Fecal Coliform Bacteria TMDL and De-Listing for the Pipestem Creek and an Unnamed Tributary in Foster, Kidder, Stutsman and Wells Counties North Dakota

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1.0 INTRODUCTION AND DESCRIPTION OF THE WATERSHED

The Pipestem Creek watershed is a 684,704 acre watershed located in Foster, Kidder, Stutsman and Wells Counties in southcentral North Dakota. Pipestem Creek flows from southeast Wells County to eastern Stutsman County where it confluences with the James River. Figure 1 shows the location of the Pipestem Creek watershed while Table 1 summarizes the watersheds geographical, hydrological and physical characteristics.

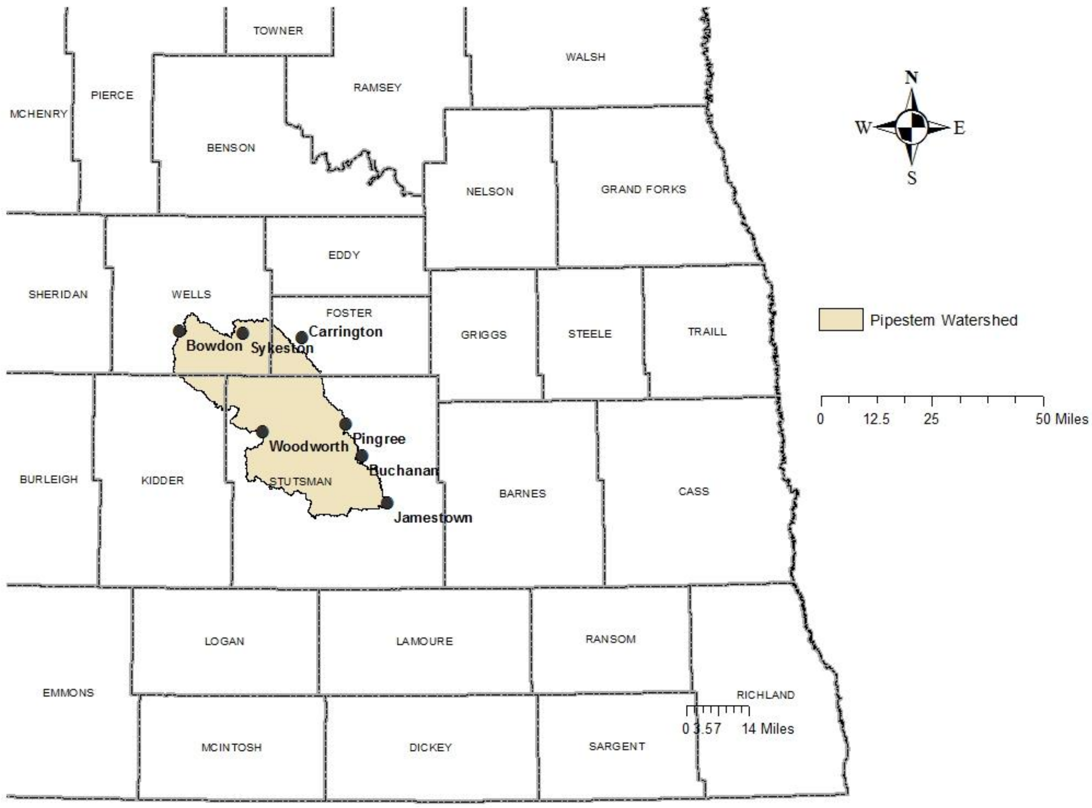

Figure 1. General Location of the Pipestem Creek Watershed in North Dakota.

Table 1. General Characteristics of the Pipestem Creek Watershed.

Legal Name	Pipestem Creek and Unnamed Tributary
Stream Classification	Class IA
Major Drainage Basin	James River
8-Digit Hydrologic Unit	10160002
Counties	Foster, Kidder, Stutsman and Wells Counties
Level III Ecoregion	Northern Glaciated Plains (46) Northern Glaciated Plains (42)
Watershed Area (acres)	684,704

1.1 Clean Water Act Section 303(d) Listing Information

Based on the 2010 Section 303 (d) List of Impaired Waters Needing TMDLs (NDDoH, 2010), the North Dakota Department of Health has identified a 25.21 mile segment of Pipestem Creek from its beginning downstream to Sykeston Dam (ND-10160002-001-S_00), a 29.22 mile segment of Pipestem Creek from its confluence with Little Pipestem Creek downstream to Dam #4 (ND-10160002-010-S_00), a 21 mile segment of Pipestem Creek from Dam #4 downstream to Pipestem Reservoir (ND-10160002-012-S_00), and a 40.74 mile segment of an unnamed tributary to Pipestem Creek (ND-10160002-013-S_00) as fully supporting, but threatened for recreational uses. The impairments are due to fecal coliform bacteria (Tables 2-5 and Figure 2).

Table 2. Pipestem Creek Section 303(d) Listing Information for Assessment Unit ID ND-10160002-001-S_00.

