figure 1. Upper Big Sioux Watershed Location in South Dakota and HUC Boundaries

Primary soil groups vary by county, however the most likely to be associated with bacterial contamination are those closest to the segment. Grant County soil associations of interest include the LaDelle-Doray-Playmoor and Renshaw-Fordville-Divide. These associations are most frequently located within the stream corridors or immediately adjacent terraces and uplands. Codington County soil associations found in a similar aspect on the landscape include the Estelline-Fordville-Renshaw and Lamoure-Rauville. (USDA 1977 and USDA 1966)

Landuse in the watershed is primarily agricultural in nature. Row crops, small grain, and grazing are the dominant uses (Table 1). Agricultural practices such as grazing stream corridors, animal feeding operations, and manure applications are the most likely sources of bacterial contamination to the segment.

Table 1. Landuse Characteristics

Land use	Percentage
Cultivated Crop	49.2%
Grassland	42.3%
Developed	4.4%
Water/Wetlands	3.7%
Forest	0.4%

The watersheds climate may be characterized by extremes. Winter temperatures frequently fall to -20° F while summer heat may exceed 100° F. Precipitation averages 21 inches per year and may come as rain or snow; however 75% falls from April through September. Seasonal snowfall is 31 inches. Thunderstorms are frequently intense but short in duration occurring on average 36 days each year. (USDA, 1990)

2.0 Water Quality Standards

Each water body 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 water body. Water quality standards have been defined in South Dakota state statutes in support of these uses. 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's water quality standards, this is the method used in the states 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; 09; and 12". These contain language that generally prohibits the presence of materials causing pollutants to form, visible pollutants, nuisance aquatic life and biological integrity.

Segment 1 of the Big Sioux River has been assigned the beneficial uses of: warmwater semi-permanent fish life, irrigation waters, limited contact recreation, and fish and 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 segment 1 of the Big Sioux River for *E. coli* is 630 CFU/100mL, which is based on the chronic standard for *E. coli*. The *E. coli* criteria for the limited contact recreation beneficial use requires that 1) no sample exceeds 1178 CFU/100mL 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 630 CFU/100mL. These criteria are applicable from May 1 through September 30.

Table 2.South Dakota Water Quality Standards for Segment 1 of the Big Sioux River.

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/L 30 average March 1 to October 31	Warmwater Semi-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 February 29	
	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 Semi-Permanent Fish Life Propagation
Total Suspended Solids	≤90 (mean) ≤158 (single sample)	mg/L	Warmwater Semi-Permanent Fish Life Propagation
Temperature	≤32	°C	Warmwater Semi-Permanent Fish Life Propagation
Fecal Coliform Bacteria (May 1- Sept 30)	≤1000 (geometric mean) ≤2000 (single sample)	count/100 mL	Limited Contact Recreation
Escherichia coli Bacteria (May 1- Sept 30)	≤630 (geometric mean) ≤1178 (single sample)	count/100 mL	Limited Contact Recreation
Alkalinity ($CaCO_3$)	≤750 (mean) ≤1,313 (single sample)	mg/L	Fish and 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 and Wildlife Propagation, Recreation, and Stock Watering
pH (standard units)	≥6.5 to ≤9.0	units	Warmwater Semi-Permanent Fish Life Propagation
Solids, total dissolved	≤2,500 (mean) ≤4,375 (single sample)	mg/L	Fish and Wildlife Propagation, Recreation, and Stock Watering
Total Petroleum Hydrocarbon Oil and Grease	≤10 ≤10	mg/L	Fish and Wildlife Propagation, Recreation, and Stock Watering
Sodium Adsorption Ratio	<10	ratio	Irrigation Waters

3.0 Significant Sources

3.1 Point Sources

There are no point sources or permitted CAFO facilities within the drainage area of segment 1 of the Big Sioux River.

