E. coli Bacteria TMDL for the Upper Cannonball River, North Fork Cannonball River and Dead Horse Creek in Slope and Hettinger Counties, North Dakota

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1.0 INTRODUCTION AND DESCRIPTION OF THE WATERSHED

The Upper Cannonball River sub-basin (10130204) covers approximately 1,573 square miles, or 1,006,900 acres and is located within six counties (Adams, Billings, Grant, Hettinger, Slope and Stark Counties) (Table 1 and Figure 1). For the purposes of this TMDL, the impaired stream segments are located in Slope and Hettinger counties that comprise a watershed area of approximately 381,236 acres. The North Fork Cannonball River, Upper Cannonball River and Dead Horse Creek impaired stream segments lay within the level III Northwestern Great Plains (43) ecoregion.

Table 1. General Characteristics of the Upper Cannonball River Sub-basin.

Legal Name	Cannonball River
Stream Classification	Class IA
Major Drainage Basin	Missouri River
8-Digit Hydrologic Unit	10130204
Counties	Hettinger and Slope Counties
Level III Ecoregion	Northwestern Great Plains (43)
Watershed Area (acres)	381,236

1.1 Clean Water Act Section 303(d) Listing Information

Based on the 2012 Section 303 (d) List of Impaired Waters Needing TMDLs (NDDoH, 2012), the North Dakota Department of Health has identified a 33.25 mile segment of the North Fork Cannonball River from its confluence with White Lake watershed downstream to its confluence with Philbrick Creek (ND-10130204-047-S) and a 54.25 mile segment of the Cannonball River from its confluence with Philbrick Creek downstream to its confluence with Indian Creek (ND-10130204-032-S) as fully supporting, but threatened for recreational uses. Also listed is a 40.18 mile segment of Dead Horse Creek (including all tributaries) (ND-10130204-044-S) as not supporting recreational uses. The impairments are due to Escherichia coli bacteria (E. coli) (Tables 2-4 and Figure 1).

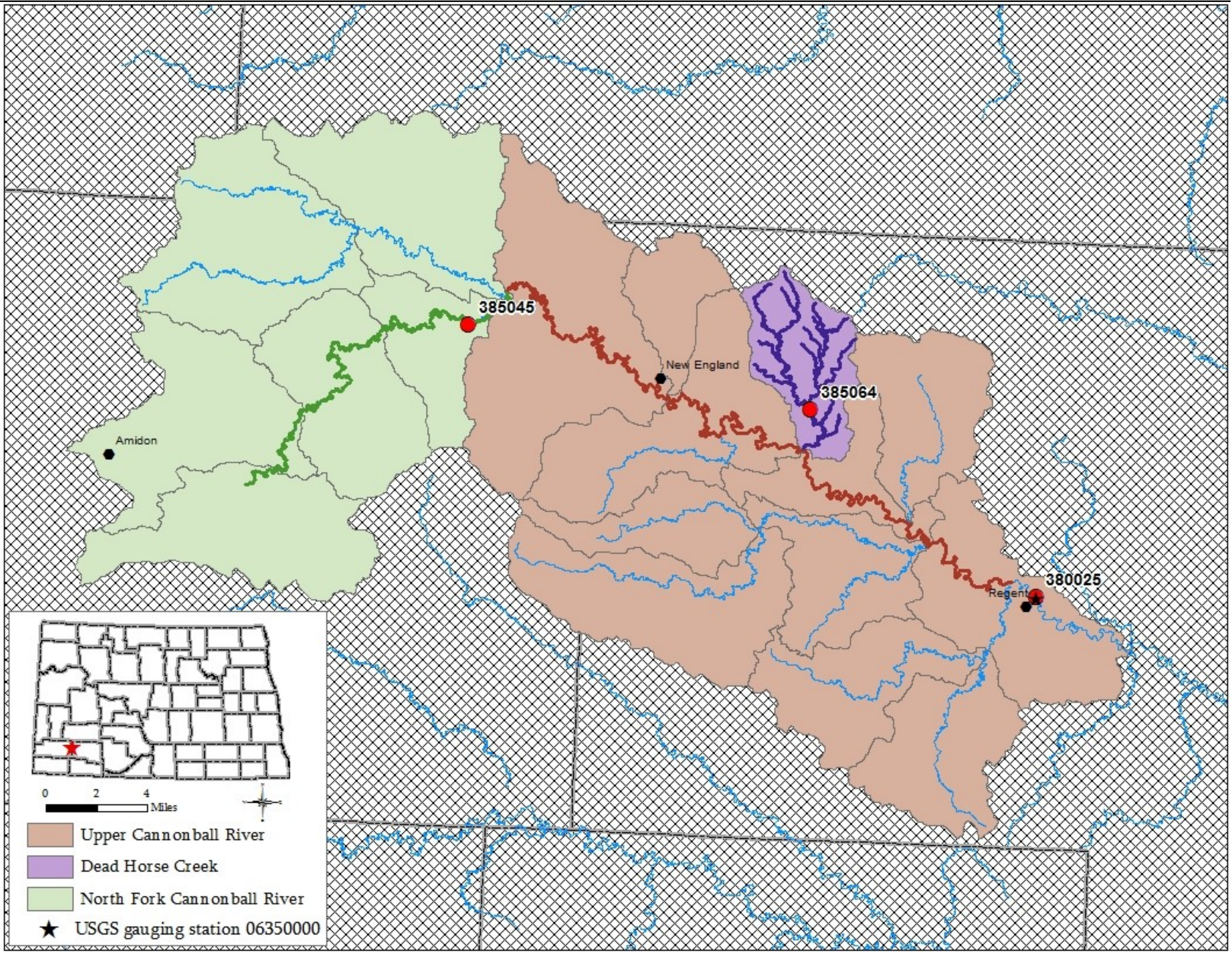


Figure 1. Upper Cannonball River, North Fork Cannonball River and Dead Horse Creek TMDL Listed Watersheds in North Dakota.

Table 2. Upper Cannonball River Section 303(d) Listing Information for Assessment Unit ID ND-10130204-032-S_00 (NDDoH, 2012).

Assessment Unit ID	ND-10130204-032-S_00
Waterbody Description	Cannonball River from its confluence with Philbrick Creek downstream to its confluence with Indian Creek
Size	54.25 miles
Designated Use	Recreation
Use Support	Fully Supporting, but Threatened
Impairment	E. coli Bacteria
TMDL Priority	Low

Table 3. North Fork Cannonball River Section 303(d) Listing Information for Assessment Unit ID ND-10130204-047-S_00 (NDDoH, 2012).

Assessment Unit ID	ND-10130204-047-S_00
Waterbody Description	North Fork Cannonball River from its confluence with White Lake watershed downstream to its confluence with Philbrick Creek
Size	33.25 miles
Designated Use	Recreation
Use Support	Fully Supporting, but Threatened
Impairment	E. coli Bacteria
TMDL Priority	Low

Table 4. Dead Horse Creek Section 303(d) Listing Information for Assessment Unit ID ND-10130204-044-S_00 (NDDoH, 2012).

Assessment Unit ID	ND-10130204-044-S_00
Waterbody Description	Dead Horse Creek (including all tributaries)
Size	40.18 miles
Designated Use	Recreation
Use Support	Not Supporting
Impairment	E. coli Bacteria
TMDL Priority	Low

1.2 Ecoregions

The watershed for the Section 303(d) listed segments highlighted in this TMDL lie within the Missouri Plateau (43a) level IV ecoregion (Figure 2). The topography of the Missouri Plateau ecoregion (43a) was largely unaffected by glaciation and retains its original soils and complex stream drainage pattern. A mixture of spring wheat, alfalfa, and grazing land covers the shortgrass prairie. The Missouri Plateau ecoregion (43a) is a semiarid rolling plain of shale, siltstone, and sandstone amongst occasional buttes and badlands. Native grasslands persist in areas of steep or broken topography, but they have been largely replaced by spring wheat and alfalfa over most of the ecoregion (USGS, 2006).

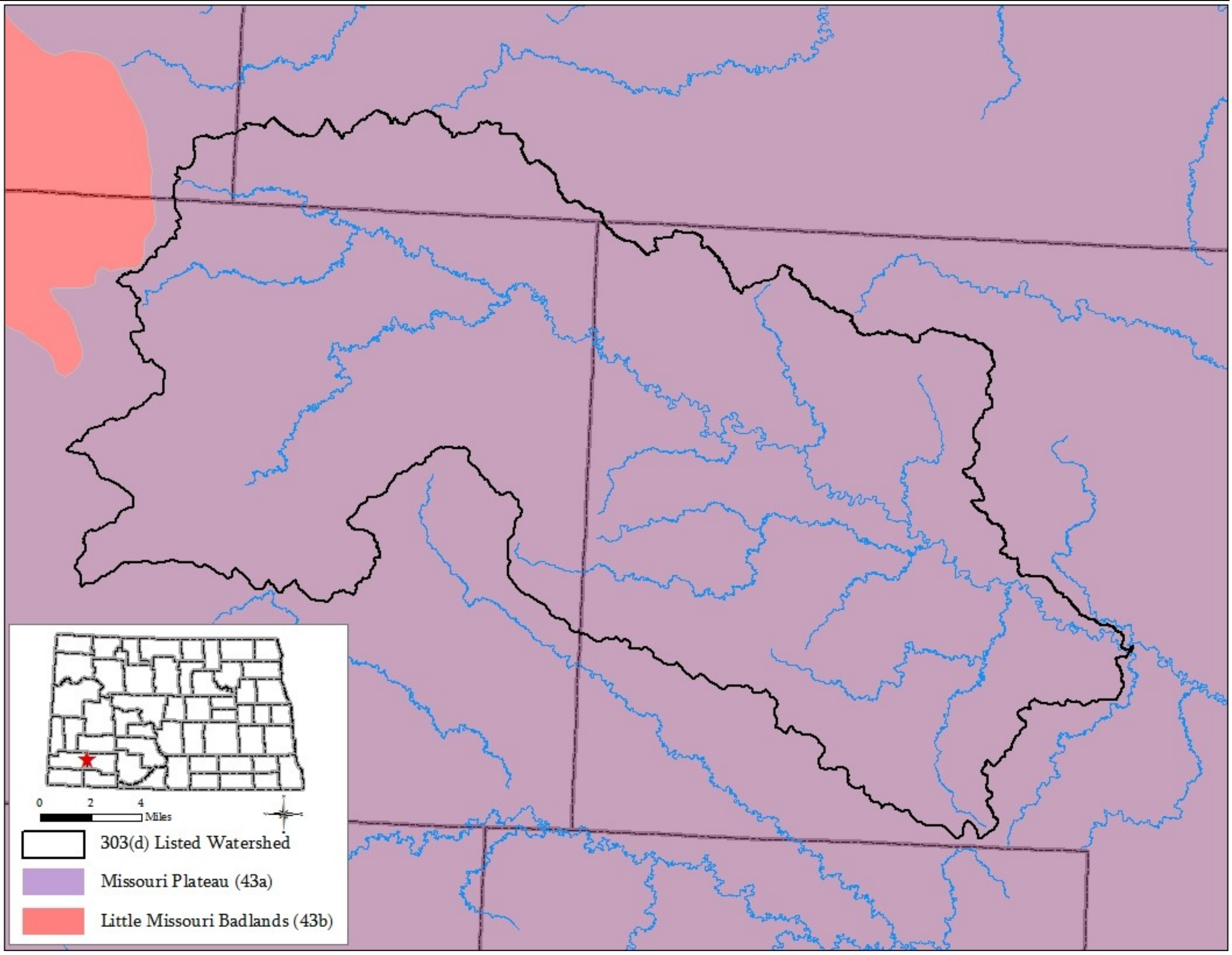


Figure 2. Level IV Ecoregions in the Upper Cannonball River, North Fork Cannonball River and Dead Horse Creek Watersheds.

1.3 Land Use

The North Fork Cannonball River, Upper Cannonball River and Dead Horse Creek watersheds encompass 381,236 acres in Slope and Hettinger Counties, North Dakota. According to National Agricultural Statistics Service (NASS) 2011 land cover data, the dominant land use in the watershed is agriculture with 57 percent used for cropland, 29 percent grassland/pasture, and the remaining 14 percent a combination of water, wetlands, or developed/open space (Figure 3). The dominant crops grown in the watershed are spring wheat, durum wheat, canola, and sunflowers.

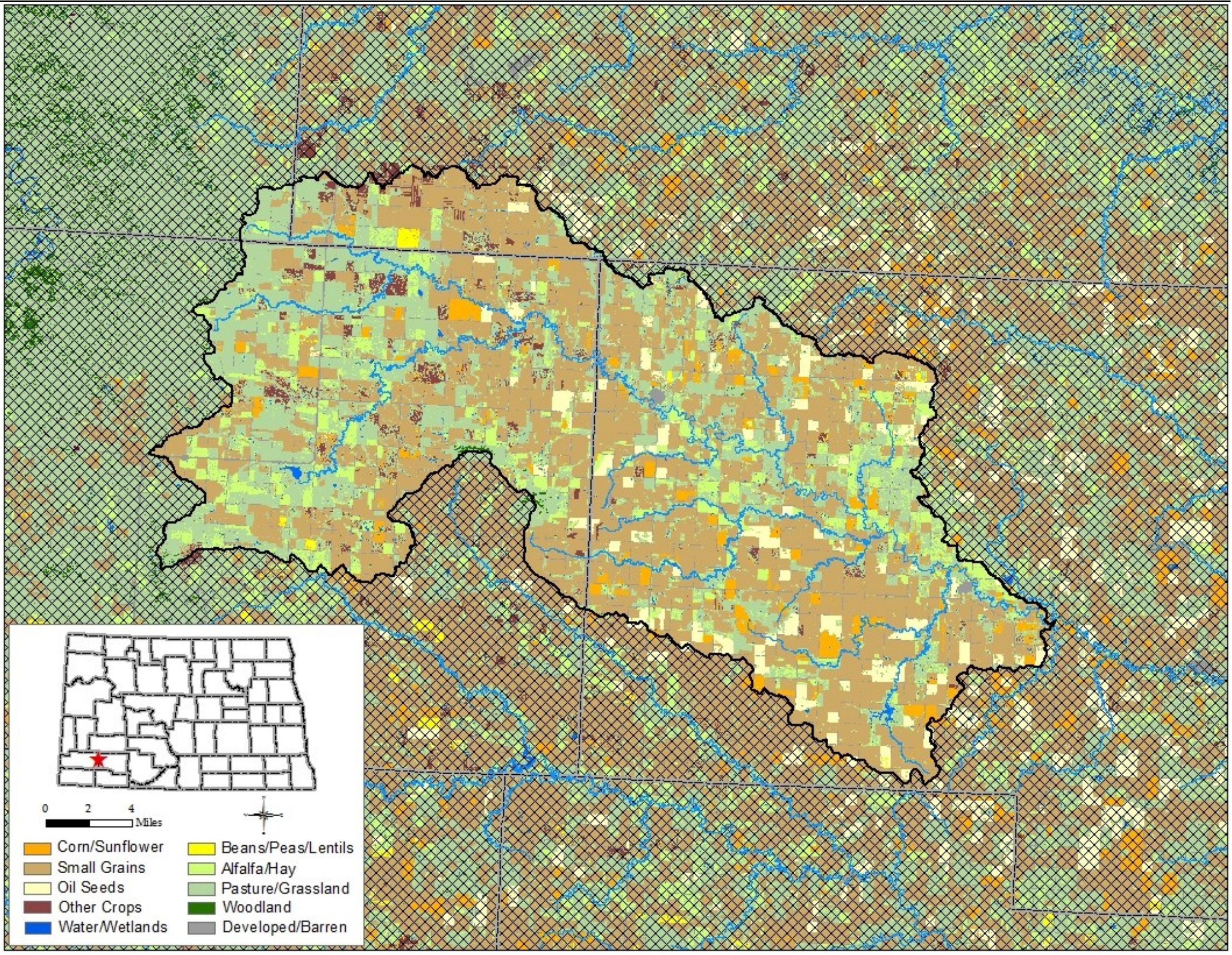


Figure 3. Land Use in the Upper Cannonball River, North Fork Cannonball River and Dead Horse Creek watersheds (NASS, 2011).

1.4 Climate and Precipitation

North Dakota's climate is characterized by large temperature variation across all time scales, light to moderate irregular precipitation, plentiful sunshine, low humidity, and nearly continuous wind. Its location at the geographic center of North America results in a strong continental climate, which is intensified by the mountains to the west. There are no barriers to the north or south so a combination of cold, dry air masses originating in the far north and warm humid air masses originating in the tropical regions regularly overflow the state. Movement of these air masses and their associated fronts causes near continuous wind and often results in large day to day temperature fluctuations in all seasons.

The climate of the region varies significantly depending on the season. Climate data for the period of 2003 through 2012 was obtained from the North Dakota Agricultural Network (NDAWN) monitoring station at Mott, ND, which is located seven miles west of the Upper Cannonball River watershed. The annual average daily temperature is 42° F, with an average monthly temperature of 72° F in July and 15° F in January (Figure 4). Average annual precipitation is approximately 13 inches for the region, with yearly averages ranging from 8.93 to 17.2 during the period from 2003 through 2012 (Figure 5).