Assessment Unit ID	ND-10160002-001-S_00
Assessment Unit ID Description	Pipestem Creek from its beginning, downstream to Sykeston Dam (Lake Hiawatha)
Size	25.21 miles
Designated Use	Recreation
Use Support	Fully Supporting, but Threatened
Impairment	Fecal Coliform Bacteria
TMDL Priority	Low

Table 3. Pipestem Creek Section 303(d) Listing Information for Assessment Unit ID ND-10160002-010-S_00.

Assessment Unit ID	ND-10160002-010-S_00
Assessment Unit ID Description	Pipestem Creek from its confluence with Little Pipestem Creek, downstream to Dam #4
Size	29.22 miles
Designated Use	Recreation
Use Support	Fully Supporting, but Threatened
Impairment	Fecal Coliform Bacteria
TMDL Priority	Low

Table 4. Pipestem Creek Section 303(d) Listing Information for Assessment Unit ID ND-10160002-012-S_00.

Assessment Unit ID	ND-10160002-012-S_00
Assessment Unit ID Description	Unnamed tributary watershed to Pipestem Creek
Size	40.74 miles
Designated Use	Recreation
Use Support	Fully Supporting, but Threatened
Impairment	Fecal Coliform Bacteria
TMDL Priority	Low

Table 5. Pipestem Creek Section 303(d) Listing Information for Assessment Unit ID ND-10160002-013-S_00.

Assessment Unit ID	ND-10160002-013-S_00
Assessment Unit ID Description	Pipestem Creek from Dam #4, downstream to Pipestem Reservoir.
Size	21 miles
Designated Use	Recreation
Use Support	Fully Supporting, but Threatened
Impairment	Fecal Coliform Bacteria
TMDL Priority	Low

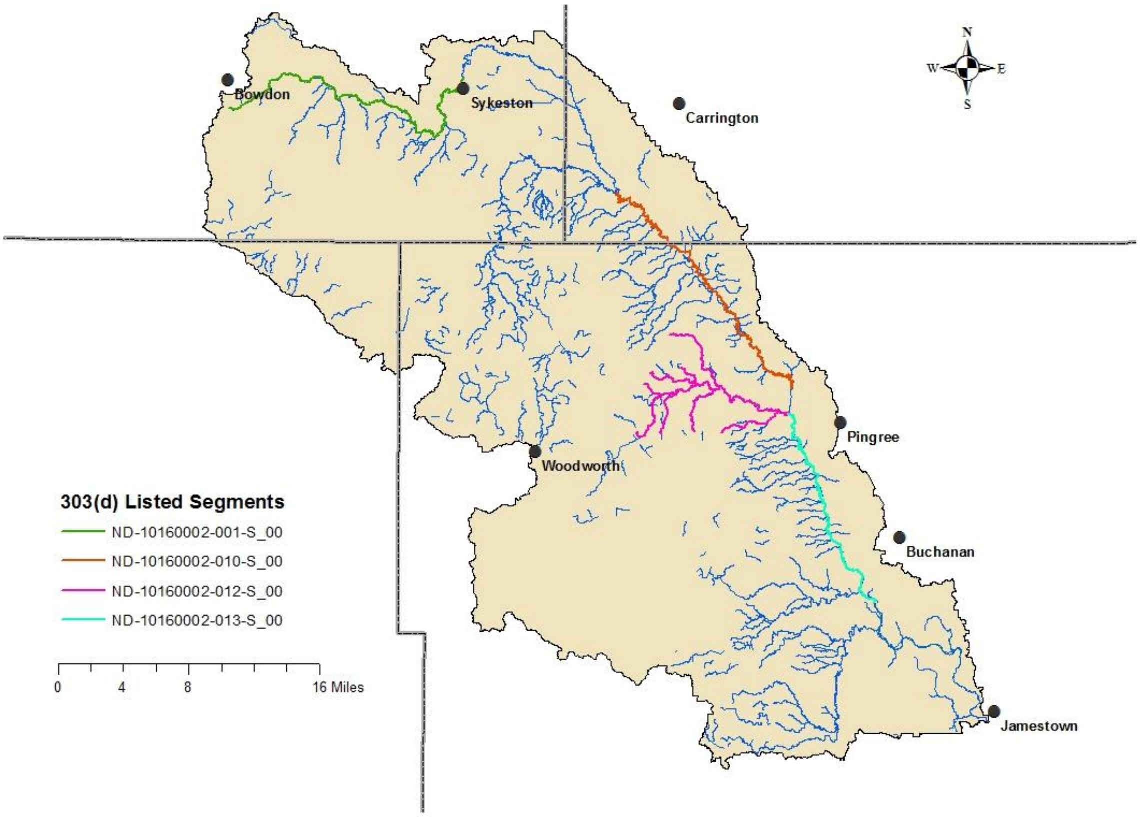

Figure 2. Pipestem Creek TMDL Listed Segments.

1.2 Ecoregions

Approximately 55 percent of the Pipestem Creek watershed lies within the Missouri Coteau (42a) and Collapsed Glacial Outwash (42b) level IV ecoregions of the Northwestern Glaciated Plains level III ecoregion (Figure 4). Semi-permanent and permanent wetlands are common in the Missouri Coteau and Collapsed Glacial Outwash ecoregions and most do not contribute to surface water inputs of Pipestem Creek (Figure 3).