3.2 Non-Point Sources

Nonpoint sources of *E. coli* in segment 1 of the Big Sioux River come primarily from agricultural sources. Due to an absence of literature values, loading calculations were based on data which is further described in Section 4.3. Data from the 2010 National Agricultural Statistic Survey (USDA, 2010) and from the 2002 South Dakota Game Fish and Parks County Wildlife Assessment (Huxoll, 2002) were utilized for livestock and wildlife densities. Animal density information was used to estimate relative source contributions of bacteria loads and is summarized in Table 3. Production of *E. coli* bacteria in the watershed is estimated at 1.2E+15 colony forming units.

Table 3. Big Sioux River *E. coli* Sources

Species	#/mile	#/acre	FC/Animal/Day	FC/Acre	Percent
Dairy cow	4.80	7.5E-03	4.46E+10	334725000	4.8%
Beef	80.00	1.3E-01	3.90E+10	4875000000	70.5%
Hog	17.19	2.7E-02	1.08E+10	290151818	4.2%
Sheep	22.11	3.5E-02	1.96E+10	677090909	9.8%
Horse	1.45	2.3E-03	5.15E+10	117000000	1.7%
Poultry1	466.36	7.3E-01	1.36E+08	99101287	1.4%
All Wildlife	Sum of all Wildlife			518989894	7.5%
Human	2.18	3.4E-03	1.95E+09	6647727	0.1%
Turkey (Wild)2	0.06	9.4E-05	1.10E+08	10313	
Goose3	1.43	2.2E-03	7.99E+08	1785266	
Deer3	4.57	7.1E-03	3.47E+08	2477797	
Beaver3	0.36	5.6E-04	2.00E+05	113	
Raccoon3	5.71	8.9E-03	5.00E+09	44609375	
Coyote/Fox4	1.15	1.8E-03	1.75E+09	3144531	
Muskrat2	34.24	5.4E-02	2.50E+07	1337500	
Opossom5	0.14	2.2E-04	5.00E+09	1093750	
Mink5	1.71	2.7E-03	5.00E+09	13359375	
Skunk5	3.99	6.2E-03	5.00E+09	31171875	
Badger5	0.26	4.1E-04	5.00E+09	2031250	
Jackrabbit5	3.57	5.6E-03	5.00E+09	27890625	
Cottontail5	28.53	4.5E-02	5.00E+09	222890625	
Squirrel5	21.4	3.3E-02	5.00E+09	167187500	

1 Regional Poultry Numbers used from 2002 census

2 USEPA 2001

3 Bacteria Indicator Tool Worksheet

4 Best Professional Judgment based off of Dogs

5 FC/Animal/Day copied from Raccoon to provide a more conservative estimate of background effects of wildlife

3.2.1 Natural Background Sources

Wildlife within the watershed is a natural background source of *E. coli*. Wildlife population density estimates were obtained from the South Dakota Department of Game, Fish, and Parks. Best estimates suggest wildlife account for approximately 7.5% of the bacteria produced in the watershed.

3.2.2 Human Sources

Approximately 1500 people reside in the watershed (Census 2010). Septic systems are assumed to be the primary disposal source for residents in the watershed. Table 3 includes all human produced *E. coli* and does not include expected reductions as a result of delivery to a septic system. Human bacteria production may be estimated at 1.95E+9 (Yagow et al. 2001). When included as a total load in the table, the population produced loads accounting for about 0.1% of all bacteria 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 segment.

3.2.3 Agricultural Sources

Manure from livestock is a potential source of *E. coli* to the river. Livestock in the basin are predominantly beef cattle. They may contribute *E. coli* directly by defecating while wading in the stream, or by defecating while grazing on rangelands or in feeding areas, which is then washed off during precipitation events. Table 4 allocates the sources of bacteria production in the watershed into three primary categories. The summary is based on several assumptions. Feedlots 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 grass and human contributions were excluded.

Table 4. *E. coli* Source Allocation for Segment 1 Big Sioux River

Source	Percentage
Feedlots	22.1%
Livestock on Grass	70.3%
Wildlife	7.5%

4.0 Technical Analysis

4.1 Data Collection Method

To develop the *E. coli* TMDL, data were collected from SDDENR ambient water quality monitoring site WQM 46BSA1 from 2001 until 2011 and from targeted sites from 2005 through 2011. Flow data was collected by the USGS at gauging site 6479438, located near Watertown, SD from 1972 through 2011. A series of targeted sites were more intensely monitored for bacteria concentrations during 2011 to help identify sources of impairments.