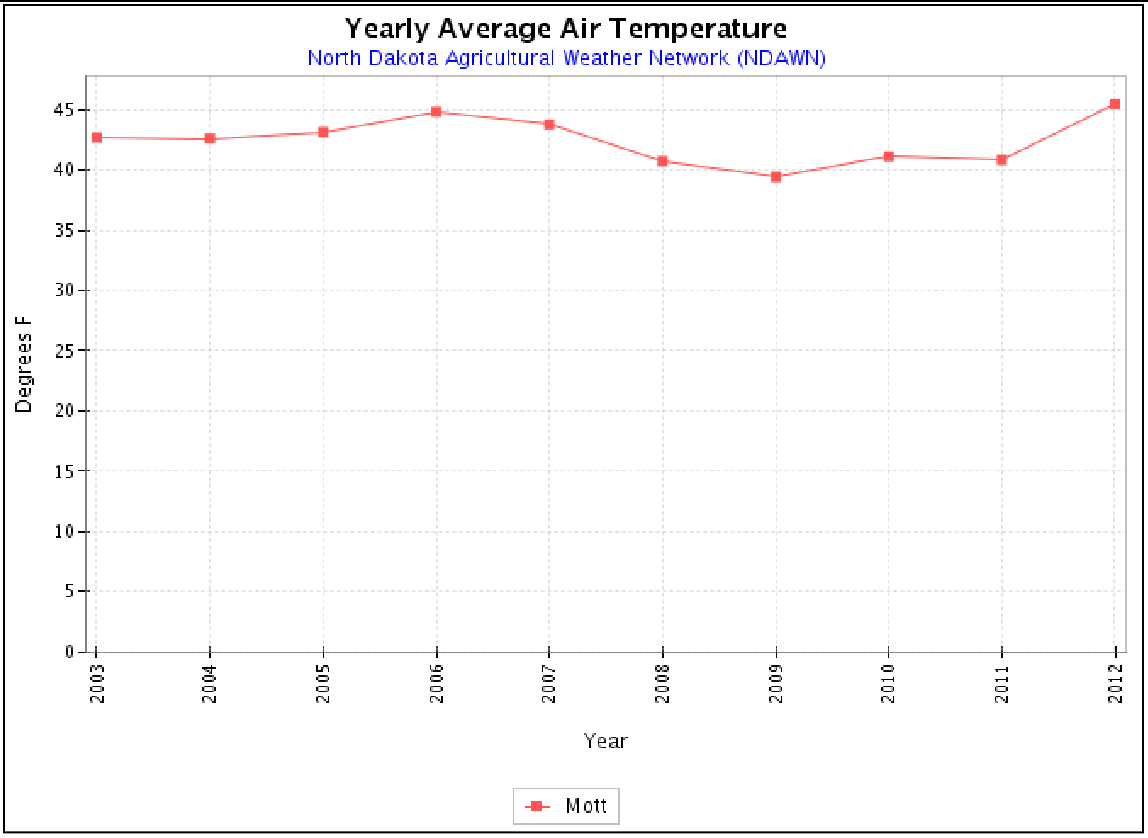


Figure 4. Annual Average Air Temperature at Mott, North Dakota from 2003-2012 (NDAWN).

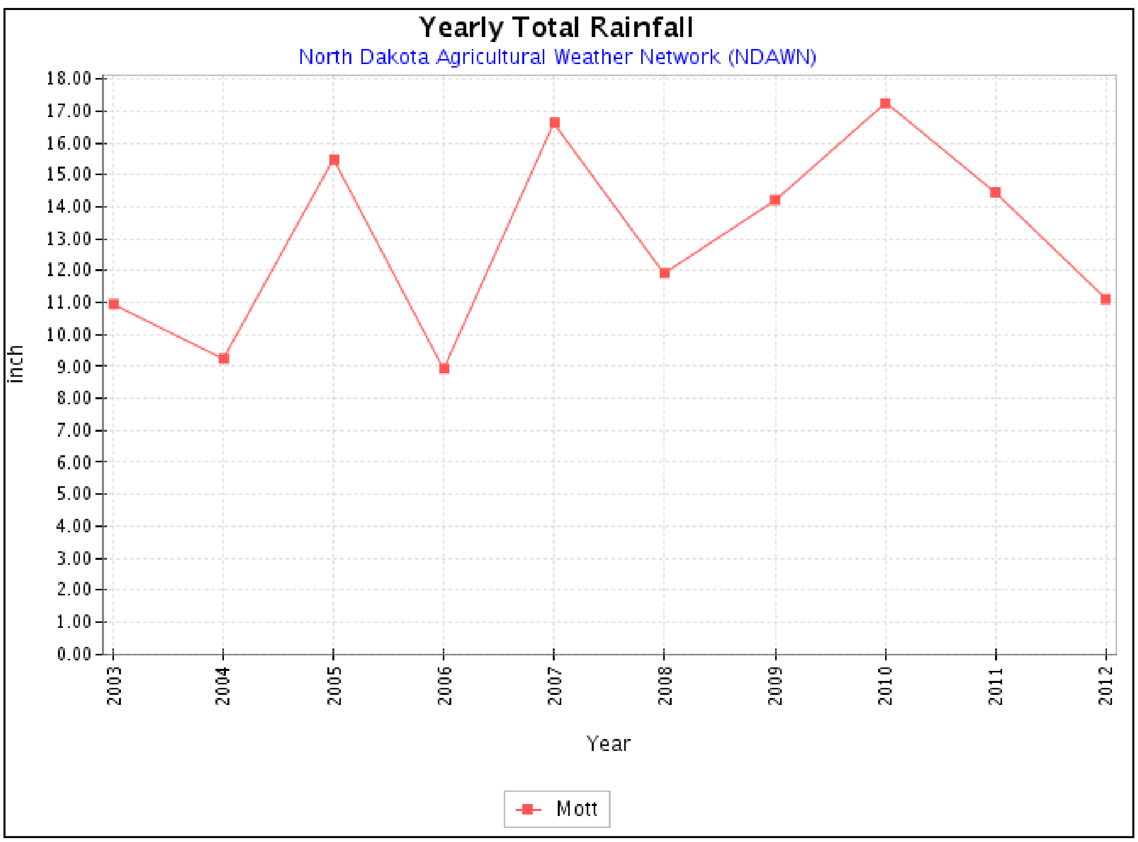


Figure 5. Annual Total Precipitation at Mott, North Dakota from 2003-2012 (NDAWN).

1.5 Available Data

1.5.1 E. coli Bacteria Data

In coordination with the Quality Assurance Project Plan for the Upper Cannonball River Manure Management Implementation Project (QAPP) (NDDoH, 2007) E. coli bacteria samples were collected at three locations corresponding with each of the three impaired reaches addressed in this TMDL. Monitoring site 380025 in the Upper Cannonball River watershed is located near Regent, ND and is associated with assessment unit ID ND-10130204-032-S_00; monitoring site 385064 in the Dead Horse Creek watershed is located six miles east and one and one mile south of New England, ND and is associated with assessment unit ID ND-10130204-044-S_00; and monitoring site 385045 in the North Fork Cannonball River watershed is located 14 miles east and six miles north of Amidon, ND and is associated with ND-10130204-047-S_00. All sites were sampled weekly when flow conditions were present during the recreation season (May 1st – September 30th). Sampling was conducted by the Slope-Hettinger County Soil Conservation District.

Tables 5-7 provide a summary of E. coli monthly geometric mean concentrations. Also provided as part of the assessment is the percentage of samples exceeding 409 CFU/100mL and the recreational use assessment by month. The monthly geometric mean E. coli bacteria concentration and the percent of samples over 409 CFU/100ml were calculated for each month (May-September) using those samples collected during each month from 2008 through 2011.

Table 5. Summary of E. coli Bacteria Data for Site 380025 (2008-2011).

Month	N	Geometric Mean Concentration (CFU/100mL)	Percentage of Samples Exceeding 409 CFU/100mL	Recreational Use Assessment
May	31	32	6%	Fully Supporting
June	35	157	23%	Not Supporting
July	32	67	6%	Fully Supporting
August	34	25	0%	Fully Supporting
September	34	14	0%	Fully Supporting

Table 6. Summary of E. coli Bacteria Data for Site 385064 (2008-2011).

Month	N	Geometric Mean Concentration (CFU/100mL)	Percentage of Samples Exceeding 409 CFU/100mL	Recreational Use Assessment
May	39	24	3%	Fully Supporting
June	31	477	61%	Not Supporting
July	14	636	64%	Not Supporting
August	11	89	9%	Fully Supporting
September	8	32	0%	Fully Supporting

Table 7. Summary of E. coli Bacteria Data for Site 385045 (2008-2011).

Month	N	Geometric Mean Concentration (CFU/100mL)	Percentage of Samples Exceeding 409 CFU/100mL	Recreational Use Assessment
May	39	30	8%	Fully Supporting
June	35	95	6%	Fully Supporting
July	25	62	8%	Fully Supporting
August	30	84	10%	Fully Supporting, but Threatened
September	23	89	9%	Fully Supporting

Analysis of E. coli bacteria data collected at site 380025 demonstrated that all months were fully supporting the recreational beneficial uses except June (Table 5). The geometric mean and percent exceeded calculations for beneficial uses in the month of June were not supporting recreational uses.

Analysis of E. coli bacteria data collected at site 385064, demonstrated that the months of May, August and September were fully supporting the recreational beneficial uses (Table 6). The geometric mean and percent exceeded calculations for beneficial uses in the month of June and July were not supporting recreational uses.

The recreational use support assessment for site 385045 concluded that all months were fully supporting recreational beneficial uses except August (Table 7). The percent exceeded calculations for beneficial uses in the month of August were fully supporting, but threatened. Complete set of data for this analysis is provided in (Appendix A).

1.5.2 Hydraulic Discharge

The discharge record for the period 1992 through 2011 was constructed using data obtained from the United States Geological Survey (USGS) gauging station 06350000. USGS gauging station 06350000 is collocated with water quality monitoring site 380025 on the Cannonball River at Regent, North Dakota (Figure 1). The discharge record for the two upstream TMDL segments, ND-10130204-044-S_00 (site 385064) and ND-10130204-047-S_00 (site 385045), was constructed using the Drainage Area Ratio Method (DARM) (Ries et al., 2000) and the discharge record obtained for USGS gauging station 06350000.

2.0 WATER QUALITY STANDARDS

The Clean Water Act requires that Total Maximum Daily Loads (TMDLs) be developed for waters on a state's Section 303(d) list. A TMDL is defined as “the sum of the individual wasteload allocations for point sources and load allocations for non point sources and natural background” such that the capacity of the waterbody to assimilate pollutant loadings is not exceeded. The purpose of a TMDL is to identify the pollutant load reductions or other actions that should be taken so that impaired waters will be able to attain water quality standards. TMDLs are required to be developed with seasonal variations and must include a margin of safety that addresses the uncertainty in the analysis. Separate TMDLs are required to address each pollutant or cause of impairment, which in this case is E. coli bacteria.

2.1 Narrative North Dakota Water Quality Standards

The North Dakota Department of Health has set narrative water quality standards that apply to all surface waters in the State. The narrative general water quality standards are listed below (NDDoH, 2011).

- All waters of the State shall be free from substances attributable to municipal, industrial, or other discharges or agricultural practices in concentrations or combinations that are toxic or harmful to humans, animals, plants, or resident aquatic biota.

- No discharge of pollutants, which alone or in combination with other substances shall:

    a. Cause a public health hazard or injury to environmental resources;
    b. Impair existing or reasonable beneficial uses of the receiving water; or
    c. Directly or indirectly cause concentrations of pollutants to exceed applicable standards of the receiving waters.

In addition to the narrative standards, the NDDoH has set biological goal for all surface waters in the state. The goal states "the biological condition of surface waters shall be similar to that of sites or waterbodies determined by the department to be regional reference sites" (NDDoH, 2011).

2.2 Numeric North Dakota Water Quality Standards

The Cannonball River is a Class II stream. The NDDoH definition of a Class II stream is shown below (NDDoH, 2011).

Class II- The quality of the waters in this class shall be the same as the quality of class I streams, except that additional treatment may be required to meet the drinking water requirements of the department. Streams in this classification may be intermittent in nature which would make these waters of limited value for beneficial uses such as municipal water, fish life, irrigation, bathing, or swimming.

The North Fork Cannonball River and Dead Horse Creek are Class III streams. The NDDoH definition of a Class III stream is shown below (NDDoH, 2011).

Class III- The quality of the waters in this class shall be suitable for agricultural and industrial uses. Streams in this class generally have low average flows with prolonged periods of no flow. During periods of no flow, they are of limited value for recreation and fish and aquatic biota. The quality of these waters must be maintained to protect secondary contact recreation uses (e.g., wading), fish and aquatic biota, and wildlife uses.

Table 8 provides a summary of the numeric E. coli bacteria criteria which applies to Class II and III streams. The E. coli bacteria standard applies only during the recreation season from May 1 to September 30.

Table 8. North Dakota Bacteria Water Quality Standards for Class II and III Streams.

Parameter	Standard	
	Geometric Mean[1]	Maximum[2]
E. coli Bacteria	126 CFU/100 mL	409 CFU/100 mL

[1] Expressed as a geometric mean of representative samples collected during any consecutive 30-day period.
[2] No more than 10 percent of samples collected during any consecutive 30-day period shall individually exceed the standard.

3.0 TMDL TARGETS

A TMDL target is the value that is measured to judge the success of the TMDL effort. TMDL targets must be based on state water quality standards, but can also include site specific values when no numeric criteria are specified in the standard. The following TMDL target for the Upper Cannonball River, North Fork Cannonball River and Dead Horse Creek is based on the NDDoH water quality standard for E. coli bacteria.

3.1 E. coli Bacteria Target

The Cannonball River, North Fork Cannonball River and Dead Horse Creek are impaired because of E. coli bacteria. The Cannonball River, North Fork Cannonball River and Dead Horse Creek are classified as fully supporting, but threatened and not supporting recreational beneficial uses because of E. coli bacteria counts exceeding the North Dakota water quality standard. The North Dakota water quality standard for E. coli bacteria is a geometric mean concentration of 126 CFU/100 mL during the recreation season from May 1 to September 30. Thus, the TMDL target for this report is 126 CFU/100 mL. In addition, no more than ten percent of samples collected for E. coli bacteria should exceed 409 CFU/100 mL.

While the standard is intended to be expressed as the 30-day geometric mean, the target is based on the 126 CFU/100 mL geometric mean standard. Expressing the target in this way will ensure the TMDL will result in both components of the standard being met and recreational uses are restored.

4.0 SIGNIFICANT SOURCES

4.1 Point Source Pollution Sources

Within the Cannonball River watershed, there is a permitted municipal point source for the city of New England, ND. This facility is permitted through the North Dakota Pollutant Discharge Elimination System (NDPDES) Program through a general permit. There have been no discharges in over 20 years for the New England, ND (population 555) facility, nor is it anticipated to discharge at any time in the near future. It is, therefore, determined to be a non-contributing point source to the Cannonball River.

There are five known animal feeding operations (AFOs) in the contributing watershed of the Cannonball River. The five AFOs in the Cannonball River watershed include two small (0-300 animal units (AUs)) AFOs and three medium (301-999 AUs) AFOs which have permits to operate. All five AFOs are zero discharge facilities and are not deemed a significant point source of E. coli bacteria loadings to the Cannonball River.

4.2 Nonpoint Source Pollution Sources

The TMDL listed segments of the Upper Cannonball River, North Fork Cannonball River and Dead Horse Creek are experiencing E. coli bacteria pollution from nonpoint sources in the watersheds. Unpermitted AFOs and livestock grazing and watering in proximity to the river are common along the TMDL listed segments.

The southwest portion of North Dakota typically experiences short duration, but intense precipitation during the spring. These storms can cause overland flooding and rising river levels. Due to the close proximity of livestock grazing and watering to the river (grassland areas on the land use map, Figure 3), it is likely that they contribute to the E. coli bacteria pollution in the listed segments of the Upper Cannonball River, North Fork Cannonball River and Dead Horse Creek.

These assessments are supported by the load duration curve analysis (Section 5.3) which shows exceedences of the E. coli bacteria standard occurring during all flow regimes.

Wildlife may also contribute to the E. coli bacteria found in the water quality samples, but most likely in a lower concentration. Wildlife are nomadic with fewer numbers concentrating in a specific area, thus decreasing the probability of their contribution of fecal matter in significant quantities.

Septic system failure might also contribute to the E. coli bacteria in the water quality samples. Failures can occur for several reasons, although the most common reason is improper maintenance (e.g., age, inadequate pumping). Other reasons for failure include improper installation, location, and choice of system. Harmful household chemicals can also cause failure by killing the bacteria that digest the waste. While the number of systems that are not functioning properly is unknown, it is estimated that 28 percent of the systems in North Dakota are failing (EPA, 2002).

5.0 TECHNICAL ANALYSIS

In TMDL development, the goal is to define the linkage between the water quality target and the identified source or sources of the pollutant (i.e., E. coli bacteria) to determine the load reduction needed to meet the TMDL target. To determine the cause and effect relationship between the water quality target and the identified source, the "load duration curve" methodology was used.

The loading capacity or TMDL is the amount of a pollutant (e.g., E. coli bacteria) a waterbody can receive and still meet and maintain water quality standards and beneficial uses. The following technical analysis addresses the E. coli bacteria reductions necessary to achieve the water quality standards target for E. coli bacteria of 126 CFU/100 mL with an explicit margin of safety of 10 percent.

5.1 Mean Daily Stream Flow

Daily stream discharge values were collected at one stream location within the Cannonball River's impaired reaches listed in this TMDL. This location was at the USGS gauging station located near Regent, N.D (06350000). The USGS station has operated continuously since 1950 and is collocated with the NDDoH monitoring location 380025. For the purposes of this report, the last twenty years (1992-2011) of historical discharge records will be used to describe the hydrology of the Cannonball River watershed. This block of time should account for wet and dry cycles through the hydrological history of USGS gauging station 06350000.