Figure 3. Temporary and Seasonal Wetlands on the Missouri Coteau and Drift Plains.

The remaining 45 percent of the Pipestem Creek watershed is located in the Drift Plains level IV ecoregion (46i) of the Northern Glaciated Plains level III ecoregion. The Drift Plains ecoregions is characterized by generally flat to occasionally rolling topography with a thick layer of glacial till left behind by Wisconsinan glaciation. Prior to cultivation, the Drift Plain grasslands were a mixture of tall grass and short grass prairie. Seasonal and temporary wetlands are common to the Drift Plains but, unlike the Missouri Coteau, nearly the entire area contributes to surface water inputs to the Pipestem Creek.

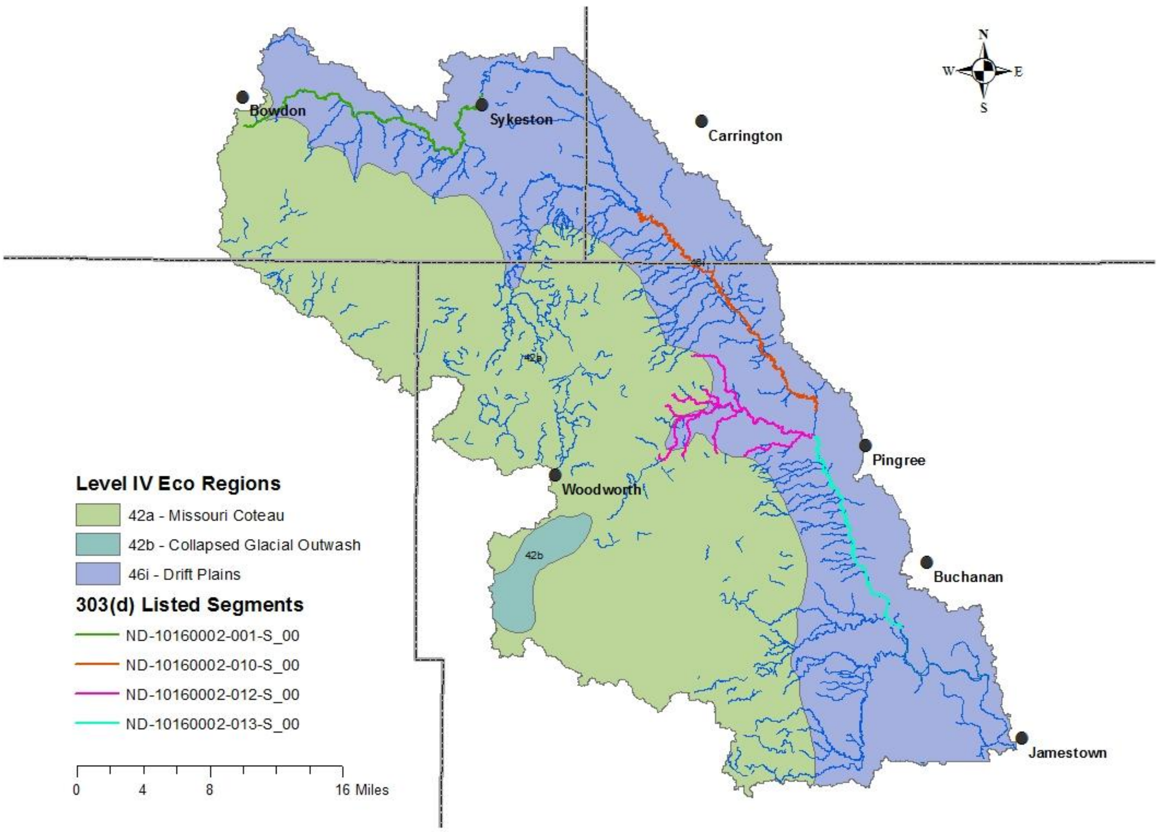

Figure 4. Level IV Ecoregions in the Pipestem Creek Watershed.

1.3 Land Use

Cropland data from the North Dakota Agricultural Statistics Service (NASS) for the years of 1999 and 2010 show changes in cropping practices. These changes are partially dictated by the changes in commodity markets and conservation programs. The NASS data from 1999 indicated that the Pipestem Creek watershed was dominated by pasture/rangeland and non-agricultural uses (Table 6). In 2010, due to increased market prices, soybean acres were the most dominant with grasslands becoming the second most dominant land use (Table 6, Figure 5). Accurate comparisons between non-cropland acreages from 1999 and 2010 could not be made because the method of determining and classifying those acres was changed by NASS.