Unless otherwise noted, analysis was completed with modeling programs according to the most recent version of the Water Quality Modeling in South Dakota document (SDDENR 2009).

4.2 Flow Analysis

Long term hydrologic records are available at two sites within the segment. The USGS gauging station 06479438 is located approximately 5 miles north of Watertown, SD (Figure 2). Flow data from this site was available from 1972 to 2011 and was used to develop the TMDL. A second USGS gauge is located near Florence, SD on the Big Sioux River. This location is near the upstream end of the segment and the period of record is shorter than the Watertown site. The site at Watertown accounts for all discharges that are generated within the segments drainage area.

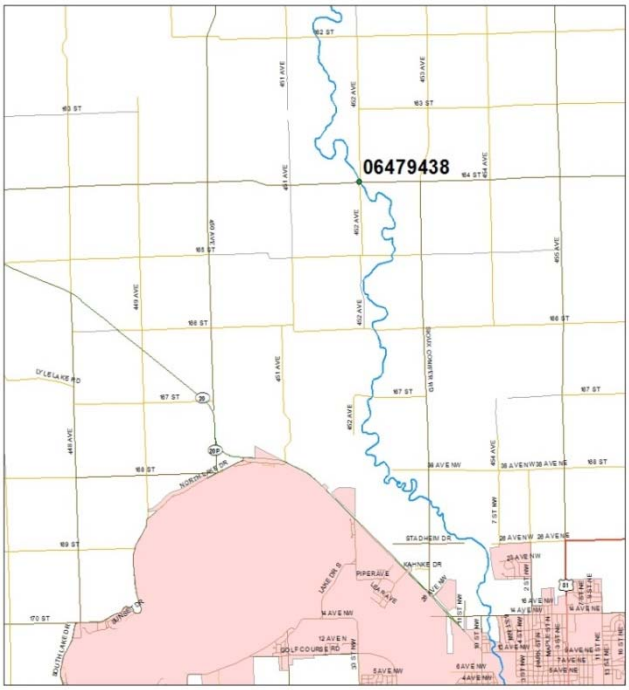

Figure 2. USGS Gauge 06479438 Near Watertown, SD

Analysis of the flow frequencies at the Watertown gauge resulted in the selection of three distinct flow regimes (Figure 3). The first two flow regimes were broken at the 10th and 40th percentiles as suggested in EPA guidance for the development of load duration curves. Multiple years of sample data yielded 90% of the data within these two zones. Late fall and winter discharges are typically smaller than spring and summer flows. Due to the frequency of larger flows during the spring and summer months and the increased recreation, higher flow rates are the most critical for evaluation.

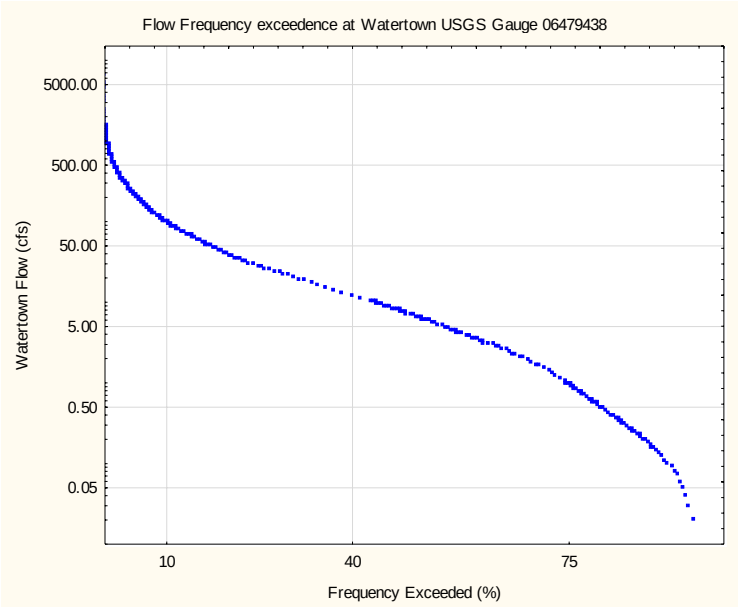

Figure 3. Flow Frequency at USGS Gauge 06479438

The remaining limb of the hydrograph was not divided into separate flow regimes at the 60th and 90th percentiles. Many of these flows fall outside of the recreation season. It is characterized by the 1 cfs low flow off-ramp for fisheries standards at the 75th percentile. As the primary component of the limited contact recreation use, limited fishing opportunities at low flows significantly reduces opportunities for use.