The discharge record for TMDL segment ND-10130204-032-S_00 was constructed using data obtained from the USGS gauging station (06350000), while the discharge records for the two upstream TMDL segments, ND-10130204-047-S_00 and ND-10130204-044-S_00, were constructed using the Drainage Area Ratio Method (DARM) (Ries et al., 2000) using the downstream USGS gauging station 06350000 as the index station. The DARM assumes that the streamflow at the ungauged site(s) is hydrologically similar (same per unit area) to the stream gauging station used as an index. This assumption is justified since the ungauged sites (385045 and 385064) are located upstream of the index station (06350000) on tributaries to the Cannonball River.

Drainage area for the ungauged sites (385045 and 385064) and the index station (06350000) were determined through GIS using digital elevation models (DEMs). Streamflow data from 1992 through 2011 for the index station (06350000) was obtained from the USGS Water Science Center website from 1992-2011 (http://nd.water.usgs.gov/). The index station (06350000) streamflow data was then divided by the drainage area to determine streamflow per unit area at the index station. Those values are then multiplied by the drainage area for the ungauged sites to obtain estimated flow statistics for the ungauged sites.

5.2 Flow Duration Curve Analysis

The flow duration curve serves as the foundation for the load duration curve used in the TMDL. Flow duration curve analysis looks at the cumulative frequency of historic flow data over a specified time period. A flow duration curve relates flow (expressed as mean daily discharge) to the percent of time those mean daily flow values have been met or exceeded. The use of *"percent of time exceeded"* (i.e., duration) provides a uniform scale ranging from 0 to 100 percent, thus accounting for the full range of stream flows for the period of record. Low flows are exceeded most of the time, while flood flows are exceeded infrequently (EPA, 2007).

A basic flow duration curve runs from high to low (0 to 100 percent) along the x-axis with the corresponding flow value on the y-axis (Figure 6). Using this approach, flow duration intervals are expressed as a percentage, with zero corresponding to the highest flows in the record (i.e., flood conditions) and 100 to the lowest flows in the record (i.e., drought). Therefore, as depicted in Figure 6, a flow duration interval of ten percent, associated with a stream flow of 29 cubic feet per second (cfs), implies that ten percent of all observed mean daily discharge values equal or exceed 29 cfs.

Once the flow duration curve is developed for the stream site, flow duration intervals can be defined which can be used as a general indicator of hydrologic condition (i.e., wet vs dry conditions and to what degree). These intervals (or zones) provide additional insight about conditions and patterns associated with the impairment (E. coli bacteria in this case) (EPA, 2007). As depicted in Figure 6, the flow duration curve for site 380025 representing TMDL segment ND-10130204-032-S was divided into four zones, one representing high flows (0-10 percent), another for moist conditions (10-50 percent), one for dry conditions (50-90 percent) and one for low flows (90-100 percent).

These flows intervals were defined by examining the range of flows for the site for the period of record and then by looking for natural breaks in the flow record based on the flow duration curve plot (Figure 6-8). A secondary factor in determining the flow intervals used in the analysis is the number of E. coli bacteria observations available for each flow interval.

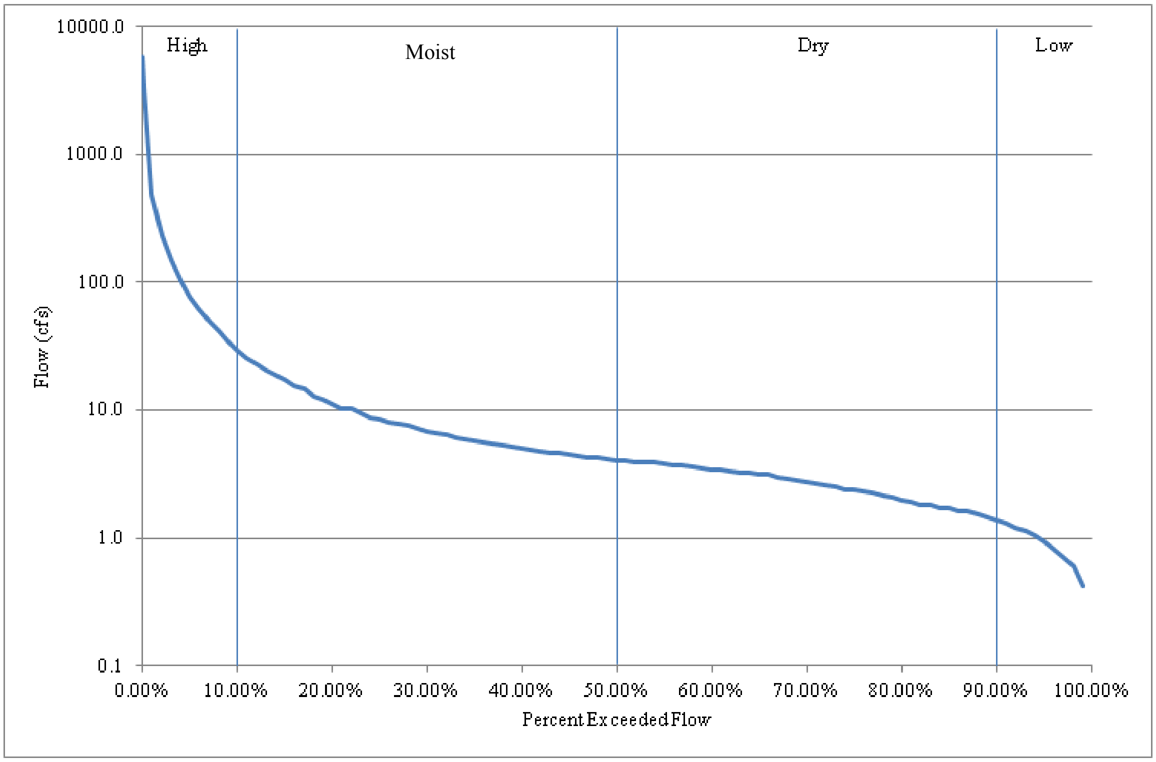


Figure 6. Flow Duration Curve for the Upper Cannonball River Monitoring Station 380025.

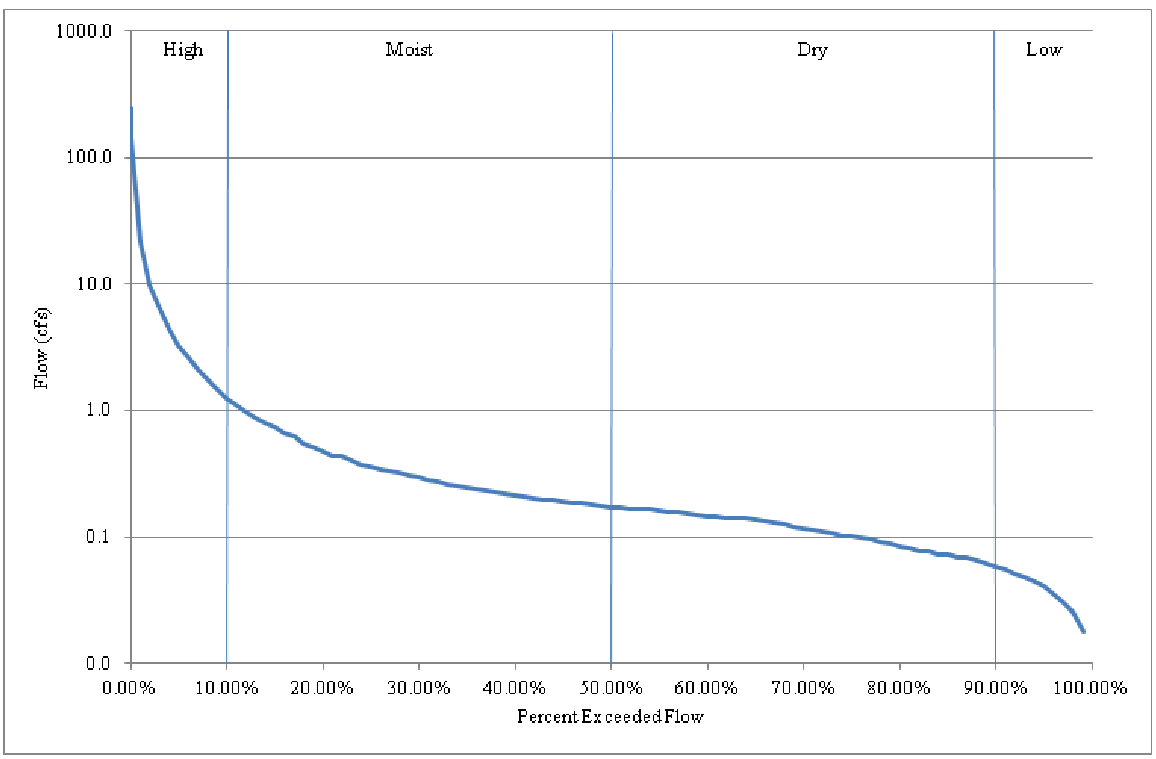


Figure 7. Flow Duration Curve for Dead Horse Creek Monitoring Station 385064.

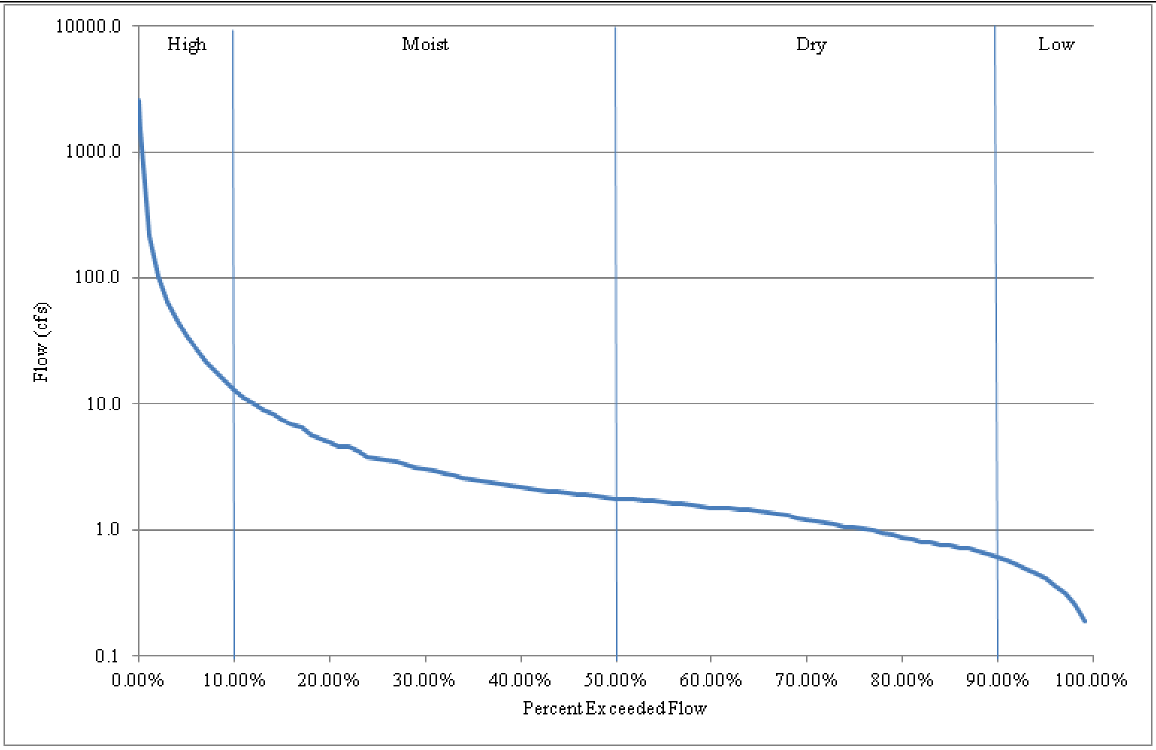


Figure 8. Flow Duration Curve for the North Fork Cannonball River Monitoring Station 385045.

5.3 E. coli Bacteria Load Duration Curve Analysis

An important factor in determining NPS pollution loads is variability in stream flows and loads associated with high and low flow. To better correlate the relationship between the pollutant of concern (i.e., E. coli bacteria) and the hydrology of the Section 303(d) TMDL listed segments, a load duration curve was developed for the Upper Cannonball River, North Fork Cannonball River and Dead Horse Creek. The load duration curves for the impaired reaches were derived using the E. coli bacteria TMDL target of 126 CFU/100 mL and the flows generated as described in Sections 5.1 and 5.2.

Observed in-stream E. coli bacteria data obtained from monitoring sites 380025, 385045 and 285064 in 2008-2011 (Appendix A) were converted to a pollutant load by multiplying E. coli bacteria concentrations by the mean daily flow and a conversion factor. These loads are plotted against the percent exceeded of the flow on the day of sample collection (Figures 9-11). Points plotted above the 126 CFU/100 mL target curve exceed the State water quality target. Points plotted below the curve are meeting the State water quality target of 126 CFU/100 mL.

For each flow interval or zone, a regression relationship was developed between the samples which occur above the TMDL target (126 CFU/100 mL) curve and the corresponding percent exceeded flow. The load duration curve for sites 380025, 385045 and 285064 depicting a regression relationship for each flow interval are provided in Figures 9-11.

In the example below, the regression line for each flow regime was then used with the midpoint of the percent exceeded flow for that interval to calculate the existing E. coli bacteria load for that flow interval. In the example provided in Figure 9, the regression relationship between observed E. coli bacteria loading and percent exceeded flow for the high flow interval (0-10 percent) are:

E. coli bacteria load (expressed as 10^7 CFUs/day) = antilog (Intercept + (Slope*Percent Exceeded Flow))

Where the midpoint of the high interval from 0 to 10 percent is 5 percent, the existing E. coli bacteria load is:

E. coli bacteria load (10^7 CFUs/day) = antilog (6.14 + (-19.63*0.05))
= 145,428 x 10^7 CFUs/day

The midpoint for the high flow interval is also used to estimate the TMDL target load. In the case of the previous example, the TMDL target load for the midpoint of the high flow regime, or 5.0 percent, exceeded the 126 CFU/100 mL TMDL target curve and is equal to 23,924 x 10^7 CFUs/day (Figure 9). TMDL target loads are similarly derived for each of the remaining flow regimes (i.e., moist, dry, low).

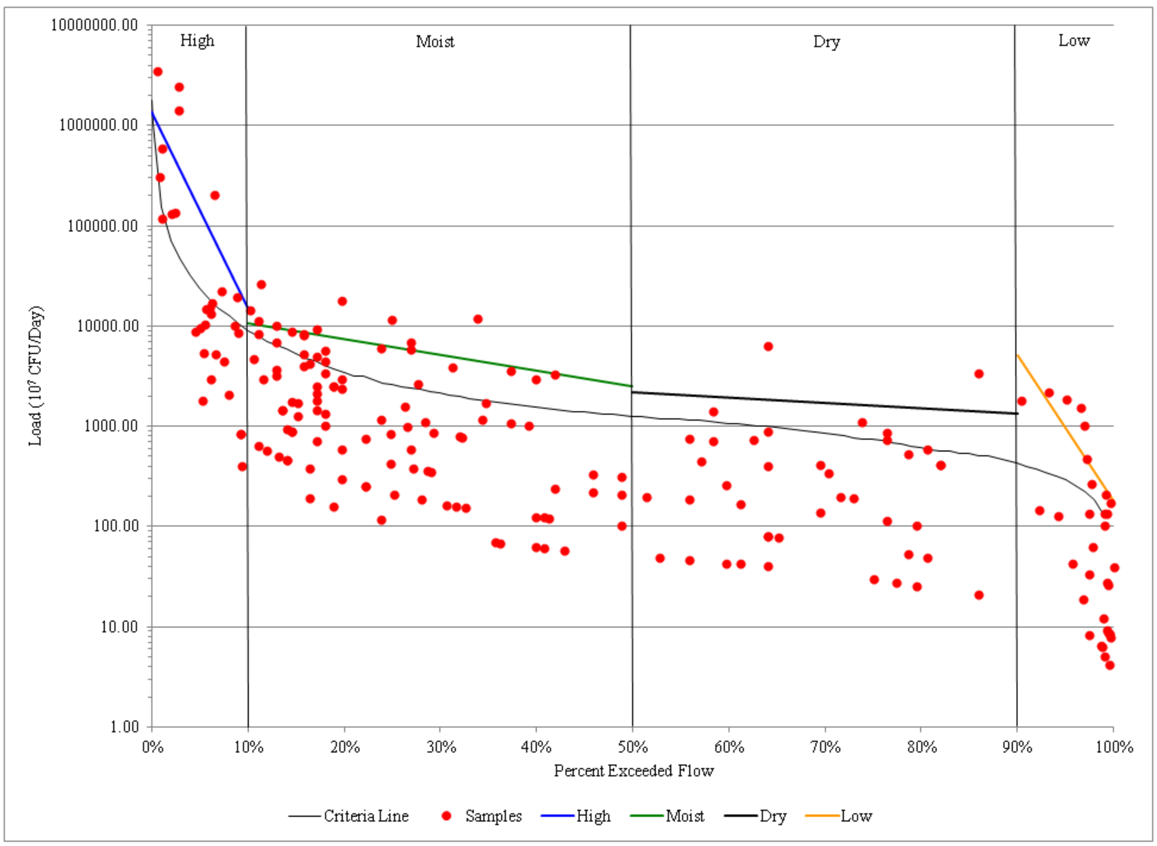


Figure 9. E. coli Bacteria Load Duration Curve for the Upper Cannonball River Monitoring Station 380025 (The curve reflects flows from 1992-2011).