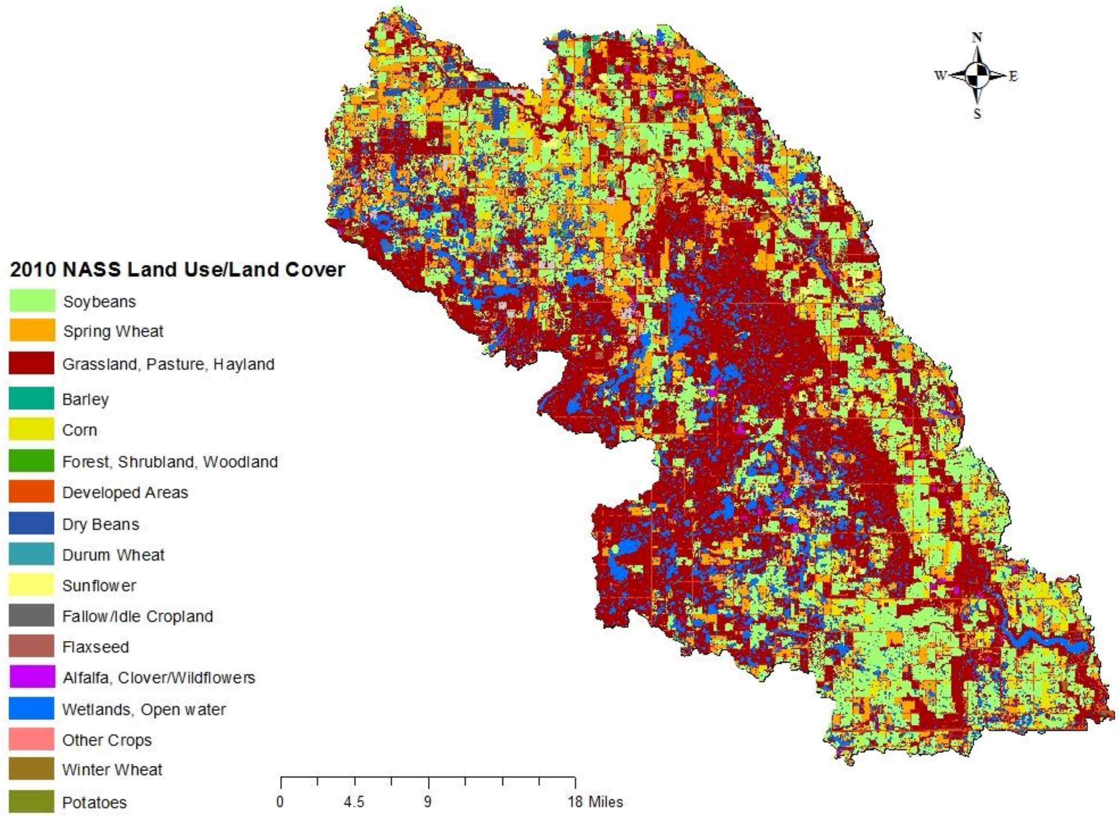

Figure 5. Land Use in the Pipestem Creek Watershed (NASS, 2010).

Table 6. Dominant Land Use/Land Cover in the Pipestem Creek Watershed in 1999 and 2010 (based on NASS Land Use/Cover Data).

Land Use/Land Cover	1999 Acres	Land Use/Land Cover	2010 Acres
Pasture, Non-Ag, Range	293,764	Soybeans	158,107
Idle/Fallow/CRP	97,016	Grassland Herbaceous	155,507
Sunflower	66,181	Spring Wheat	78,297
Spring Wheat	65,925	Pasture/Grass	68,255
Durum Wheat	48,932	Pasture/Hay	55,508
Barley	42,307	Open Water	47,254
Hay	20,273	Corn	30,212
Dry Beans	15,968	Wetlands	26,995

1.4 Climate and Precipitation

Figure 6 shows the average total monthly precipitation at Sykeston, ND as reported from weather station 328608 of the High Plains Regional Climate Center (HPRCC). Precipitation occurs primarily during the summer months, with most occurring in June. Total annual precipitation is about 18 inches.

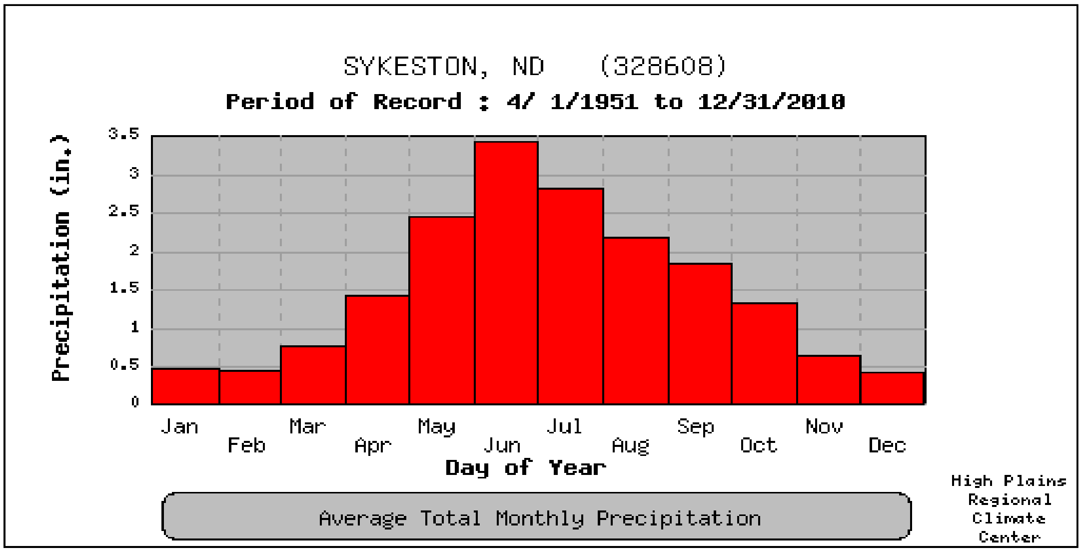

Figure 6. Annual Total Monthly Precipitation at Sykeston, North Dakota from 1951-2010, High Plains Regional Climate Center (HPRCC).