Recreation standards are in affect for the entire hydrograph. Due to the lower frequency of these flows during the recreation season and the limited use opportunities at low flows, evaluating them as a single group will sufficiently address the TMDL.

4.3 Sample Data

An absence of available literature values for *E. coli* necessitated a need for a surrogate measure for analysis purposes. Fecal coliform and *E. coli* data were collected simultaneously at sites throughout ecoregion 46. *E. coli* is a fecal coliform bacterium and both indicators originate from common sources in somewhat consistent proportions. As a result, fecal coliform data may be used as a surrogate for *E. coli* data.

Fecal and *E. coli* concentrations from over 2200 paired samples were transformed logarithmically and plotted. Fecal coliform concentration was plotted on the X-axis and *E. coli* concentration on the Y-axis (Figure 4). Applying a best fit line to these data sets yields a useful relationship with an r^2 value of 0.6381. In the case of ecoregion 46, the equation yields nearly a 1:1 relationship suggesting that fecal coliform data may be directly substituted in an absence of adequate E. coli data.

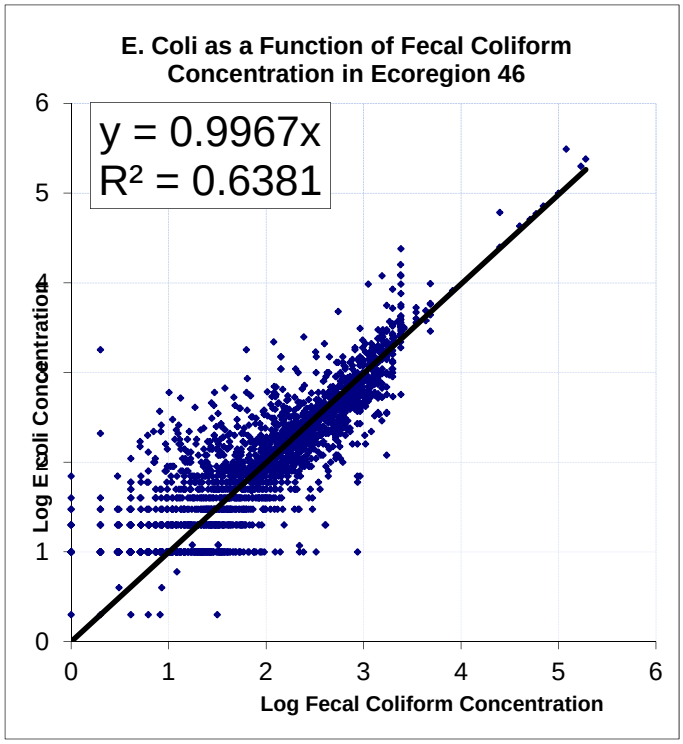

Figure 4. *E. coli* as a Function of Fecal Coliform in Eco 46

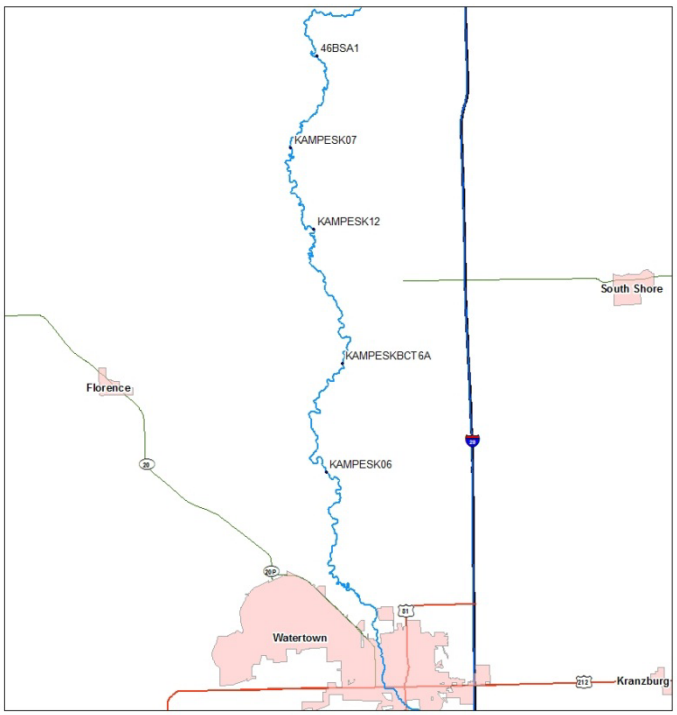

Figure 5. *E. coli* Sample Site Locations Segment 1 Big Sioux