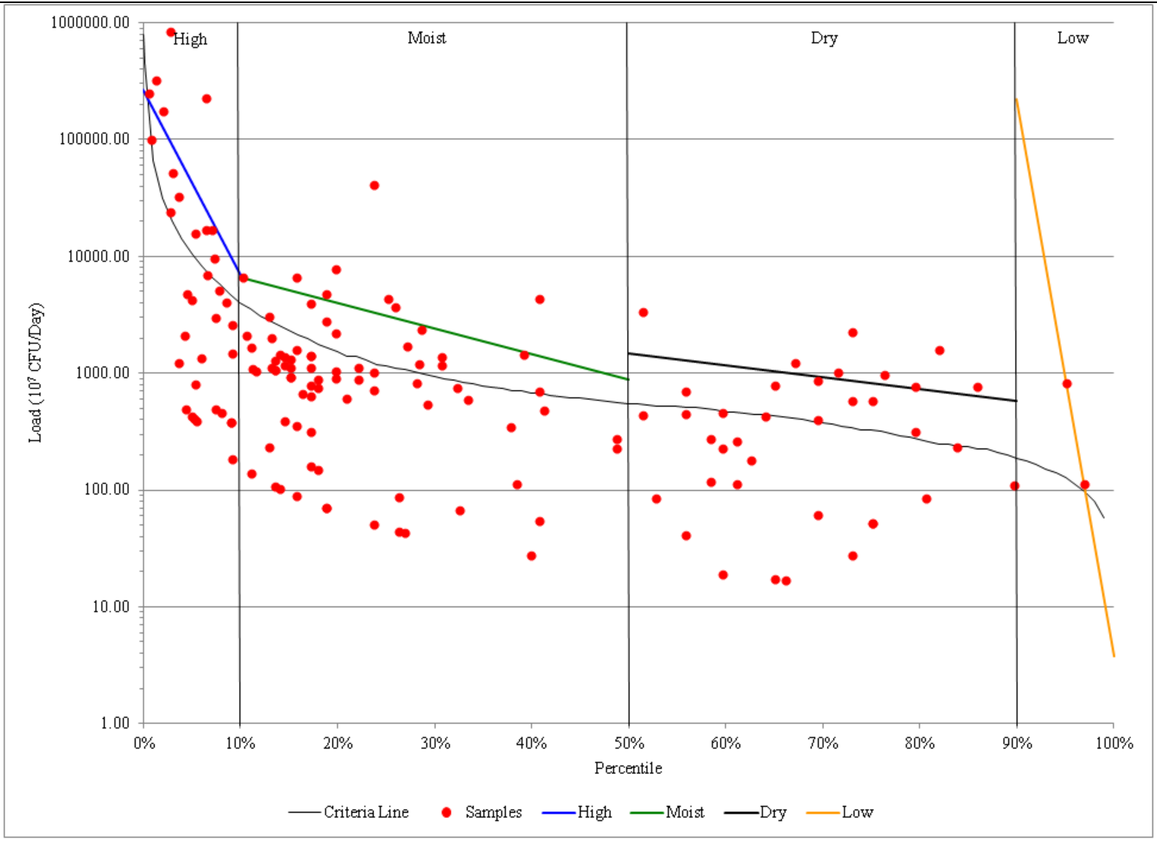


Figure 10. E. coli Bacteria Load Duration Curve for Dead Horse Creek Monitoring Station 385064 (The curve reflects flows from 1992-2011).

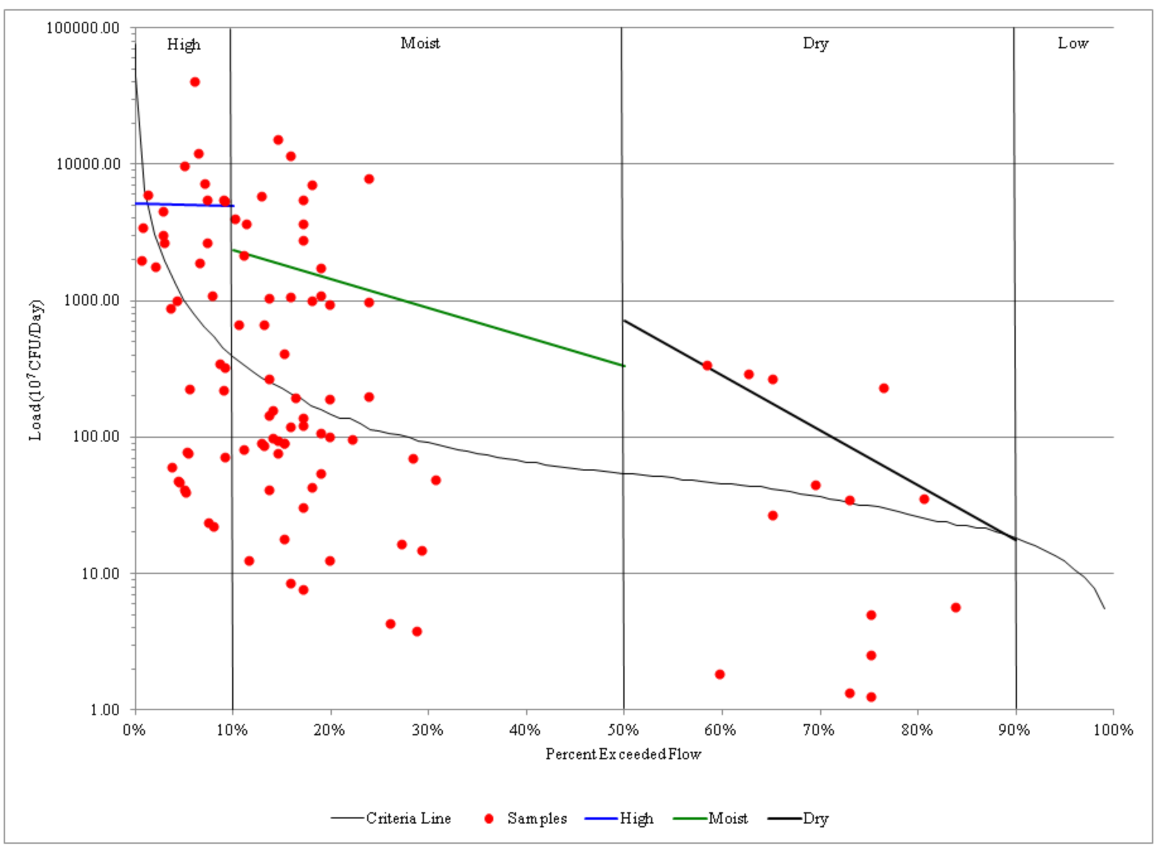


Figure 11. E. coli Bacteria Load Duration Curve for the North Fork Cannonball River Monitoring Station 385045 (The curve reflects flows from 1992-2011).

5.4 Waste Load Allocation Analysis

The discharge monitoring report (DMR) for the city of New England, ND indicates this wastewater treatment system has not discharged in the last 20 years. Due to projected population demographics for New England and the current size and capacity of the city's lagoons, it is not expected to discharge any time in the near future. It is, therefore, assumed to be a zero discharge facility and WLA will be included in the TMDL for assessment unit ND-10130204-032-S_00.

5.5 Loading Sources

The load reductions needed for the Upper Cannonball River, North Fork Cannonball River and Dead Horse Creek E. coli bacteria TMDLs can generally be allotted to nonpoint sources. Based on the data available, the general focus of best management practices (BMPs) and load reductions for the listed waterbody should be on riparian grazing adjacent to or in close proximity to the Cannonball River/Dead Horse Creek.

Significant sources of E. coli bacteria loading were defined as nonpoint source pollution originating from livestock. One of the more important concerns regarding nonpoint sources is variability in stream flows. Variable stream flows often cause different source areas and loading mechanisms to dominate (Cleland, 2003). As previously described, four flow regimes (i.e., high, moist, dry and low conditions) were selected to represent the hydrology of the listed segments on the Cannonball River and Dead Horse Creek when applicable (Figures 9-11).

By relating runoff characteristics to each flow regime one can infer which sources are most likely to contribute to E. coli bacteria loading. Animals grazing in the riparian area contribute E. coli bacteria by depositing manure where it has an immediate impact on water quality. Due to the close proximity of manure to the stream or by direct deposition in the stream, riparian grazing impacts water quality at high flow or under moist and dry conditions (Table 9). In contrast, intensive grazing of livestock in the upland and not in the riparian area has a high potential to impact water quality at high flows and medium impact under moist conditions (Table 9). Exclusion of livestock from the riparian area eliminates the potential of direct manure deposit and therefore is considered to be of high importance at all flows. However, intensive grazing in the upland creates the potential for manure accumulation and availability for runoff at high flows and a high potential for E. coli bacteria contamination.

Table 9. Nonpoint Sources of Pollution and Their Potential to Pollute at a Given Flow Regime.

Nonpoint Sources	Flow Regime		
	High Flow	Moist Conditions	Dry Conditions
Riparian Area Grazing (Livestock)	H	H	H
Animal Feeding Operations	H	M	L
Manure Application to Crop and Range Land	H	M	L
Intensive Upland Grazing (Livestock)	H	M	L

Note: Potential importance of nonpoint source area to contribute E. coli bacteria loads under a given flow regime. (H: High; M: Medium; L: Low)

6.0 MARGIN OF SAFETY AND SEASONALITY

6.1 Margin of Safety

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency (EPA) regulations require that "TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numerical water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality." The margin of safety (MOS) can be either incorporated into conservative assumptions used to develop the TMDL (implicit) or added to a separate component of the TMDL (explicit).

To account for the uncertainty associated with known sources and the load reductions necessary to reach the TMDL target of 126 CFU/100 mL, a ten percent explicit margin of safety was used for this TMDL. The MOS was calculated as ten percent of the TMDL. In other words ten percent of the TMDL is set aside from the load allocation as a MOS. The ten percent MOS was derived by taking the difference between the points on the load duration curve using the 126 CFU/100 mL standard and the curve using the 113 CFU/100 mL.

6.2 Seasonality

Section 303(d)(1)(C) of the Clean Water Act and associated regulations require that a TMDL be established with seasonal variations. The Upper Cannonball River, North Fork Cannonball River and Dead Horse Creek TMDLs address seasonality because the flow duration curves were developed using 20 years of USGS gauge data encompassing all 12 months of the year. Additionally, the water quality standard is seasonally based on the recreation season from May 1 to September 30 and controls will be designed to reduce E. coli bacteria loads during the season covered by the standard.

7.0 TMDL

Table 10 provides an outline of the critical elements of the bacteria TMDL for the TMDL listed segments. TMDLs for the Upper Cannonball River (ND-10130204-032-S_00), North Fork Cannonball River (ND-10130204-047-S_00) and Dead Horse Creek (ND-10130204-044-S_00) are summarized in Tables 11-13. The TMDLs provide a summary of average daily loads by flow regime necessary to meet the water quality target (i.e., TMDL). The TMDL for each segment and flow regime provide an estimate of the existing daily load and estimate of the average daily loads necessary to meet the water quality target (i.e., TMDL load). The TMDL load includes a load allocation from known nonpoint sources and a 10 percent margin of safety.

It should be noted that the TMDL loads, load allocations, and the MOS are estimated based on available data and reasonable assumptions and are to be used as a guide for implementation. The actual reduction needed to meet the applicable water quality standards may be higher or lower depending on the results of future monitoring.

Table 10. TMDL Summary for the Upper Cannonball River, North Fork Cannonball River and Dead Horse Creek.

Category	Description	Explanation
Beneficial Use Impaired	Recreation	Contact Recreation (i.e., swimming, fishing)
Pollutants	E. coli Bacteria	See Section 2.1
E. coli TMDL Target	126 CFU/100 mL	Based on the current state water quality standard for E. coli bacteria.
Significant Sources	Nonpoint Sources	No contributing Point Sources in Subwatershed
Margin of Safety (MOS)	Explicit	10%

TMDL = LC = WLA + LA + MOS

where

LC = loading capacity, or the greatest loading a waterbody can receive without violating water quality standards;

WLA = wasteload allocation, or the portion of the TMDL allocated to existing or future point sources;

LA = load allocation, or the portion of the TMDL allocated to existing or future non-point sources;

MOS = margin of safety, or an accounting of the uncertainty about the relationship between pollutant loads and receiving water quality. The margin of safety can be provided implicitly through analytical assumptions or explicitly by reserving a portion of the loading capacity.

Table 11. E. coli Bacteria TMDL (10^7 CFU/day) for the Upper Cannonball River Assessment Unit ID ND-10130204-032-S_00, as Represented by Site 380025.

	Flow Regime			
	High Flow	**Moist Conditions**	**Dry Conditions**	**Low Flow**
Existing Load	145,428	5,207	1,718	961
TMDL	23,924	2,127	851	292
WLA	0	0	0	0
LA	21,532	1914	766	263
MOS	2,392	213	85	29

Table 12. E. coli Bacteria TMDL (10^7 CFU/day) for Dead Horse Creek Assessment Unit ID ND-10130204-044-S_00, as Represented by Site 385064.

	Flow Regime			
	High Flow	**Moist Conditions**	**Dry Conditions**	**Low Flow**
Existing Load	5,051	877	112	
TMDL	1,021	91	36	12[1]
WLA	0	0	0	No Reduction Necessary
LA	919	82	33	
MOS	102	9	3	

[1]TMDL load is provided as a guideline for watershed management and BMP implementation.

Table 13. E. coli Bacteria TMDL (10^7 CFU/day) for the North Fork Cannonball River Assessment Unit ID ND-10130204-047-S_00, as Represented by Site 385045.

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
Existing Load	43,087	2,434	920	913
TMDL	10,536	937	375	129
WLA	0	0	0	0
LA	9,482	843	337	116
MOS	1,054	94	38	13

8.0 ALLOCATION

The point source in the watershed is given a small wasteload allocation based on its future projected discharges, population size, and State water quality standards. The remaining E. coli load allocation for this TMDL is allocated to nonpoint sources in the watershed. The entire nonpoint source load is allocated as a single load because there is not enough detailed source data to allocate the load to individual uses (e.g., animal feeding, septic systems, riparian grazing, or waste management).

Nonpoint source pollution is a contributor to elevated E. coli bacteria levels for this report's listed reaches in the Cannonball River watershed. The E. coli bacteria samples and load duration curve analysis of the impaired reaches identified all flow regimes for of E. coli bacteria exceedences for the 126 CFU/100 mL target except for segment ND-10130204-044-S where all flow regimes exceeded the target except for the low flow regime. To reduce NPS pollution for the flow regimes, specific BMPs are described in Section 8.1 that will mitigate the effects of E. coli bacteria loading to the impaired reaches.

To achieve the TMDL targets identified in the report, it will require the wide spread support and voluntary participation of landowners and residents in the watershed. The TMDLs described in this report are a plan to improve water quality by implementing BMPs through non-regulatory approaches. BMPs are methods, measures, or practices that are determined to be a reasonable and cost effective means for a land owner to meet nonpoint source pollution control needs (EPA, 2001). This TMDL plan is put forth as a recommendation for what needs to be accomplished for the Upper Cannonball River, North Fork Cannonball River and Dead Horse Creek and their associated watersheds to restore and maintain its recreational uses. Water quality monitoring should continue in order to measure BMP effectiveness and determine through adaptive management if loading allocation recommendations need to be adjusted.
Controlling nonpoint sources is an immense undertaking requiring extensive financial and technical support. Provided that technical/financial assistance is available to stakeholders, these BMPs have the potential to significantly reduce E.coli bacteria loading to the Cannonball River. The following sections describe in detail those BMPs that will reduce E. coli bacteria levels in the watersheds.

8.1 Livestock Management Recommendations

Livestock management BMPs are designed to promote healthy water quality and riparian areas through management of livestock and associated grazing land. Fecal matter from livestock, erosion from poorly managed grazing, land and riparian areas can be a significant source of E. coli bacteria loading to surface water. Precipitation, plant cover, number of animals, and soils are factors that affect the amount of bacteria delivered to a waterbody because of livestock. These specific BMPs are known to reduce nonpoint source pollution from livestock.

Livestock exclusion from riparian areas- This practice is established to remove livestock from grazing riparian areas and watering in the stream. Livestock exclusion is accomplished through fencing. A reduction in stream bank erosion can be expected by minimizing or eliminating hoof trampling. A stable stream bank will support vegetation that will hold banks in place and serve a secondary function as a filter from nonpoint source runoff. Added vegetation will create aquatic habitat and shading for macroinvertebrates and fish. Direct deposit of fecal matter into the stream and stream banks will be eliminated as a result of livestock exclusion by fencing.

Water well and tank development- Fencing animals from stream access requires an alternative water source. Installing water wells and tanks satisfies this need and provides a quality water source that keeps animals from wading and defecating in streams. This will reduce the probability of pathogenic infections to livestock and the public.

Prescribed grazing- This practice is used to increase ground cover and ground stability by rotating livestock throughout multiple fields. Grazing with a specified rotation minimizes overgrazing and resulting erosion. The Natural Resource Conservation Service (NRCS) recommends grazing systems to improve and maintain water quality and quantity. Duration, intensity, frequency and season of grazing can be managed to enhance vegetation cover and litter, resulting in reduced runoff, improved infiltration, increased quantity of soil water for plant growth and better manure distribution and increased rate of decomposition, (NRCS, 1998). In a study by Tiedemann et al. (1998), as presented by EPA (1993), the effects of four grazing strategies on bacteria levels in thirteen watersheds in Oregon were studied during the summer of 1984. Results of the study (Table 14) showed that when livestock are managed at a stocking rate of 19 acres per animal unit month, with water developments and fencing, bacteria levels were reduced significantly.