1.5 Available Data

<u>1.5.1 Fecal Coliform Bacteria Data</u>

Fecal coliform bacteria samples were collected in 2000 at four sites, each associated with one of the Section 303(d) listed segments (Figure 7). In 2003, the implementation phase of the project utilized long-term sampling stations which were monitored on a routine basis. As part of a separate project, site 380152 was the only site to be monitored in 2008 and therefore the only site to be monitored for seven years.

While the state of North Dakota has an E. coli bacteria standard (see Section 2.0), no E. coli data are available for the TMDL reaches.

Tables 7-10 provide a summary of fecal coliform bacteria geometric mean concentrations, the percentage of samples exceeding 400 CFU/100mL, and the recreational use assessment by month for the four TMDL listed waterbodies. The geometric mean fecal coliform bacteria concentration and the percent of samples over 400 CFU/100ml was calculated for each month (May-September) using those samples collected during each month in 2003-2007 and 2009.

Monitoring results at site 385043 indicate that assessment unit ID ND-10160002-001-S_00 is meeting the previous state standards for fecal coliform bacteria. Therefore, it is meeting all of its beneficial uses and will be presented for de-listing in the next Section 303(d) Impaired Waters listing cycle.

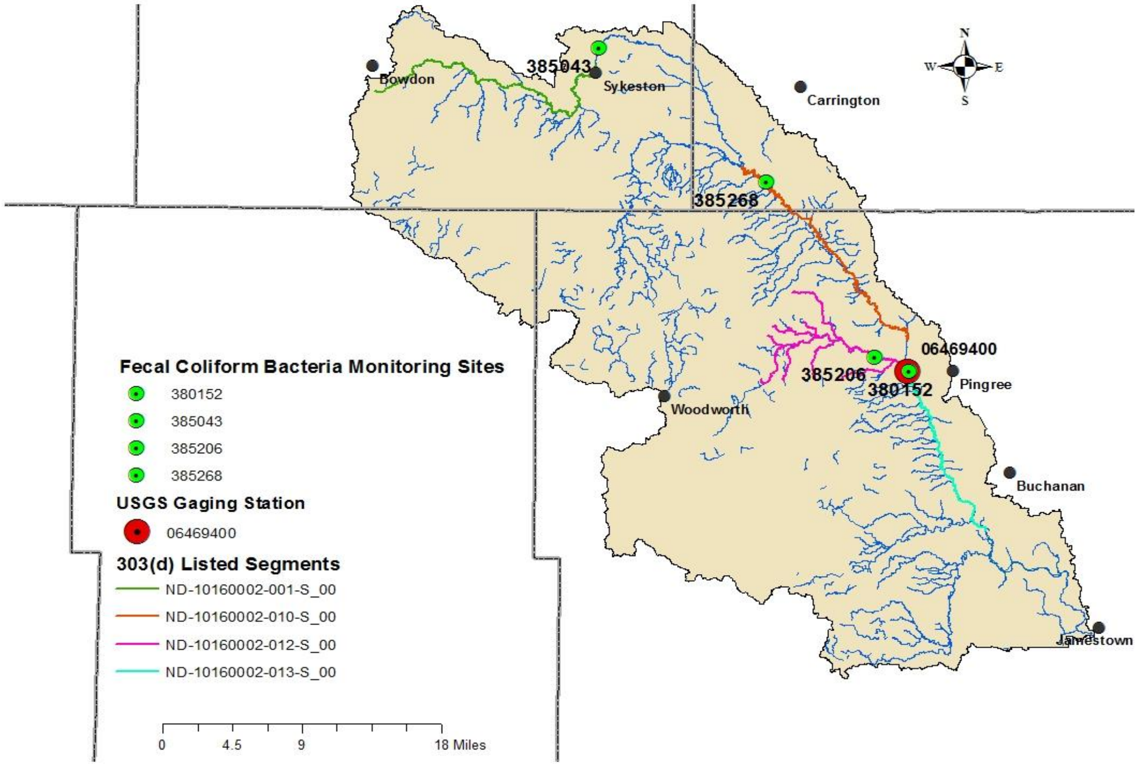

Figure 7. Fecal Coliform Bacteria Sample Sites on Pipestem Creek.

Table 7. Summary of Fecal Coliform Data for Site 385043 (Data Collected in 2003-2007 and 2009).

Month	N	Geometric Mean Concentration (CFU/100mL)	Percentage of Samples Exceeding 400 CFU/100mL	Recreational Use Assessment
May	31	12	0%	Fully Supporting
June	26	16	4%	Fully Supporting
July	20	17	5%	Fully Supporting
August	7	36	0%	Fully Supporting
September	5	11	0%	Fully Supporting

Table 8. Summary of Fecal Coliform Data for Site 385268 (Data Collected in 2003-2007 and 2009).