Sample site locations may be found in Figure 5. Site 46BSA1(WQM BSA1) is part of the state's ambient stream monitoring program and will provide a continued source of data on the segments condition. Sites KAMPESK07, KAMPESK12, and KAMPESK06 were part of a previous assessment on the upper Big Sioux Basin. Site KAMPESKBCT06 was added to the assessment efforts for the 2011 sampling season to provide better spatial representation of the segment. An additional ambient monitoring site 460655 (WQM 55) is located in the segment 2 immediately downstream of the boundary between the segments. Segment 2 was not listed for bacterial impairments indicating that the impairments are localized to segment 1.

A total of 143 *E. coli* samples were available for analysis within the listed segment. Samples consisted of only *E. coli* data and substitutions with fecal coliforms were limited to the source allocations. Multiple sites were sampled on a single day within the reach, which presented two options for data analysis. Averaging the same day samples would give a good overall view of the entire reach, but it would have detracted from localized acute impairments. To better represent the acute conditions, each point was treated as an independent sample representative of the reach as a whole.

Data distributions by site are graphically depicted in Figure 6. Each site had multiple samples that were above the acute water quality standard set for the stream (1178 cfu/ 100mL). Although the dataset had a significant number of samples, an insufficient number of chronic calculations could be performed to provide an adequate dataset to evaluate the chronic standard.