Table 14. Bacterial Water Quality Response to Four Grazing Strategies (Tiedemann et al., 1988).

Grazing Strategy		Geometric Mean Bacteria Count
Strategy A:	Ungrazed	40/L
Strategy B:	Grazing without management for livestock distribution; 20.3 ac/AUM.	150/L
Strategy C:	Grazing with management for livestock distribution: fencing and water developments; 19.0 ac/AUM	90/L
Strategy D:	Intensive grazing management, including practices to attain uniform livestock distribution and improve forage production with cultural practices such as seeding, fertilizing, and forest thinning; 6.9 ac/AUM	950/L

Waste management system- Waste management systems can be effective in controlling up to 90 percent of bacteria loading originating from confined animal feeding areas (Table 15). A waste management system is made up of various components designed to control nonpoint source pollution from concentrated animal feeding operations (CAFOs) and animal feeding operations (AFOs). Diverting clean water from the feeding area and containing dirty water from the feeding area in a pond are typical practices of a waste management system. Manure handling and application of manure is designed to be adaptive to environmental, soil and plant conditions to minimize the probability of contamination of surface water.

Table 15. Relative Gross Effectiveness[a] of Confined Livestock Control Measures (Pennsylvania State University, 1992a).

Practice[b] Category	Runoff[c] Volume	Total[d] Phosphorus (%)	Total[d] Nitrogen (%)	Sediment (%)	Fecal Bacteria (%)
Animal Waste System[e]	-	90	80	60	85
Diversion System[f]	-	70	45	NA	NA
Filter Strips[g]	-	85	NA	60	55
Terrace System	-	85	55	80	NA
Containment Structures[h]	-	60	65	70	90

NA = Not Available.
a Actual effectiveness depends on site-specific conditions. Values are not cumulative between practice categories.
b Each category includes several specific types of practices.
c - = reduction; + = increase; 0 = no change in surface runoff.
d Total phosphorus includes total and dissolved phosphorus; total nitrogen includes organic-N, ammonia-N and nitrate-N.
e Includes methods for collecting, storing and disposing of runoff and process-generated wastewater.
f Specific practices include diversion of uncontaminated water from confinement facilities.
g Includes all practices that reduce contaminant losses using vegetative control measures.
h Includes such practices as waste storage ponds, waste storage structures and waste treatment lagoons.

8.2 Other Recommendations

Vegetative filter strip- Vegetative filter strips are used to reduce the amount of sediment, particulate organics, dissolved contaminants, nutrients, and in the case of this TMDL, fecal coliform bacteria entering streams. The effectiveness of filter strips and other BMPs in removing bacteria is quite successful. Results from a study by Pennsylvania State University (1992a) as presented by EPA (1993), suggest that vegetative filter strips are capable of removing up to 55 percent of bacteria loading to rivers and streams (Table 15). The ability of the filter strip to remove contaminants is dependent on field slope, filter strip slope, erosion rate, amount and particulate size distribution of sediment delivered to the filter strip, density and height of vegetation, and runoff volume associated with erosion producing events (NRCS, 2001).

Septic System- Septic systems provide an economically feasible way of disposing of household wastes where other means of waste treatment are unavailable (e.g., public or private treatment facilities). The basis for most septic systems involves the treatment and distribution of household wastes through a series of steps involving the following:

1. A sewer line connecting the house to a septic tank
2. A septic tank that allows solids to settle out of the effluent
3. A distribution system that dispenses the effluent to a leach field
4. A leaching system that allows the effluent to enter the soil

Septic system failure occurs when one or more components of the septic system do not work properly and untreated waste or wastewater leaves the system. Wastes may pond in the leach field and ultimately run off directly into nearby streams or percolate into groundwater. Untreated septic system waste is a potential source of nutrients (nitrogen and phosphorus), organic matter, suspended solids, and fecal bacteria. Land application of septic system sludge, although unlikely, may also be a source of contamination.

Septic system failure can occur for several reasons, although the most common reason is improper maintenance (e.g., age, inadequate pumping). Other reasons for failure include improper installation, location and choice of system. Harmful household chemicals can also cause failure by killing the bacteria that digest the waste. While the number of systems that are not functioning properly is unknown, it is estimated that 28 percent of the systems in North Dakota are failing (EPA, 2002).

9.0 PUBLIC PARTICIPATION

To satisfy the public participation requirement of this TMDL, a letter was sent to the following agencies and/or organizations notifying them that the draft report was available for review and public comment. Those included in the mailing were as follows:

- Slope and Hettinger County Water Resource Boards;
- Slope-Hettinger County Soil Conservation District ;
- Natural Resource Conservation Service (State Office); and
- U.S. Environmental Protection Agency, Region VIII

In addition to mailing copies of this TMDL report for the Upper Cannonball River, North Fork Cannonball River and Dead Horse Creek to interested parties, the draft TMDL report was posted on the North Dakota Department of Health, Division of Water Quality web site at http://www.ndhealth.gov./WQ/SW/Z2 TMDL/TMDLs Under PublicComment/B Under Public Commment.html . A 30 day public notice soliciting comment and participation was also published in The Herald (New England, ND serving Hettinger and Slope Counties).

In response to the NDDoH's request for comments, the Natural Resources Conservation Service (NRCS) (State Office) sent a letter dated September 10, 2013. In this letter the NRCS stated that they had no comments on the TMDL report "at this time", but "does welcome the chance to comment on the alternatives." Comments were also received from US EPA Region 8, which were provided as part of their normal public notice review (Appendix D). The NDDoH's response to US EPA Region 8's comments are provided in Appendix E.

10.0 MONITORING

In 1999, Slope-Hettinger Soil Conservation District (SCD) entered into an agreement with the NDDoH to collect water quality, biological, and land-use data on the North Branch of the Cannonball River and Philbrick Creek for the open-water year 2000. Water quality monitoring was initiated due to local concerns that the rivers and streams were declining physically, chemically and biologically. The SCD then became interested in expanding the water quality sampling and landuse monitoring to include the entire Cannonball River watershed within the Slope and Hettinger county boundaries over three years, starting in the spring of 2001 and concluding in the fall of 2003. Due to the magnitude of the watershed, the assessment was designed to track a series of discrete subwatersheds each year of the project with the entire watershed assessed by the fall of 2003. The Upper Cannonball River Watershed Assessment indicated that E. coli bacteria were a concern and may be impairing recreational uses of the Cannonball River and its tributaries.

To address the use impairments identified during the assessment, the SCD initiated an implementation project from April 2006 through September 2011. Termed the "Upper Cannonball River Manure Management Implementation Project", the project goal was to reduce E. coli bacteria concentrations in the river and its tributaries, thereby restoring recreational uses to fully supporting status. To achieve this goal, the SCD implemented two objectives. Theye are 1) to inform and educate all residents within the Upper Cannonball Watershed on water quality topics as it relates to manure management; and 2) to reduce E. coli bacteria concentrations to below the state standard levels by improving livestock grazing and manure management in the watershed. A summary of project results can also be found in the Water Quality Monitoring Results of the Upper Cannonball Manure Management Implementation Project report (NDDoH, 2011).

While bacteria monitoring conducted for the "Cannonball Manure Management Implementation Project" has not shown a significant reduction in bacteria concentrations over the last four years, concentrations have remained steady and may be showing a slight improvement. Overall, the BMPs applied during the project do seem to have improved water quality in portions of the watershed.

With the "Upper Cannonball River Manure Management Implementation Project" completed, there are no current plans to continue monitoring. If the SCD initiates a phase II manure management and BMP implementation project, then monitoring will be reinitiated. It would be expected that sampling would be conducted at the same sites as were sampled from 2006-2011.

11.0 TMDL IMPLEMENTATION STRATEGY

As stated in Section 10.0, the Slope-Hettinger Soil Conservation District initiated the Cannonball River Manure Management Project from April 2006 through September 2011. Based on monitoring data collected as part of this implementation project, a reduction in E. coli bacteria concentrations was limited. While the results presented in this TMDL report provide targets for additional BMP implementation activities, it should recognized that implementation of TMDLs is dependent upon the availability of Section 319 NPS funds or other watershed restoration programs (e.g., USDA EQIP), as well as securing a local project sponsor and the required matching funds. Provided these three requirements are in place, a project implementation plan (PIP) can be developed in accordance with the TMDL and submitted to the North Dakota Nonpoint Source Pollution Task Force and EPA for approval. As was the case with the Cannonball River Manure Management Project, it should also be recognized that the implementation of the BMPs contained in the NPS PIP is voluntary. Therefore, success of any TMDL implementation project is ultimately dependent on the ability of the local project sponsor to find cooperating producers.

Monitoring is an important and required component of any PIP. As a part of the PIP, data are collected to monitor and track the effects of BMP implementation as well as to judge overall project success. Quality Assurance Project Plans (QAPPs) detail the strategy of how, when and where monitoring will be conducted to gather the data needed to document the TMDL implementation goal(s). As data are gathered and analyzed, watershed restoration tasks are adapted to place BMPs where they will have the greatest benefit to water quality.

12.0 REFERENCES

Cleland. 2003. *TMDL Development from the "Bottom Up" – Part III: Duration Curves and Wet Weather Assessment*. America's Clean Water Foundation, Washington, D.C.

EPA. 1993. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. EPA 840-B-92-002. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

EPA. 2001. Protocol for Developing Pathogen TMDLs. EPA 841-R-00-002. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

EPA. 2002. Onsite Wastewater Treatment Systems Manual. EPA/625/R-00/008. U. S. Environmental Protection Agency. Office of Water, Office of Research and Development.

EPA. 2007. An Approach for Using Load Duration Curves in the Development of TMDLs. EPA-841-B-07-006. U.S. Environmental Protection Agency, Office of Water, Washington, DC. Available at http://www.epa.gov/owow/tmdl/techsupp.html

NDAWN. 2012. McHenry, North Dakota Weather Station. North Dakota Agriculture Weather Network. North Dakota State University, Fargo, North Dakota. Available at http://ndawn.ndsu.nodak.edu/index.html

NDDoH. 2007. Quality Assurance Project Plan for the Upper Cannonball River Manure Management Implementation Project. North Dakota Department of Health, Division of Water Quality. Bismarck, North Dakota.

NDDoH. 2011. *Standards of Quality for Waters of the State.* NDCC 61-28-04, 23-33, 61-2. Environmental Health Section, North Dakota Department of Health. Bismarck, North Dakota.

NDDoH. 2011.Water Quality Monitoring Results of the Upper Cannonball River Manure Management Implemenation Project. North Dakota Department of Health, Division of Water Quality. Bismarck, North Dakota. Available at http://iaspub.epa.gov/pls/grts/f?p=110:700:5823346840376::NO:RP,700:P700_PRJ_SEQ:24906.

NDDoH. 2012. *North Dakota 2012 Integrated Section 305(b) Water Quality Assessment Report and Section 303(d) List of Waters Needing Total Maximum Daily Loads.* North Dakota Department of Health, Division of Water Quality. Bismarck, North Dakota.

NRCS. 1998. *Natural Resources Conservation Service Practice Specification* 528. USDA-Natural Resources Conservation Service, North Dakota. Available at http://efotg.nrcs.usda.gov

NRCS. 2001. *Natural Resources Conservation Service Practice Specification 393* – Filter Strip (Acres) [Online]. USDA – Natural Resources Conservation Service, North Dakota. Available at http://www.nd.nrcs.usda.gov/resources/section4/standards/Section4.html.

Pennsylvania State University. 1992. Nonpoint Source Database. Pennsylvania State University, Department of Agricultural and Biological Engineering, University Park, PA.

Ries, K. G., III and P. J. Friesz. 2000. *Methods for Estimating Low-Flow Statistics for Massachusetts Streams.* U.S. Geological Survey Water Resources Investigations Report 00-4135. U.S. Geological Survey, Reston, VA.

Tiedemann, A.R., D.A. Higgins, T.M. Quigley, H.R. Sanderson, and C. C. Bohn.1988. *Bacterial Water Quality Responses to Four Grazing Strategies – Comparison with Oregon Standards*.

USGS. 2006. *Ecoregions of North Dakota and South Dakota*. United States Geological Survey. Available at http://www.npwrc.usgs.gov/resource/habitat/ndsdeco/nodak.html.

Appendix A
E. coli Bacteria Data Collected for Sites 380025, 385064 and 385045

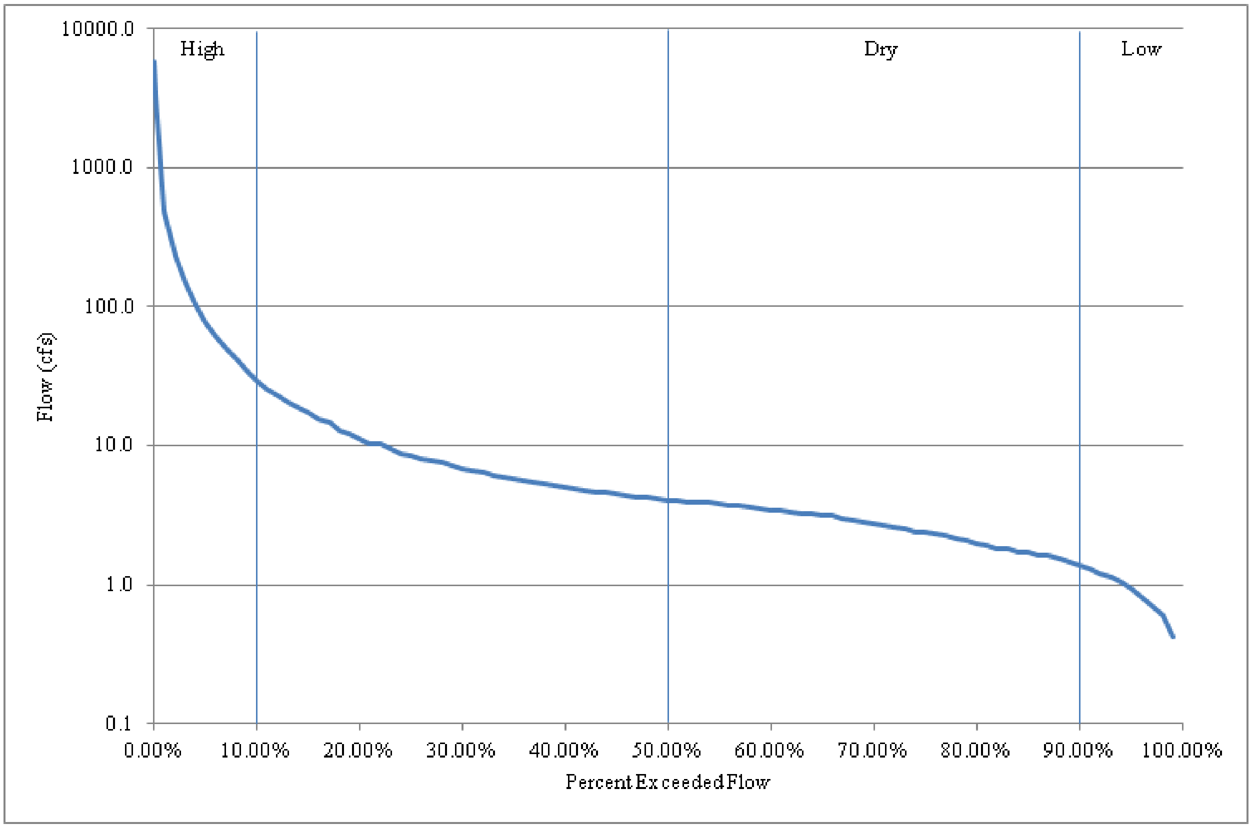
380025 - Cannonball River - 0.25 Miles NE of Regent										
	May		June		July		August		Sept	
	5/5/2008	5	6/2/2008	150	7/1/2008	280	8/4/2008	50	9/2/2008	10
	5/6/2008	5	6/3/2008	130	7/7/2008	800	8/5/2008	50	9/8/2008	5
	5/13/2008	20	6/9/2008	90	7/8/2008	800	8/11/2008	5	9/9/2008	10
	5/19/2008	10	6/10/2008	110	7/14/2008	150	8/12/2008	10	9/15/2008	5
	5/20/2008	20	6/16/2008	160	7/15/2008	220	8/18/2008	10	9/16/2008	10
	5/27/2008	10	6/23/2008	800	7/21/2008	220	8/19/2008	5	9/22/2008	10
	5/4/2009	40	6/24/2008	800	7/22/2008	130	8/25/2008	30	9/23/2008	30
	5/6/2009	20	6/30/2008	560	7/28/2008	90	8/26/2008	10	9/29/2008	5
	5/11/2009	10	6/2/2009	40	7/29/2008	30	8/4/2009	10	9/30/2008	5
	5/13/2009	10	6/3/2009	100	7/7/2009	30	8/5/2009	20	9/2/2009	280
	5/18/2009	10	6/8/2009	190	7/8/2009	110	8/10/2009	10	9/8/2009	20
	5/20/2009	10	6/9/2009	130	7/13/2009	260	8/11/2009	20	9/9/2009	20
	5/26/2009	70	6/15/2009	20	7/14/2009	190	8/17/2009	10	9/14/2009	10
	5/27/2009	30	6/17/2009	1500	7/20/2009	30	8/25/2009	5	9/16/2009	5
	5/3/2010	10	6/23/2009	40	7/21/2009	70	8/26/2009	20	9/21/2009	80
	5/4/2010	20	6/24/2009	200	7/28/2009	10	8/31/2009	30	9/22/2009	5
	5/10/2010	10	6/30/2009	110	7/29/2009	10	8/2/2010	50	9/28/2009	20
	5/11/2010	40	6/1/2010	100	7/6/2010	300	8/4/2010	50	9/29/2009	5
	5/17/2010	20	6/7/2010	130	7/7/2010	140	8/10/2010	60	9/8/2010	20
	5/19/2010	10	6/8/2010	430	7/13/2010	120	8/11/2010	50	9/13/2010	20
	5/24/2010	180	6/15/2010	60	7/14/2010	240	8/16/2010	30	9/14/2010	30
	5/25/2010	6200	6/16/2010	140	7/19/2010	80	8/18/2010	10	9/20/2010	5
	5/2/2011	10	6/21/2010	100	7/27/2010	10	8/24/2010	120	9/22/2010	10
	5/10/2011	60	6/22/2010	600	7/28/2010	10	8/30/2010	90	9/27/2010	5
	5/11/2011	30	6/29/2010	550	7/5/2011	200	8/31/2010	100	9/29/2010	10
	5/16/2011	40	6/30/2010	350	7/6/2011	210	8/1/2011	80	9/6/2011	5
	5/18/2011	20	6/1/2011	540	7/11/2011	130	8/2/2011	10	9/7/2011	50
	5/23/2011	1500	6/7/2011	50	7/12/2011	80	8/8/2011	40	9/12/2011	50
	5/24/2011	190	6/8/2011	90	7/18/2011	80	8/10/2011	50	9/13/2011	20
	5/25/2011	100	6/13/2011	3600	7/19/2011	5	8/15/2011	5	9/19/2011	50
	5/31/2011	250	6/15/2011	300	7/25/2011	100	8/16/2011	200	9/21/2011	60
			6/21/2011	90	7/26/2011	170	8/22/2011	20	9/26/2011	10
			6/22/2011	40			8/23/2011	10	9/28/2011	10
			6/27/2011	100			8/29/2011	20	9/30/2011	5
			6/28/2011	5						
Number of samples	31		35		32		34		34	
Geometric Mean	32		157		67		25		14	
% exceeding 409	6.45%		22.90%		6.25%		0.00%		0.00%	
Use attainment	FS		NS		FS		FS		FS	