Month	N	Geometric Mean Concentration (CFU/100mL)	Percentage of Samples Exceeding 400 CFU/100mL	Recreational Use Assessment
May	29	86	10%	Fully Supporting, but Threatened
June	26	165	19%	Fully Supporting, but Threatened
July	22	173	18%	Fully Supporting, but Threatened
August	21	260	48%	Not Supporting
September	15	181	27%	Fully Supporting, but Threatened

Table 9. Summary of Fecal Coliform Data for Site 385206 (Data Collected in 2003-2007 and 2009).

Month	N	Geometric Mean Concentration (CFU/100mL)	Percentage of Samples Exceeding 400 CFU/100mL	Recreational Use Assessment
May	27	95	7%	Fully Supporting
June	25	150	12%	Fully Supporting, but Threatened
July	16	319	50%	Not Supporting
August	6	202	33%	Not Supporting
September	4	NA	NA	Insufficient Data

Table 10. Summary of Fecal Coliform Data for Site 380152 (Data Collected in 2003-2007 and 2009).

Month	N	Geometric Mean Concentration (CFU/100mL)	Percentage of Samples Exceeding 400 CFU/100mL	Recreational Use Assessment
May	33	29	6%	Fully Supporting
June	28	142	7%	Fully Supporting
July	20	313	50%	Not Supporting
August	21	80	10%	Fully Supporting
September	17	50	12%	Fully Supporting, but Threatened

Monthly sampling results for the remaining three TMDL listed waterbodies were often fully supporting or fully supporting, but threatened with at least one month of not supporting status (Tables 8-10).

1.5.2 Hydraulic Discharge

From 1974 to the present the stream stage and discharge of Pipestem Creek have been measured continuously by the U.S. Geological Survey (USGS) at a gauging station located near Pingree, ND (06469400) which is collocated with water quality site 380152 (Figure 7). The average annual discharge for this site for the period 1974-2009 is provided in Figure 8. The annual average discharge for the years 2003 to 2008 were below the 36 year average of 43.4 cubic feet per second (cfs), while the annual average discharge for 2009 was 172 cfs, the highest for the entire record (Figure 8). The high average annual discharge in 2009 and lower annual average discharges recorded from 2003 to 2008 are explained by precipitation (rain) and snowfall measurements collected during the project monitoring period.

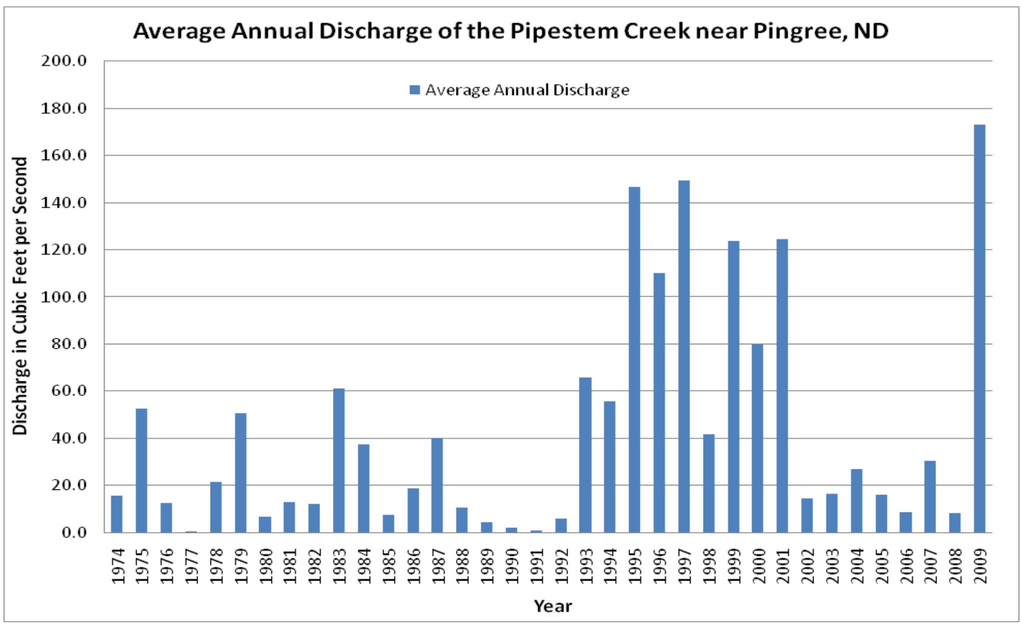

Figure 8. Average Annual Discharge of the Pipestem Creek USGS Station 06469400 near Pingree, ND

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 Assessment Unit ID 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 fecal coliform bacteria.

2.1 Narrative 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:
  (1) Cause a public health hazard or injury to environmental resources;
  (2) Impair existing or reasonable beneficial uses of the receiving water; or
  (3) 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 Water Quality Standards

The Pipestem Creek is a Class IA stream. The NDDoH definition of a Class IA stream is shown below (NDDoH, 2011).