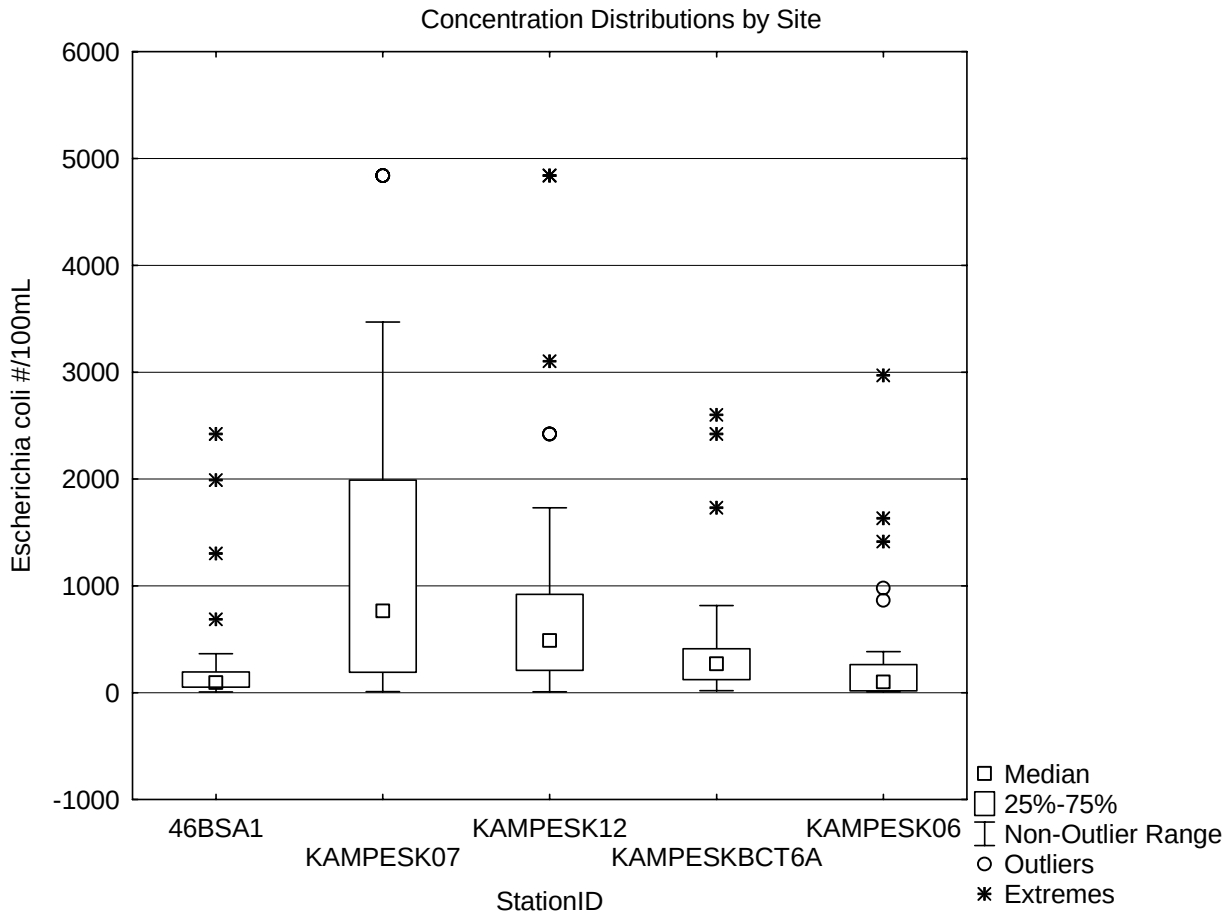

Figure 6. *E. coli* Concentration Distribution for Sites in Segment 1 Big Sioux River

The data in Figure 6 indicate that mitigation efforts should be primarily focused on two distinct segments. The most important for the segments overall condition is between sites BSA1 and KAMPESK07. This segment accounts for 36 km2 or 8,900 acres (approximately 5% of the drainage area). Secondary targeting should address the area immediately upstream of the WQM site. Impairments at this site are intermittent; however the frequency is sufficient to impair the segment. Each of the samples that exceed the 630 cfu/ 100mL standard occurred at flows above 200 cfs.

The data is graphically represented as individual loadings calculated based on the flow at the Watertown USGS gauge. It is plotted against the load frequency curve for Watertown based on the limited contact standard of 630 colony forming units/ 100mL (Figure 7). Flow regime breaks were made as described in section 4.2. Sample data is heavily skewed to the higher flow regimes with a rapid decrease in frequency as flow rates decline. This corresponds to the seasonal flow of the river. Lower flows do occur during the recreation season, and periodic samples have been collected which provide a representation of these conditions. Reduction calculations for the higher flow zones were based upon the 95th percentile for each zone. To provide a larger margin of safety for the lower flow zone, the zone maximum was used as a basis for reductions.