385064 - Dead Horse Creek										
	May		June		July		August		Sept	
	5/4/2008	5	6/1/2008	130	7/6/2009	80	8/1/2011	10	9/5/2011	90
	5/5/2008	5	6/2/2008	950	7/7/2009	230	8/2/2011	150	9/6/2011	200
	5/11/2008	10	6/8/2008	810	7/13/2009	3600	8/7/2011	90	9/11/2011	5
	5/12/2008	20	6/9/2008	830	7/14/2009	1100	8/8/2011	80	9/13/2011	20
	5/18/2008	30	6/15/2008	5	7/20/2009	500	8/14/2011	50	9/18/2011	20
	5/19/2008	170	6/16/2008	900	7/21/2009	230	8/15/2011	120	9/20/2011	90
	5/26/2008	150	6/1/2009	20	7/5/2011	8000	8/16/2011	1300	9/25/2011	5
	5/27/2008	80	6/8/2009	2600	7/6/2011	6800	8/21/2011	130	9/26/2011	70
	5/4/2009	5	6/10/2009	310	7/11/2011	4900	8/23/2011	40		
	5/6/2009	5	6/22/2009	70	7/12/2011	40	8/28/2011	80		
	5/11/2009	20	6/24/2009	70	7/18/2011	1300	8/29/2011	80		
	5/12/2009	60	6/29/2009	240	7/19/2011	800				
	5/13/2009	90	6/30/2009	90	7/25/2011	630				
	5/18/2009	30	6/1/2010	6300	7/26/2011	30				
	5/19/2009	5	6/2/2010	1400						
	5/26/2009	40	6/7/2010	790						
	5/27/2009	20	6/8/2010	1400						
	5/31/2009	5	6/15/2010	2400						
	5/3/2010	50	6/16/2010	1800						
	5/4/2010	50	6/20/2010	700						
	5/11/2010	50	6/22/2010	750						
	5/12/2010	10	6/27/2010	8000						
	5/17/2010	40	6/28/2010	1000						
	5/18/2010	5	6/5/2011	70						
	5/25/2010	180	6/6/2011	100						
	5/26/2010	2100	6/12/2011	550						
	5/1/2011	5	6/13/2011	270						
	5/2/2011	10	6/19/2011	1200						
	5/8/2011	5	6/22/2011	340						
	5/9/2011	5	6/26/2011	1500						
	5/10/2011	30	6/27/2011	1500						
	5/11/2011	10								
	5/15/2011	5								
	5/16/2011	5								
	5/22/2011	140								
	5/23/2011	20								
	5/24/2011	50								
	5/30/2011	170								
	5/31/2011	80								
Number of samples	39		31		14		11		8	
Geometric Mean	24.13		476.93		635.60		89.08		32.12	
% exceeding 409	2.56%		61.29%		64.29%		9.09%		0.00%	
Use attainment	FS		NS		NS		FS		FS	

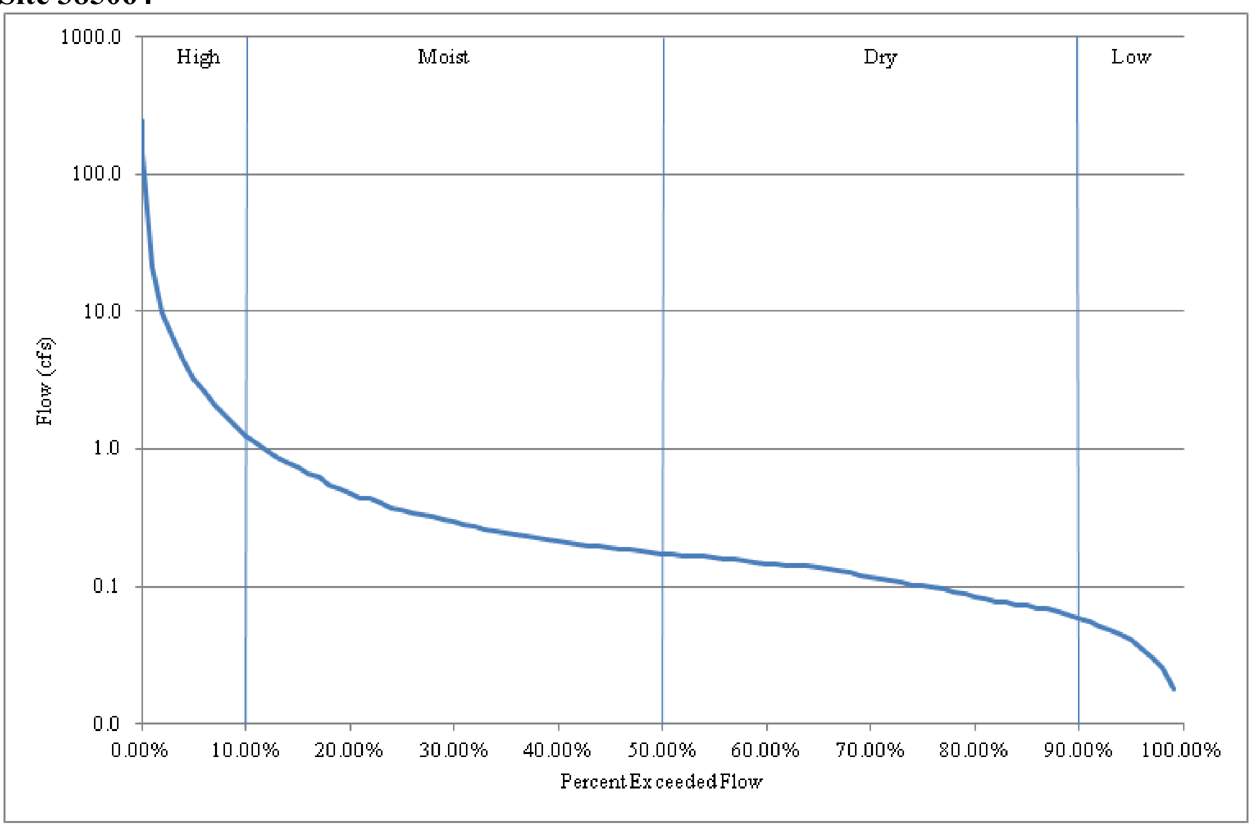
385045 - Cannonball River - North Fork - 14 miles East, 6 miles North of Amidon										
	May		June		July		August		Sept	
	5/4/2008	10	6/1/2008	800	7/7/2008	800	8/3/2009	10	9/1/2009	100
	5/5/2008	20	6/2/2008	390	7/6/2009	70	8/4/2009	100	9/8/2009	760
	5/11/2008	20	6/8/2008	230	7/7/2009	70	8/9/2009	4000	9/9/2009	10
	5/12/2008	220	6/9/2008	50	7/13/2009	250	8/10/2009	480	9/15/2009	60
	5/18/2008	120	6/15/2008	60	7/14/2009	190	8/17/2009	10	9/16/2009	20
	5/19/2008	40	6/16/2008	30	7/20/2009	60	8/18/2009	90	9/21/2009	110
	5/26/2008	20	6/23/2008	410	7/21/2009	70	8/24/2009	60	9/22/2009	120
	5/27/2008	5	6/30/2008	140	7/27/2009	50	8/25/2009	5	9/28/2009	70
	5/4/2009	10	6/1/2009	90	7/28/2009	100	8/31/2009	50	9/30/2009	30
	5/6/2009	10	6/8/2009	130	7/5/2010	5	8/3/2010	5	9/13/2010	130
	5/11/2009	5	6/10/2009	50	7/6/2010	5	8/4/2010	120	9/14/2010	350
	5/12/2009	10	6/15/2009	20	7/11/2010	160	8/8/2010	5	9/19/2010	70
	5/13/2009	40	6/17/2009	280	7/12/2010	110	8/9/2010	380	9/20/2010	170
	5/18/2009	5	6/22/2009	50	7/19/2010	260	8/15/2010	280	9/27/2010	10
	5/19/2009	40	6/24/2009	370	7/20/2010	130	8/16/2010	210	9/28/2010	20
	5/26/2009	10	6/29/2009	110	7/27/2010	800	8/22/2010	140	9/5/2011	80
	5/27/2009	5	6/30/2009	100	7/28/2010	90	8/23/2010	340	9/6/2011	70
	5/31/2009	10	6/1/2010	20	7/5/2011	70	8/29/2010	70	9/11/2011	420
	5/3/2010	5	6/2/2010	320	7/6/2011	5	8/30/2010	770	9/13/2011	200
	5/4/2010	20	6/7/2010	60	7/11/2011	10	8/1/2011	80	9/18/2011	70
	5/11/2010	60	6/8/2010	40	7/12/2011	340	8/2/2011	70	9/20/2011	150
	5/12/2010	50	6/15/2010	90	7/18/2011	5	8/7/2011	70	9/25/2011	300
	5/17/2010	60	6/16/2010	50	7/19/2011	5	8/8/2011	40	9/26/2011	190
	5/18/2010	20	6/20/2010	50	7/25/2011	90	8/14/2011	50		
	5/25/2010	140	6/22/2010	600	7/26/2011	60	8/15/2011	40		
	5/26/2010	3800	6/27/2010	100			8/16/2011	210		
	5/1/2011	5	6/28/2010	5			8/21/2011	50		
	5/2/2011	10	6/5/2011	250			8/23/2011	90		
	5/8/2011	5	6/6/2011	20			8/28/2011	200		
	5/9/2011	5	6/12/2011	60			8/29/2011	170		
	5/10/2011	5	6/13/2011	4900						
	5/11/2011	200	6/19/2011	50						
	5/15/2011	10	6/22/2011	120						
	5/16/2011	50	6/26/2011	70						
	5/22/2011	730	6/27/2011	10						
	5/23/2011	240								
	5/24/2011	140								
	5/30/2011	320								
	5/31/2011	760								
Number of Samples	39		35		25		30		23	
Geometric Mean	30.31		94.87		62.1		83.51		89.46	
% Exceeding 409	7.69%		5.71%		8.00%		10.00%		8.70%	
Use Attainment	FS		FS		FS		FST		FS	

Appendix B
Flow Duration Curve for Sites 380025, 385064 and 385045

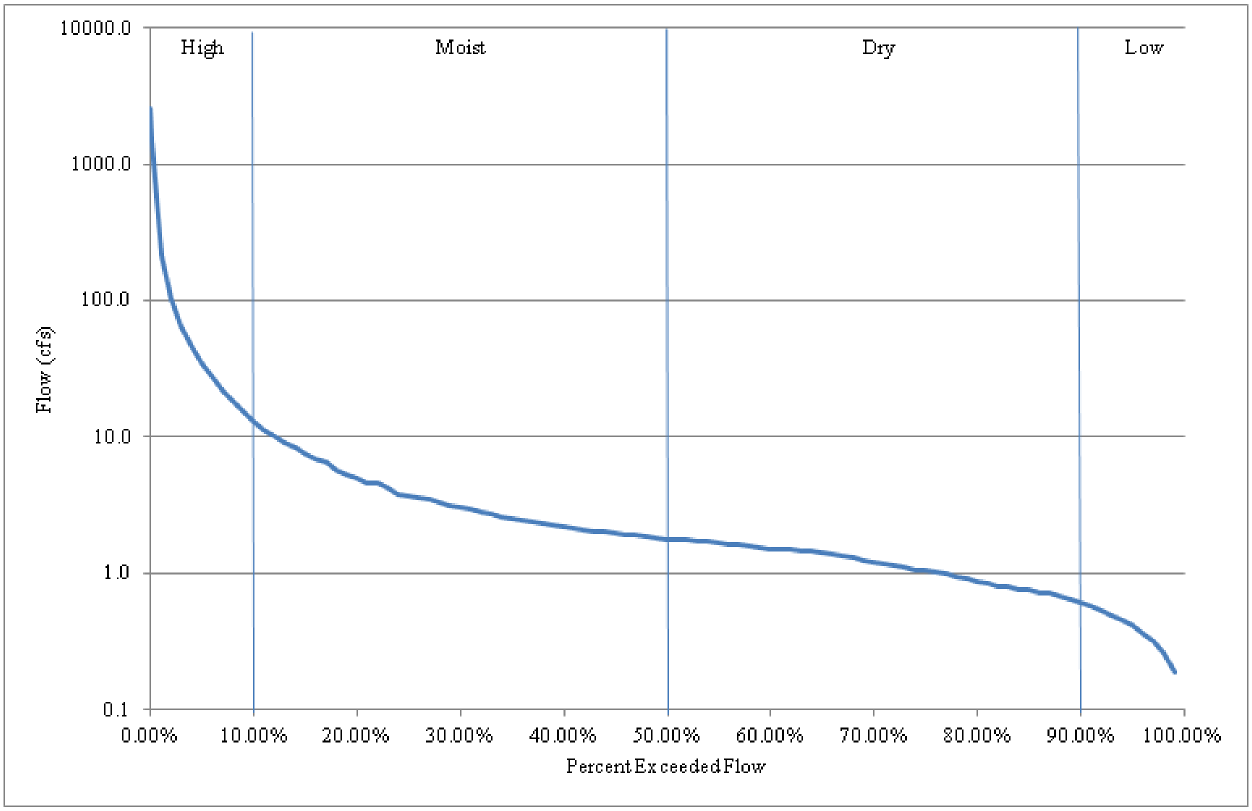
Site 380025



Site 385064



Site 385045

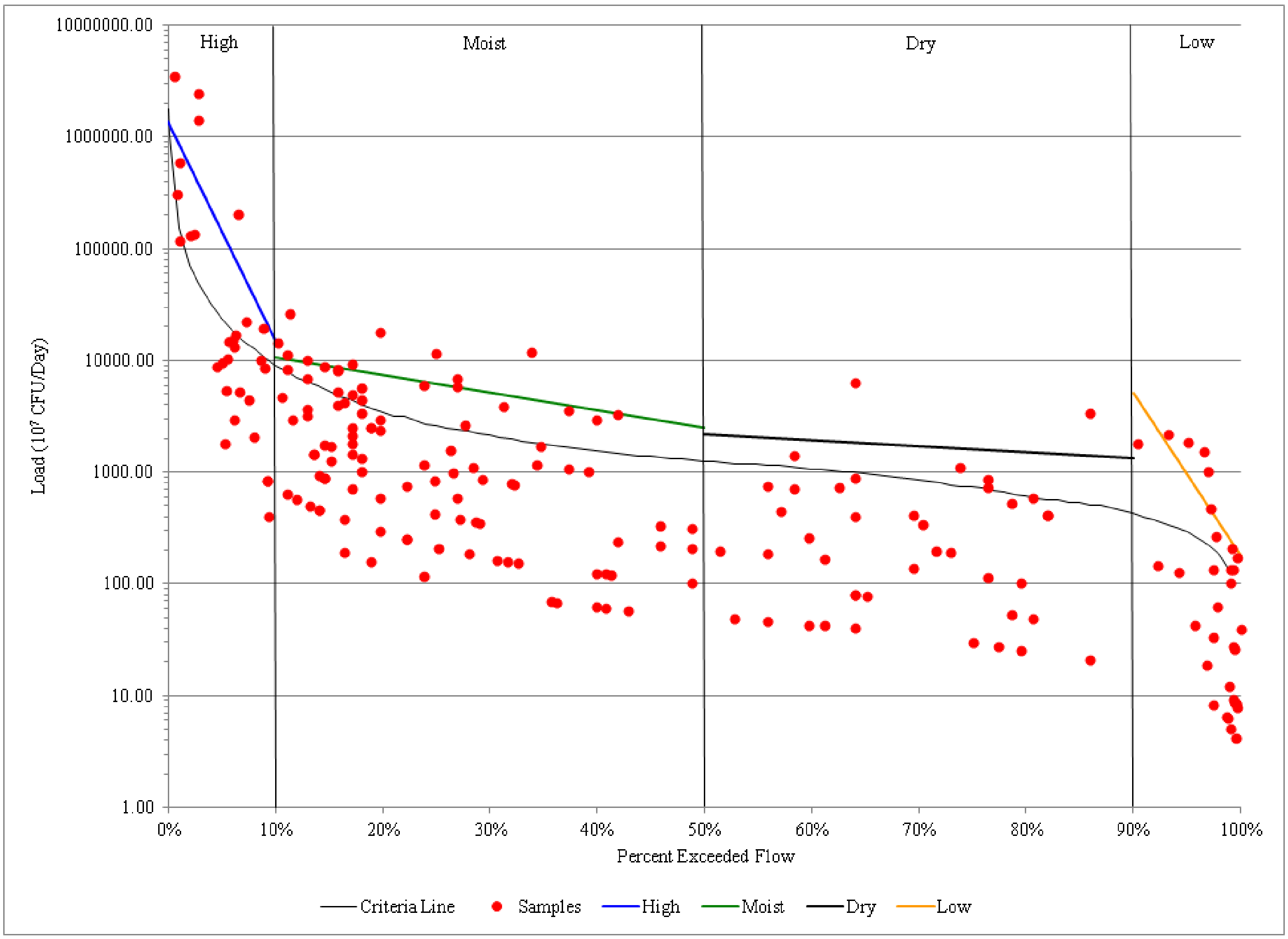


10000.0
1000.0
100.0
10.0
1.0
0.1
Flow (cfs)
High
Moist
Dry
Low
0.00%
10.00%
20.00%
30.00%
40.00%
50.00%
60.00%
70.00%
80.00%
90.00%
100.00%
Percent Exceeded Flow