Class IA- The quality of the waters in this class shall be the same as the quality of class I streams, except that where natural conditions exceed class I criteria for municipal and domestic use, the availability of softening or other treatment methods may be considered in determining whether ambient water quality meets the drinking water requirements of the department.

Effective January 2011, the Department revised the state water quality standards. In these latest revisions the Department eliminated the fecal coliform bacteria standard, retaining only the E. coli bacteria standard for the protection of recreational uses. This standards change was recommended by the US EPA as E. coli is believe to be a better indicator of recreational use risk (i.e., incidence of gastrointestinal disease).

Table 11 provides a summary of the current numeric E. coli criteria which applies to Class II and III streams as well as the former fecal coliform bacteria standard. The E. coli bacteria standard applies only during the recreation season from May 1 to September 30.

Table 11. North Dakota Bacteria Water Quality Standards for Class IA Streams.

Parameter	Standard	
	Geometric Mean[1]	Maximum[2]
*Fecal Coliform Bacteria**	*200 CFU/100 mL*	*400 CFU/100 mL*
E. coli Bacteria	126 CFU/100 mL	409 CFU/100 mL

* Previous State water quality standard.
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 implementation 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 a state's water quality standards. Since the E. coli bacteria water quality standard of 126 CFUs/100 mL is now the current applicable water quality standard for bacteria it is the primary TMDL target for the two Pipestem Creek impaired TMDL segments and the tributary segment. Even though it is no longer considered a numeric criterion in the water quality standards for North Dakota, the secondary TMDL target for these TMDL segments remains the fecal coliform bacteria standard of 200 CFUs/100 mL. In addition, no more than ten percent of the samples may exceed 409 CFUs/100 mL for E. coli or 400 CFUs/100 mL for fecal coliform bacteia. While the 126 CFUs/100 mL and 200 CFUs/100 mL E. coli and fecal coliform bacteria criterion are intended to be expressed as a 30-day geometric mean, for purposes of this TMDL, both are expressed as the daily average concentration based on a single grab sample. It is assumed that by expressing both the fecal coliform TMDL and the E. coli TMDL in this way will ensure the TMDLs will result in the target being met during all flow regimes, that both components of the criterion will be met, and that recreational uses will be restored.

As stated previously (see Section 1.5.1), there are currently no E. coli data available for the two listed TMDL reaches. Pipestem Creek reaches ND-10160002-010-S_00, ND-10160002-013-S_00 and unnamed tributary reach ND-10160002-012-S_00 were assessed as fully supporting, but threatened for recreational uses due to exceedences of the fecal coliform bacteria standard which was in effect at the time of the TMDL listing. For this reason, the fecal coliform standard will remain the secondary TMDL target, while the E.coli standard will be considered the primary TMDL target and TMDLs will be provided for both for the three TMDL segments which are the focus of this report.

4.0 SIGNIFICANT SOURCES

4.1 Point Source Pollution Sources

Within the watershed area of the three TMDL listed segments which are the focus of this report (ND-10160002-010-S_00, ND-10160002-013-S_00 and ND-10160002-012-S_00), there are fourteen (14) permitted animal feeding operations (AFOs) (Figure 9). The NDDoH has permitted eight (8) medium (301-999 AUs) AFOs and six (6) small ($\leq$ 300 AUs) to operate. All AFOs are zero discharge facilities and are not deemed a significant point source of fecal coliform or E. coli bacteria loadings to Pipestem Creek or its tributaries.