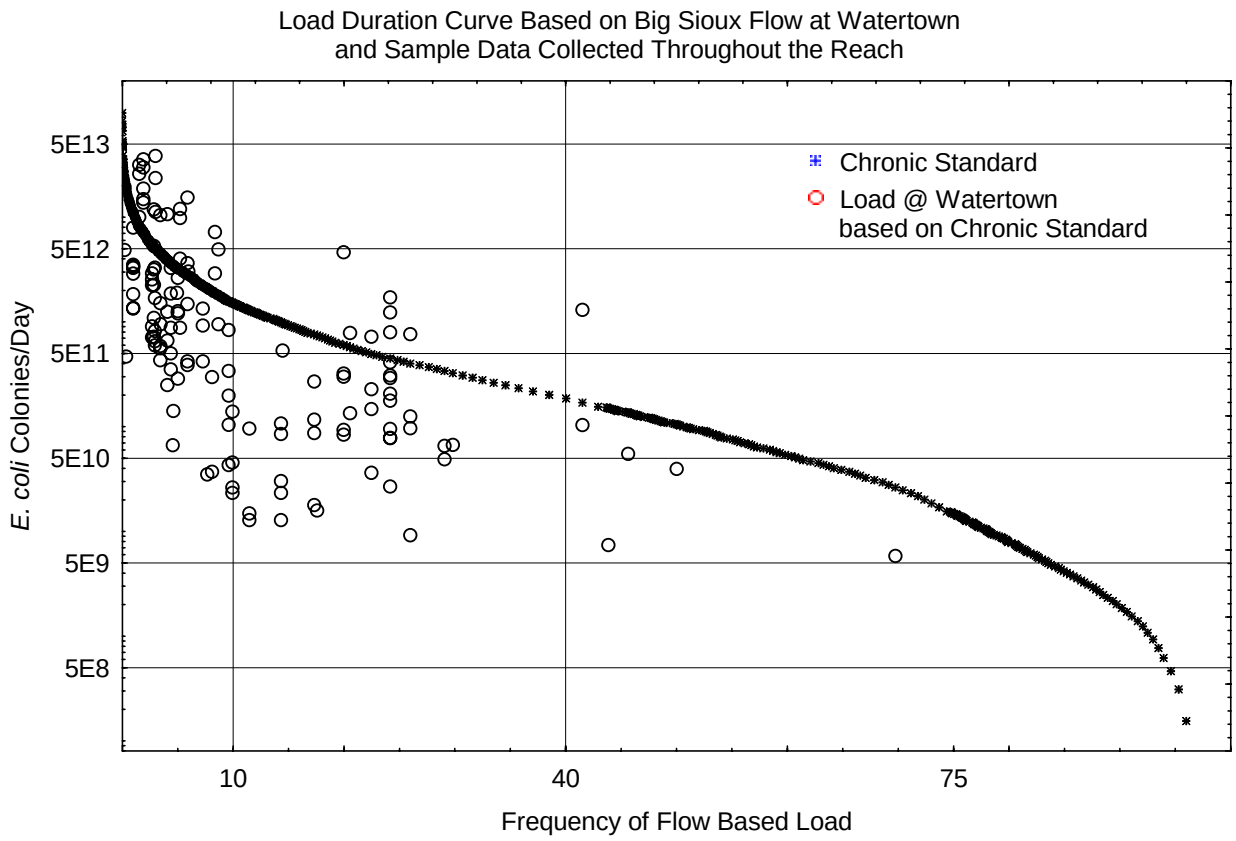

Figure 7. *E. coli* Load Duration Curve for Segment 1 of the Big Sioux River

5.0 TMDL and Allocations

Table 5 depicts the numeric TMDL calculations for each flow zone from Figure 7. Current loads were based off of the 95th percentile flow and concentration for the high and middle flow zones. The low flow zone utilized the maximum concentration as an additional margin of safety due to the low frequency of flow occurrence during the sampling season. To assure standard attainment with the limited dataset, reduction calculations were based on reducing a single sample to the more conservative chronic value of 630 cfu/ 100 mL. No point sources exist in the segment requiring all reductions to come from nonpoint sources.

Table 5. *E. coli* TMDL and Flow Zone Allocations for Segment 1 Big Sioux River

TMDL Component	Flow Zone (expressed as CFU/day)		
	High	Middle	Low
	>100 cfs	12-100 cfs	<12 cfs
LA	4.5E+13	8.0E+11	8.3E+10
WLA	0	0	0
MOS	4.9E+13	6.8E+11	9.2E+10
TMDL @ 630 CFU/ 100 mL	9.4E+13	1.5E+12	1.8E+11
Current Load*	4.2E+14	3.8E+12	1.4E+12
Load Reduction	78%	61%	87%

5.0.1 Flow Zone 1 (<10% flow frequency exceedence)

Flow zone 1 represents the high flows in the Big Sioux River. The lower limit of this zone is the 10th percentile, which corresponds to a flow rate of approximately 100 CFS. Flows in this zone represent the peak of storm event hydrographs and are most frequent during spring and early summer. They are commonly the product of spring snowmelt events but may be generated by large rain events. Load reductions of 78% are required to lower bacteria concentrations to a level that would assure both the acute and chronic standards are met.