Appendix C
Load Duration Curve, Estimated Load, TMDL Target, and Percent Load Reduction Required for Sites 380025, 385064 and 385045

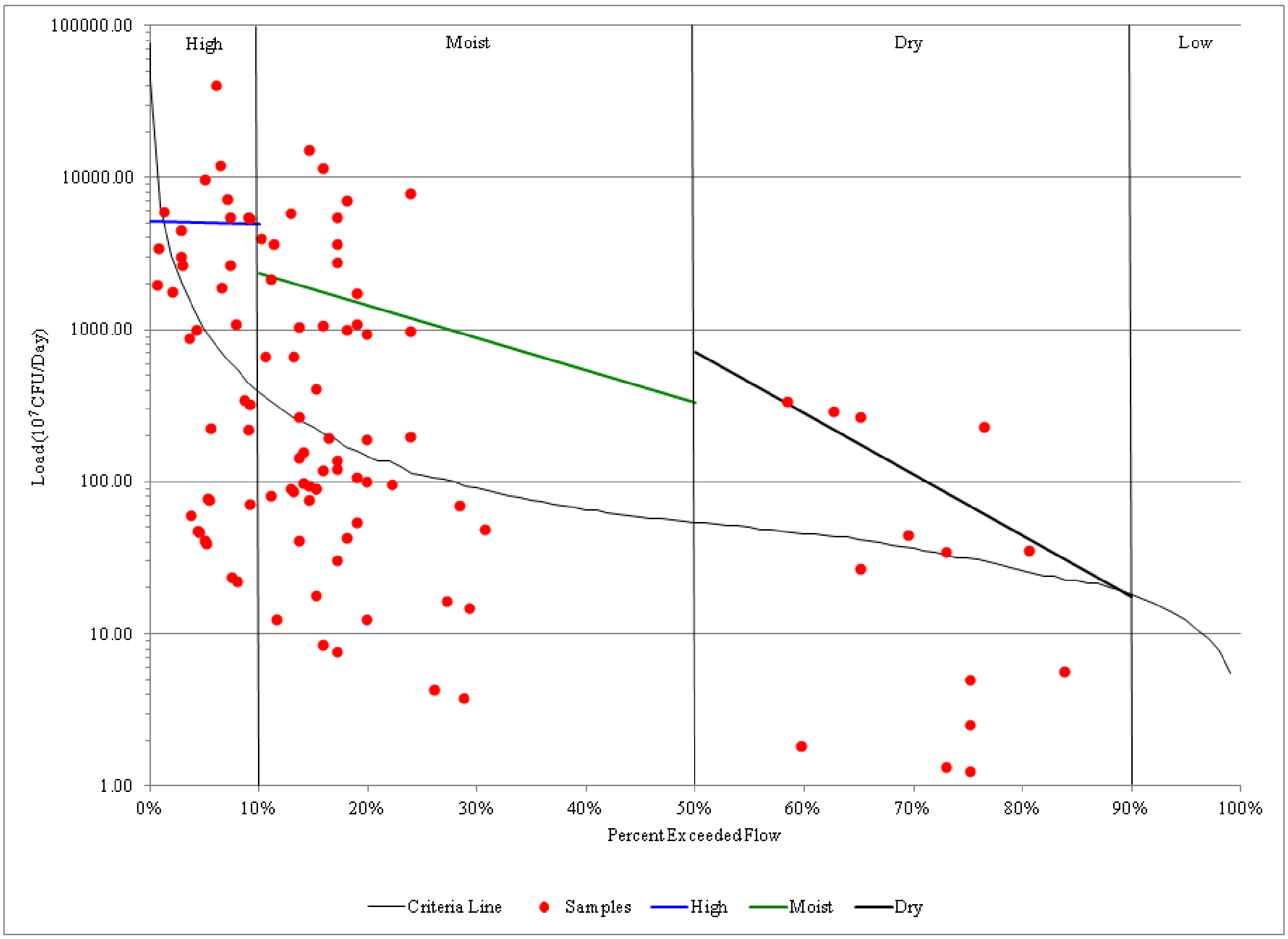
380025 – Upper Cannonball River

	Load (10^7 CFU/Day)				Load (10^7 CFU/Period)		
	Median Percentile	**Existing**	**TMDL**	**Days**	**Existing**	**TMDL**	**Percent Reduction**
High	5.00%	145428.14	23924.13	36.50	5308127.15	873230.81	83.55%
Moist	30.00%	5206.98	2126.59	146.00	760218.78	310482.06	59.16%
Dry	70.00%	1717.84	850.64	146.00	250805.18	124192.83	50.48%
Low	95.00%	961.23	292.41	36.50	35085.01	10672.82	69.58%
			Total	365	6354236	1318579	79.25%



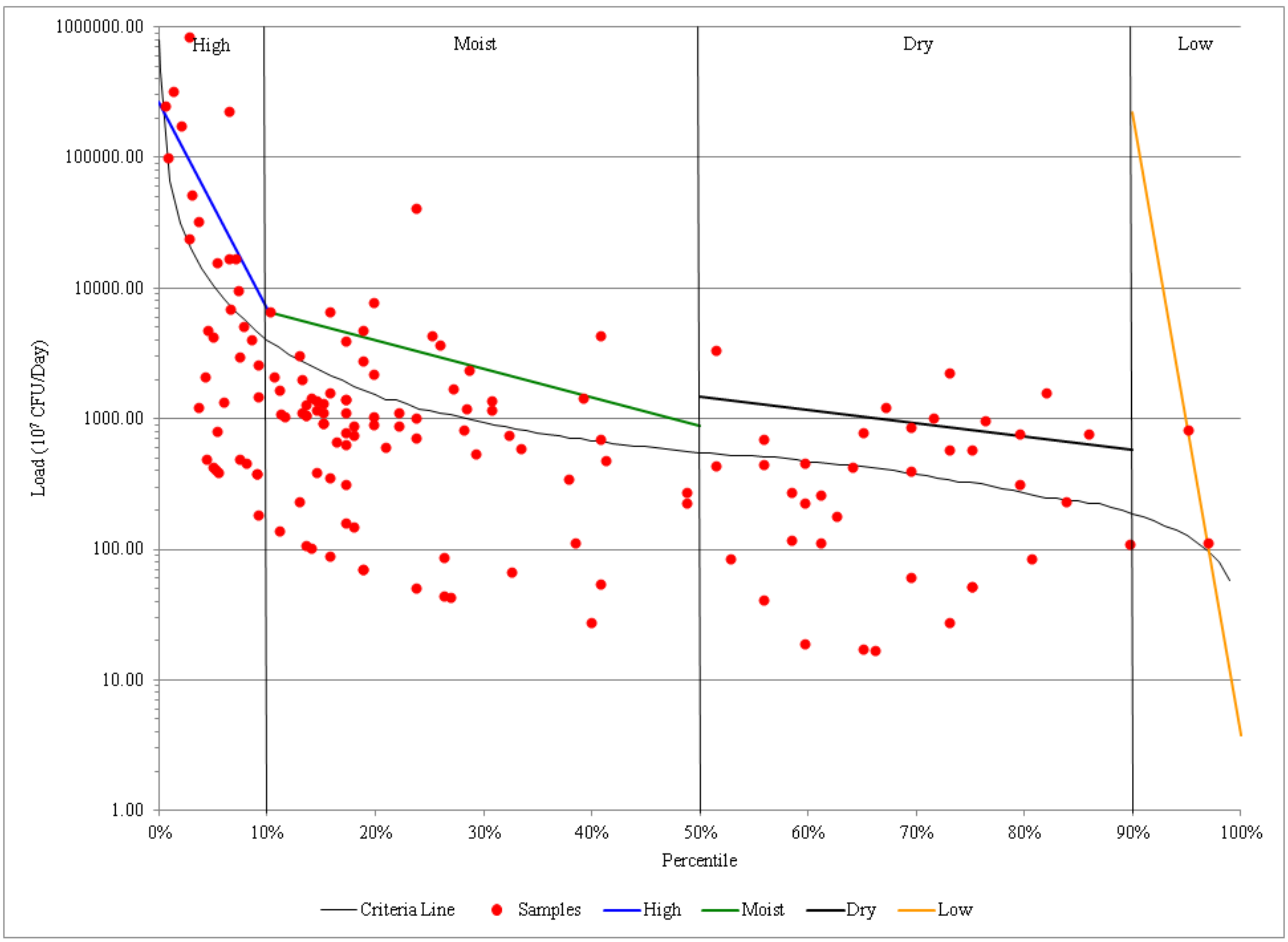
385064 – Dead Horse Creek

	Load (10^7 CFU/Day)				Load (10^7 CFU/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
High	5.00%	5050.61	1021.23	36.50	184347.29	37274.91	79.78%
Moist	30.00%	876.68	90.78	146.00	127995.39	13253.30	89.65%
Dry	70.00%	112.40	36.31	146.00	16410.16	5301.32	67.69%
			Total	329	328753	55830	83.02%



385045 - Cannonball River - North Fork - 14 miles East, 6 miles North of Amidon, ND

	Load (10^7 CFU/Day)				Load (10^7 CFU/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
High	5.00%	43087.35	10535.83	36.50	1572688.38	384557.78	75.55%
Moist	30.00%	2434.14	936.52	146.00	355384.02	136731.65	61.53%
Dry	70.00%	919.72	374.61	146.00	134279.13	54692.66	59.27%
Low	95.00%	912.54	128.77	36.50	33307.67	4700.15	85.89%
			Total	365	2095659	580682	72.29%



Appendix D
EPA Region 8 TMDL Review Form and Decision Document

EPA REGION 8 TMDL REVIEW FORM AND DECISION DOCUMENT

TMDL Document Info:

Document Name:	**E. coli Bacteria TMDLs for the Upper Cannonball River, North Fork Cannonball River and Dead Horse Creek in Slope and Hettinger Counties, North Dakota**
Submitted by:	**Mike Ell, North Dakota Department of Health**
Date Received:	**September 6, 2013**
Review Date:	**November 26, 2013**
Reviewer:	**Vern Berry, US Environmental Protection Agency**
Rough Draft / Public Notice / Final Draft?	**Public Notice**
Notes:	

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

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

Approval Notes to the Administrator:

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

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

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

Each of the following eight sections describes the factors that EPA Region 8 staff considers when reviewing TMDL documents. Also included in each section is a list of EPA's review elements 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 this review form 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 form 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

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

Review Elements:

☒ Each TMDL document submitted to EPA should include a notification of the document status (e.g., pre-public notice, public notice, final), and a request for EPA review.

☐ 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 notification of the availability of the public notice draft TMDL document was submitted to EPA via a letter attached to an email received on September 6, 2013. The letter includes the details of the public notice, explains how to obtain a copy of the TMDL, and requests the submittal of comments to NDDoH by October 6, 2013.*

Comments: *None.*

1.2 Identification of the Waterbody, Impairments, and Study Boundaries

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

Review Elements:

☒ 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

<u>Summary:</u>
Physical Setting and Listing History:
The TMDL document includes three impaired stream segments within the Upper Cannonball watershed (HUC 10130204) in south-western North Dakota. These stream segments are part of the larger Missouri River basin. The three impaired segments drain a watershed area of approximately 381,236 acres and are located in Slope and Hettinger Counties, North Dakota.

The impaired segments included in the TMDL document are: 1) Cannonball River from its confluence with Philbrick Creek downstream to its confluence with Indian Creek (54.25 miles; ND-10130204-032-S_00); 2) North Fork Cannonball River from its confluence with White Lake watershed downstream to its confluence with Philbrick Creek (33.25 miles; ND-10130204-047-

S_00); and 3) Dead Horse Creek, including all its tributaries (40.18 miles; ND10130204-044-S_00).

The TMDL document addresses the recreational use impairments from E. coli bacteria. The complete impairment information is included in the table below.

CHAPTER 33-16-02.1, Appendix 1 of the North Dakota Century Code assigns the following classifications for the stream segments in this TMDL document. All tributaries not specifically mentioned in Appendix 1 are classified as Class III streams:

Class II – Cannonball River, Segment ND-10130204-032-S_00

Class III – North Fork Cannonball River, ND-10130204-047-S_00 and Dead Horse Creek, including all its tributaries, ND-10130204-044-S_00

The designated uses for Class II and Class III streams are discussed in the Water Quality Standards section below.

***Impairment status**:*
The 2012 North Dakota Integrated Report identifies three segments in the Upper Cannonball watershed as impaired based on the following information:

Stream Segment	Designated Use / Support Status	Impairment Cause	TMDL Priority
Cannonball River ND-10130204-032-S_00	*Recreation; Fully Supporting, but Threatened*	*E. coli*	*Low*
North Fork Cannonball River ND-10130204-047-S_00	*Recreation; Fully Supporting, but Threatened*	*E. coli*	*Low*
Dead Horse Creek and all its tributaries ND-10130204-044-S_00	*Recreation; Not Supporting*	*E. coli*	*Low*

Comments: *None.*

1.3 Water Quality Standards

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

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

Review Elements:

☒ 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 identified sources. Therefore, <u>all TMDL documents must be written to meet the existing water quality standards</u> for that waterbody (CWA §303(d)(1)(C)). *Note: In some circumstances, the load reductions determined to be necessary by the TMDL analysis may prove to be infeasible and may possibly indicate that the existing water quality standards and/or assessment methodologies may be erroneous. However, the TMDL must still be determined based on existing water quality standards. Adjustments to water quality standards and/or assessment methodologies may be evaluated separately, from the TMDL.*

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

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

Recommendation:

☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary: *The Upper Cannonball watershed segments ND-10130204-032-S_00, ND-10130204-047-S_00 and ND-10130204-044-S_00, are impaired based on E. coli bacteria concentrations impacting the recreational uses. Tables 5 - 7 in the TMDL document provide a summary of the data used to determine the use impairment status.*

The mainstem Cannonball River segment is defined as a Class II stream. The quality of the waters in this class shall be the same as the quality of class I streams, except that additional treatment may be required to meet the drinking water requirements of the Department. Streams in this classification may be intermittent in nature which would make these waters of limited value for beneficial uses such as municipal water, fish life, irrigation, bathing, or swimming.

The North Fork Cannonball River and Dead Horse Creek segments are defined as Class III streams. The quality of the waters in this class shall be suitable for agricultural and industrial uses. Streams in this class generally have low average flows with prolonged periods of no flow. During periods of no flow, they are of limited value for recreation and fish and aquatic biota. The quality of these waters must be maintained to protect secondary contact recreation uses (e.g., wading), fish and aquatic biota, and wildlife uses.

Numeric criteria for E. coli have been established for North Dakota Class II and Class III streams and are presented in the excerpted Table 8 shown below. Discussion of additional applicable water quality standards for these stream segments can be found on pages 8 – 10 of the TMDL document.

Table 8. North Dakota E. coli Bacteria Water Quality Standards for Class II and III Streams.

Parameter	Standard	
	Geometric Mean[1]	Maximum[2]
E. coli Bacteria	126 CFU/100 mL	409 CFU/100 mL

[1] Expressed as a geometric mean of representative samples collected during any consecutive 30-day period.
[2] No more than 10 percent of samples collected during any consecutive 30-day period shall individually exceed the standard.

Comments: *None.*

2. Water Quality Targets

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

Review Elements:

☒ The TMDL should identify a numeric water quality target(s) for each waterbody pollutant combination. The TMDL target is a quantitative value used to measure whether or not the applicable water quality standard is attained. *Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. Occasionally, the pollutant of concern is different from the parameter that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as a numerical dissolved oxygen criterion). In such cases, the TMDL should explain the linkage between the pollutant(s) of concern, and express the quantitative relationship between the TMDL target and pollutant of concern. In all cases, TMDL targets must represent the attainment of current water quality standards.*

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

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

Summary: *The water quality targets for these TMDLs are based on the numeric water quality standards for E. coli bacteria that have been established to protect the recreational beneficial uses for the three impaired stream segments in the Upper Cannonball River watershed.*

Bacteria standards are expressed in coliform forming units (cfu) per 100 milliliters (mL) of the water sample. The E. coli target for each impaired segment is: 126 cfu/100 mL during the recreation season from May 1 to September 30. While the standards are intended to be expressed as the 30-day geometric mean, the targets for each stream segment were used to compare to values from single grab samples. This ensures that the reductions necessary to achieve the targets will be protective of both the acute (single sample value) and chronic (geometric mean of 5 samples) standards.

Comments: *None.*

3. Pollutant Source Analysis

A TMDL analysis is conducted when a pollutant load is known or suspected to be exceeding the loading capacity of the waterbody. Logically then, a TMDL analysis should consider all sources of the pollutant of concern in some manner. The detail provided in the source assessment step drives the rigor of the pollutant load allocation. In other words, it is only possible to specifically allocate quantifiable loads or load reductions to each identified source (or source category) when the relative load contribution from each source has been estimated. Therefore, the pollutant load from each identified source (or source category) should be specified and quantified. 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.

Review Elements:

- ☒ The TMDL should include an identification of the 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 the anthropogenic sources of the pollutant of concern have been identified, characterized, and 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

***<u>Summary</u>**: The TMDL document includes the landuse breakdown for the watershed based on the 2011 National Agricultural Statistics Service (NASS) data. In 2011, the dominant land use in the Upper Cannonball River watershed was agriculture. Approximately 57 percent of the landuse in the watershed was cropland, 29 percent was pasture / grassland and the remaining 14 percent was either developed space, barren or woods. The majority of the crops grown consisted of spring wheat, durum wheat, canola and sunflowers.*

Section 4.0, Significant Sources, beginning on page 10 of the TMDL document, provides the pollutant source analysis for the three listed segments in the watershed. There is one permitted point source within the drainage area of the Cannonball River segment. The city of New England, ND operates a municipal wastewater treatment facility (WWTF). Any discharges from *this facility are covered by a municipal wastewater general permit issued by the North Dakota Pollutant Discharge Elimination System Program. There have been no discharges from the New England, ND (population 555) WWTF in over 20 years, and it is not anticipated that there will be any discharges from the facility in the foreseeable future. Therefore, NDDoH has determined that this facility is a non-contributing point source to the listed segment of the Cannonball River.*

There are five permitted animal feeding operations (AFOs) within the drainage area of the listed stream segments. The NDDoH has permitted three medium (301-999 animal units (AUs)) and two small (0-300 (AUs)) AFOs to operate. All five AFOs are zero discharge facilities and are not deemed significant point sources of E. coli bacteria loadings to the Upper Cannonball watershed segments.

The bacteria pollution to these segments originates from nonpoint sources in the watershed. Unpermitted AFOs and livestock grazing and watering in proximity to the river are common along the TMDL listed segments. The southwest section of North Dakota typically experiences long duration or intense precipitation during the spring and early summer months. These storms can cause flash flooding and fast rising river levels. Due to the close proximity of livestock grazing and watering to the river, it is likely that the combination of landuse and precipitation patterns result in runoff that contributes E. coli bacteria to the three impaired segments in the watershed.

Septic system failure might contribute to the bacteria in the water quality samples. Failures can occur for several reasons, although the most common reason is improper maintenance (e.g. age, inadequate pumping). Other reasons for failure include improper installation, location, and system design. Harmful household chemicals can also cause failure by killing the bacteria that digest the waste. While the number of systems that are not functioning properly is unknown, it is estimated that 28 percent of the systems in North Dakota are failing.

Wildlife may also contribute to the bacteria found in the water quality samples, but most likely in a lower concentration. Wildlife is nomadic with fewer numbers concentrating in a specific area, thus decreasing the probability of their contribution of fecal matter in significant quantities.

Comments: *None.*

4. TMDL Technical Analysis

TMDL determinations should be supported by an analysis of the available data, discussion of the known deficiencies and/or gaps in the 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:

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

Where:

TMDL	=	Total Maximum Daily Load (also called the Loading Capacity)
LAs	=	Load Allocations
WLAs	=	Wasteload Allocations
MOS	=	Margin Of Safety

Review Elements:

- ☒ 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:

- the spatial extent of the watershed in which the impaired waterbody is located and the spatial extent of the TMDL technical analysis;
- the distribution of land use in the watershed (e.g., urban, forested, agriculture);
- 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…;
- 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);
- an explanation and analytical basis for expressing the TMDL through surrogate measures, if applicable. Surrogate measures are parameters such as percent fines and turbidity for sediment impairments; chlorophyll *a* and phosphorus loadings for excess algae; length of riparian buffer; or number of acres of best management practices.

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

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

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

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

Summary: *The technical analysis should describe the cause and effect relationship between the identified pollutant sources, the numeric targets, and achievement of water quality standards. It should also include a description of the analytical processes used, results from water quality modeling, assumptions and other pertinent information. Section 5.0, Technical Analysis, beginning on page 11 of the TMDL document, describes how the E. coli loads and loading capacities were derived in order to meet the applicable water quality standards for the three* *impaired stream segments in the Upper Cannonball watershed. The loads and loading capacities were derived using the load duration curve (LDC) approach. To correlate the relationship between the pollutant of concern, the water quality targets and the hydrology, LDCs were developed for each listed stream segment.*

Streamflow data is available for one location in the watershed. The USGS gauging station (06350000) is located on the Cannonball River, Segment ND-10130204-032-S_00, near Regent, ND. The USGS station has operated continuously since 1950 and is collocated with the NDDoH monitoring station 380025. The streamflow data collected at that station from 1992-2011, was used to develop the LDC for the Cannonball River segment and to derive the flow record for the other two listed segments.

Streamfow data for the Segments ND-10130204-047-S_00 and ND-10130204-044-S_00 were determined by utilizing the Drainage-Area Ratio Method developed by the USGS, using the data from the downstream USGS gauging station (06350000) as the index dataset. The Drainage-Area Ratio Method assumes that the stream flow at the ungauged site is hydrologically similar (same per unit area) to the stream gauging station used as an index. This assumption is justified since the ungaged monitoring sites (385045 and 385064) are located upstream of the USGS index station on tributaries to the Cannonball River.

LDCs were derived for each segment using the streamflow data, the E. coli TMDL targets and the observed bacteria data collected from the three monitoring stations (see Figure 1 of the TMDL document for a map of the monitoring locations). Observed in-stream E. coli bacteria data, obtained from the monitoring stations, was converted to pollutant loads by multiplying E. coli bacteria concentrations by the mean daily flow and a conversion factor. These loads were plotted against the percent exceeded of the flow on the day of sample collection (see Figures 9 - 11 in the TMDL document). Points plotted above the 126 cfu/100 mL target curve exceeded the TMDL target. Points plotted below the curve were meeting the State water quality standard for E. coli of 126 cfu/100 mL.

To estimate the required percent reductions in loading needed to achieve the TMDL for each stream segment, a linear regression line through the E. coli load data above the TMDL curve in each flow regime was plotted. The required percent reductions needed under the four regimes were determined using the linear regression line (see Appendix C in the TMDL document).

The LDCs represent flow-variable TMDL targets across the flow regimes shown in the TMDL document. For the three Upper Cannonball watershed segments covered by the TMDL document, the LDCs are dynamic expressions of the allowable load for any given daily flow. Loading capacities were derived from this approach for each of the listed stream segments at each flow regime. Tables 11 – 13 show the loading capacity load (i.e., TMDL load) for E. coli for the three listed segments.

Comments: *None.*

4.1 Data Set Description

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

Review Elements:

☒ 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 TMDL data description and summary for the three listed segments in the Upper Cannonball watershed are included in the Available Data section (Section 1.5) and in the data tables in Appendix A. Recent water quality monitoring was conducted from May 2008 – September 2011 and included 166 E. coli samples collected from NDDoH monitoring station 380025 (Cannonball River), 152 E. coli samples collected from NDDoH monitoring station 385045 (North Fork Cannonball River) and 103 E. coli samples collected from NDDoH monitoring station 385064 (Dead Horse Creek). The data set also includes the streamflow record from USGS gauging station 06350000. The flow data, the E. coli data and the TMDL targets, were used to develop the E. coli load duration curves for the three impaired segments in the Upper Cannonball watershed.*

Comments: *None.*

4.2 Waste Load Allocations (WLA):

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

Review Elements:

☒ EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to individual existing and 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 drainage area of the Cannonball River segment. The city of New England, ND operates municipal wastewater treatment facility (WWTF). Any discharges from this facility are covered by a municipal wastewater general permit issued by the North Dakota Pollutant Discharge Elimination System Program. There have been no discharges from the New England, ND (population 555) WWTF in over 20 years, and it is not anticipated that there will be any discharges from the facility in the foreseeable future. Therefore, NDDoH has determined that this facility is a non-contributing point source to the listed segment of the Cannonball River.*

There are five permitted animal feeding operations (AFOs) within the drainage area of the listed stream segments. The NDDoH has permitted three medium (301-999 animal units (AUs)) and two small (0-300 (AUs)) AFOs to operate. All five AFOs are zero discharge facilities and are not deemed significant point sources of E. coli bacteria loadings to the Upper Cannonball watershed segments.

For these reasons, the E. coli WLAs are zero for each segment.

Comments: *None.*

4.3 Load Allocations (LA):

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

Review Elements:

☒ 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 the 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: *The TMDL document includes the landuse breakdown for the watershed based on the 2011 National Agricultural Statistics Service (NASS) data. In 2011, the dominant land use in the Upper Cannonball River watershed was agriculture. Approximately 57 percent of the landuse in the watershed was cropland, 29 percent was pasture / grassland and the remaining 14 percent was either developed space, barren or woods. The majority of the crops grown consisted of spring wheat, durum wheat, canola and sunflowers.*

The bacteria pollution to these segments originates from nonpoint sources in the watershed. Unpermitted AFOs and livestock grazing and watering in proximity to the river are common along the TMDL listed segments. The southwest section of North Dakota typically experiences long duration or intense precipitation during the spring and early summer months. These storms can cause flash flooding and fast rising river levels. Due to the close proximity of livestock grazing and watering to the river, it is likely that the combination of landuse and precipitation patterns result in runoff that contributes E. coli bacteria to the three impaired segments in the watershed.

Septic system failure might contribute to the bacteria in the water quality samples. Failures can occur for several reasons, although the most common reason is improper maintenance (e.g. age, inadequate pumping). Other reasons for failure include improper installation, location, and system design. Harmful household chemicals can also cause failure by killing the bacteria that *digest the waste. While the number of systems that are not functioning properly is unknown, it is estimated that 28 percent of the systems in North Dakota are failing.*

Wildlife may also contribute to the bacteria found in the water quality samples, but most likely in a lower concentration. Wildlife is nomadic with fewer numbers concentrating in a specific area, thus decreasing the probability of their contribution of fecal matter in significant quantities.

By relating runoff characteristics to each flow regime one can infer which sources are most likely to contribute to E. coli bacteria loading. Animals grazing in the riparian area contribute E. coli bacteria by depositing manure where it has an immediate impact on water quality. Due to the close proximity of manure to the stream or by direct deposition in the stream, riparian grazing impacts water quality at high flow or under moist and dry conditions. In contrast, intensive grazing of livestock in the upland and not in the riparian area has a high potential to impact water quality at high flows and under moist conditions impact at moderate flows. Exclusion of livestock from the riparian area eliminates the potential of direct manure deposit and therefore is considered to be of high importance at all flows. However, intensive grazing in the upland creates the potential for manure accumulation and availability for runoff at high flows and a high potential for E. coli bacteria contamination.

Source specific data are limited so aggregate LAs are assigned to nonpoint sources with a ranking of important contributors under various flow regimes provided as seen in the following excerpted table. Aggregate load allocations for each of the impaired segments in the Upper Cannonball watershed are included in Tables 11 - 13 of the TMDL document.

Table 9. Nonpoint Sources of Pollution and Their Potential to Pollute at a Given Flow Regime.

Nonpoint Sources	Flow Regime		
	High Flow	**Moist Conditions**	**Dry Conditions**
Riparian Area Grazing (Livestock)	H	H	H
Animal Feeding Operations	H	M	L
Manure Application to Crop and Range Land	H	M	L
Intensive Upland Grazing (Livestock)	H	M	L

Note: Potential importance of nonpoint source area to contribute E. coli bacteria loads under a given flow regime. (H: High; M: Medium; L: Low)

Comments: *None.*

4.4 Margin of Safety (MOS):

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

Review Elements:

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

☐ If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS should be identified and described. The document should discuss why the assumptions are considered conservative and the effect of the assumption on the final TMDL value determined.

☒ If the MOS is explicit, the loading set aside for the MOS should be identified. The document should discuss how the explicit MOS chosen is related to the uncertainty and/or potential error in the linkage analysis between the WQS, the TMDL target, and the TMDL loading rate.

☐ If, rather than an explicit or implicit MOS, the TMDL relies upon a phased approach to deal with large and/or unquantifiable uncertainties in the linkage analysis, the document should include a description of the planned phases for the TMDL as well as a monitoring plan and adaptive management strategy.

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

Summary: *The Upper Cannonball watershed TMDL document includes explicit MOSs for each of the listed segments in the watershed. The MOSs were derived by calculating 10 percent of the loading capacity for each segment. The explicit MOSs for the three segments are included in Tables 11 - 13 of the TMDL document.*

***Comments**: None.*

4.5 Seasonality and variations in assimilative capacity:

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

Review Elements:

☒ 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 E. coli loads were taken into account. The highest steam flows typically occur during late spring, and the lowest stream flows typically occur during the winter months. The TMDLs also consider seasonality because the E. coli criteria are in effect from May 1 to September 30, as defined by the recreation season in North Dakota.*

Comments: *None.*

5. Public Participation

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

Review Elements:

☒ 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 TMDL document includes a summary of the public participation process that has occurred. It describes the opportunities the public had to be involved in the TMDL development process. Letters notifying stakeholders of the availability of the draft TMDL document were mailed to stakeholders in the watershed during public comment. Also, the draft TMDL document was posted on NDoDH's Water Quality Division website, and a public notice for comment was published in local newspapers.*

Comments: *None.*

6. Monitoring Strategy

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

Review Elements:

- ☐ 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: *Monitoring will be conducted for the variables that are currently causing impairments to the beneficial uses of the waterbody. Once a watershed restoration plan (e.g., 319 PIP) is implemented, monitoring will be conducted in the TMDL listed stream segments beginning two years after implementation and extending five years after the implementation project is complete.*

Comments: *The TMDL document should mention the existing monitoring plans and QAPP that were written for the "Upper Cannonball Manure Management Implementation Project". Is that monitoring completed or ongoing? Are there any plans to continue monitoring through that project or is some future project being considered?*

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.

Review Elements:

☐ 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: *Implementation of TMDLs is dependent upon the availability of Section 319 NPS funds or other watershed restoration programs, as well as securing a local project sponsor and the required matching funds. Provided these three requirements are in place, a project implementation plan (PIP) is developed in accordance with the TMDL and submitted to the North Dakota Nonpoint Source Pollution Task Force and EPA for approval. The implementation of the best management practices contained in the NPS PIP is voluntary. Therefore, success of any TMDL implementation project is ultimately dependent on the ability of the local project sponsor to find cooperating producers. As a part of the PIP, data are collected to monitor and track the effects of BMP implementation as well as to judge overall project success. As data are gathered and analyzed, watershed restoration tasks are adapted to place BMPs where they will have the greatest benefit to water quality.*

Comments: *The TMDL document should include a discussion of the "Upper Cannonball Manure Management Implementation Project". The goal of that project was to restore the recreational beneficial use by decreasing the fecal coliform bacteria loading to the streams in the watershed. We recommend including: a summary of the purpose and goals of the project; the status of meeting those goals; a discussion of whether the BMPs implemented for that project are expected to help meet the E. coli targets for these TMDLs; a discussion of whether the data show any noticeable water quality improvement; and a description of any additional implementation plans or proposals.*

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. Review Elements: ☒ 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 Cannonball River TMDL document includes daily loads expressed as colony forming units per day for the listed stream segments in the watershed. The daily TMDL loads for each segment are included in TMDL section (Section 7.0) of the document.*

Comments: *None.*

Appendix E
NDDoH's Response to Comments Received from EPA Region 8

US EPA Comment: The TMDL document should mention the existing monitoring plans and QAPP that were written for the "Upper Cannonball Manure Management Implementation Project". Is that monitoring completed or ongoing? Are there any plans to continue monitoring through that project or is some future project being considered?

NDDoH Response to Comment: A description and reference to the Quality Assurance Project Plan for the Upper Cannonball River Manure Management Project is provide in Section 1.5.1.

US EPA Comment: The TMDL document should include a discussion of the "Upper Cannonball Manure Management Implementation Project". The goal of that project was to restore the recreational beneficial use by decreasing the fecal coliform bacteria loading to the streams in the watershed. We recommend including: a summary of the purpose and goals of the project; the status of meeting those goals; a discussion of whether the BMPs implemented for that project are expected to help meet the E. coli targets for these TMDLs; a discussion of whether the data show any noticeable water quality improvement; and a description of any additional implementation plans or proposals.

NDDoH Response to Comment: **A** discussion of the "Upper Cannonball Manure Management Implementation Project" is provided in Sections 10.0 and 11.0.