5.0.2 Flow Zone 2 (10% to 40% flow frequency exceedence)

Zone 2 flows occur under moist conditions or following storm events, rates for this zone vary from 12 cfs up to 100 cfs. This zone is perhaps the most critical in regards to the recreation standard due to the frequency of these flows during the recreation season and the recreational opportunities available at these flow rates. Sources of contamination may be expected to be closer to the channel and somewhat easier to mitigate than those impacting the high flows. Load reductions of 61% are required to meet both the acute and chronic standards.

5.0.3 Flow Zone 3 (>40% flow frequency exceedence)

Zone 3 encompasses all flows below 12 cfs. Recreation standards apply to all flows, but lower flows result in reduced recreational opportunities. Limited data for the lowest flow zone is a product of reduced frequency of these flows during the recreational season. These flows had a single exceedence indicating the possibility that the zone is not impaired. Due to the limited data

available, this sample was used to generate a required reduction of 87%. Mitigation efforts affecting the higher flow zones are expected to also result in reductions in this zone assuring that it meets both the acute and chronic standards.

5.1 Load Allocations (LAs)

Approximately 92% of the bacteria in the watershed may be attributed to livestock. An additional 7.5% was attributed to wildlife as natural background sources. A very small amount of *E. coli*, less than 0.1%, was attributed to human sources. The high estimated percentage of livestock on grass suggests that grazing management may yield the greatest benefits.

A 78% reduction in *E. coli* from anthropogenic sources (livestock) is required in the high flow zone to fully attain the current water quality standards. The mid flow zone requires a 61% reduction in bacteria. The low flow zone requires an 87% reduction. Reducing the 95th percentile samples in each impaired flow zone below the chronic standard provides assurance that both acute and chronic standards will be met.

Flow zone reductions are relatively high; however a high rate of success could be expected when the loadings are compared with daily production rates estimated in section 3.2. Daily production of bacteria was calculated at 1.2 E+15. The calculated load for the high zone accounts for 35% of daily production rates. Considering bacteria may survive on the landscape for several days, a much smaller percentage of the total production is reaching the stream. The current load in the mid flow zone is only 0.3% of the bacteria produced on a daily basis. The loading at the mid flow zone is the equivalent of bacteria produced by less than 100 cows each day.

5.2 Waste Load Allocations (WLAs)

No point sources are located in the Big Sioux River segment 1 watershed; therefore the WLA was assigned a value of zero.

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

Seasonality is important when considering bacteria contamination. Sample data was collected from May through September when the recreation standards apply. Combining the lower frequency discharges into a single flow zone provided reductions and additional protection for all conditions.

7.0 Public Participation

STATE AGENCIES
South Dakota Department of the Environment and Natural Resources (SD DENR) was the primary state agency involved in the completion of this TMDL. Ambient water quality monitoring data in conjunction with addtitional sampling targeted in the reach were the sole source of bacteria data.

FEDERAL AGENCIES
Environmental Protection Agency (EPA) provided the primary source of funds for data analysis for this segment. Stream flow data was obtained from the United States Geologic Survey (USGS) which provided the sole source of water quantity data for this TMDL.

LOCAL GOVERNMENT, INDUSTRY, ENVIRONMENTAL, AND OTHER GROUPS AND PUBLIC AT LARGE
No formal project was associated with the collection of the data for this TMDL. Public comment and input was available through the public notice period. Public notices were placed in local and regional papers and all comments received are taken into consideration in the final document

8.0 Monitoring Strategy

The Department may adjust the load and/or waste load 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.

Segment monitoring will continue through the states Ambient Water Quality Monitoring Program which will yield additional data to determine if full support of the use is reached.

9.0 Restoration Strategy

This segment is currently part of an ongoing implementation effort in the Upper Big Sioux Watershed. Information from this TMDL will be utilized to adjust priority areas with an emphasis on meeting all management objectives for the river.

10.0 Literature Cited

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