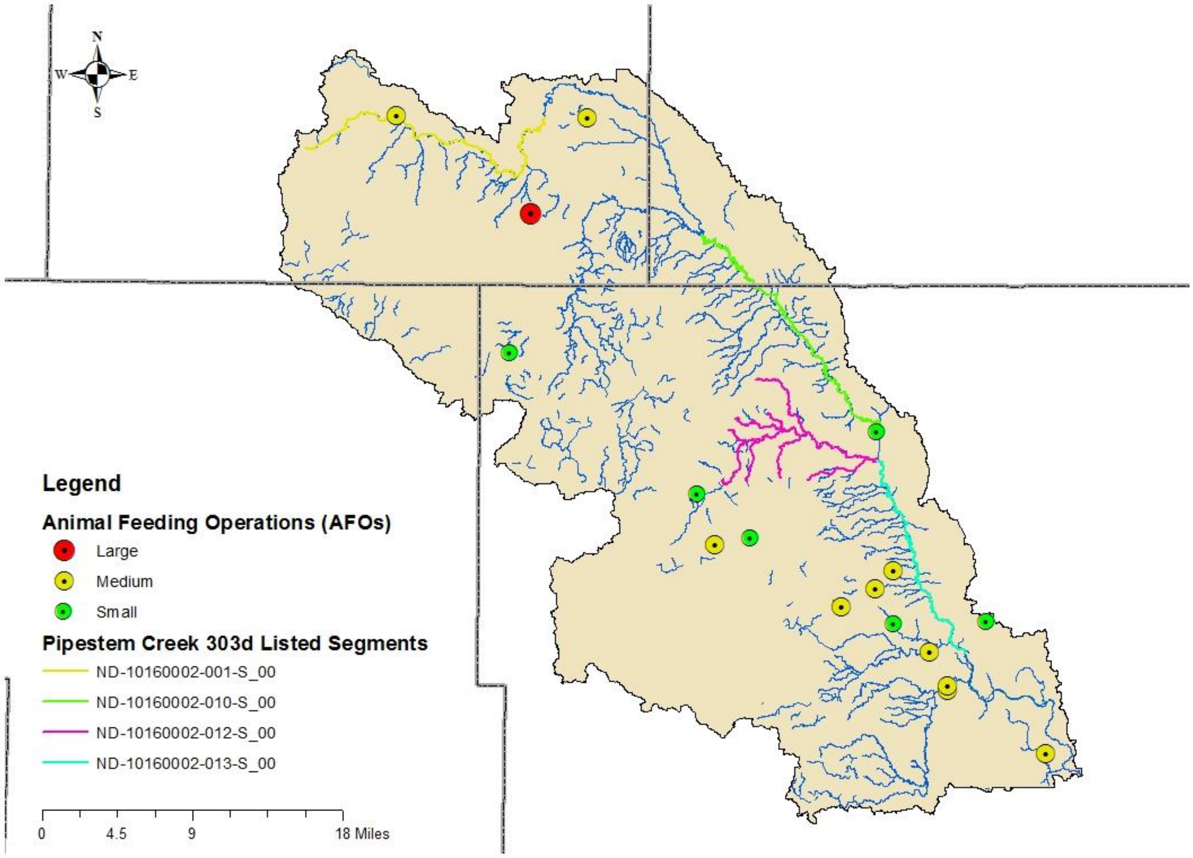

Figure 9. Permitted Animal Feeding Operations (AFOs) in the Pipestem Creek Watershed.

In the segment being presented for delisting (ND-10160002-001-S_00) there is a municipal point source located in Sykeston, ND. This facility is permitted through the North Dakota Pollutant Discharge Elimination System (NDPDES) Program. The Sykeston facility discharges infrequently for short periods of time (6-7 days) into Pipestem Creek and Lake Hiawatha. Discharges have been sampled since 1995 have never exceeded the 200 colonies/100ml water quality standard for fecal coliform bacteria (Table 12). This listed segment is being de-listed for the fecal coliform bacteria impairment, therefore the city of Sykeston will not be given a waste load allocation as part of any TMDL.

Table 12. Fecal Coliform Bacteria Results from City of Sykeston, ND Discharge Samples.

Date	Cell	Result – Fecal Coliform Bacteria
5/17/2004	Cell 3	10 CFU/100mL
4/14/2004	Cell 4	10 CFU/100mL
9/17/2001	Cell 4	130 CFU/100mL
4/14/1997	Cell 3	100 CFU/100mL
4/14/1997	Cell 4	100 CFU/100mL
5/2/1995	Cell 4	10 CFU/100mL

Additionally there is one large (1000 plus AUs) and two medium (301-999 AUs) AFOs in the watershed of assessment unit ID ND-10160002-001-S_00 that are permitted to operate. These AFOs are zero discharge facilities and are not deemed a significant point source of fecal coliform or E. coli bacteria loadings to that segment of Pipestem Creek.

4.2 Nonpoint Source Pollution Sources

The data collected during the water quality assessment (NDDoH, 2000) and subsequent water quality improvement project indicate that the primary nonpoint sources for fecal coliform bacteria, and presumably E. coli bacteria, in the Pipestem Creek watershed are as follows:

- Runoff of manure from cropland and pastureland;
- Runoff of manure from unpermitted animal feeding areas;
- Direct deposit of manure into Pipestem Creek by grazing livestock; and
- Background levels associated with wildlife.

Animal feeding areas within the Pipestem Creek watershed were identified as part of data collection effort for the assessment project (2000). The identified animal feeding areas contained almost exclusively beef or dairy cattle.

Septic system failure might also contribute to the fecal coliform and E. coli bacteria in Pipestem Creek. 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 (USEPA, 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. fecal coliform 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 total maximum daily load (TMDL) is the amount of a pollutant (e.g. E. coli or fecal coliform bacteria) a waterbody can receive and still meet and maintain water quality standards and beneficial uses. The following technical analysis addresses the fecal coliform bacteria reductions necessary to achieve the secondary water quality standard target for fecal coliform bacteria of 200 CFU/100 mL with a margin of safety.

5.1 Mean Daily Stream Flow

In central North Dakota, rain events are variable generally occurring during the months of April through August. Rain events can be sporadic and heavy or light, occurring over a short duration. Precipitation events of large magnitude, occurring at a faster rate than absorption, contribute to high runoff events. These events are represented by runoff in the high flow regime. The medium flow regime is represented by runoff that contributes to the stream over a longer duration. The low flow regime is characteristic of drought or precipitation events of small magnitude and do not contribute to runoff.

Mean daily flows for the period January 1974 through December 2009 were used in the development of the flow duration curve and load duration curve for site 380152, which represents assessment unit ID ND-10160002-013-S_00. These data were obtained from the collocated USGS gauge site located near Pingree, ND (06469400). For site 385268, which represents assessment unit ID ND-10160002-010-S_00, the mean daily flow record used in flow duration curve development and in the development of the load duration curve was synthesized using a regression relationship developed for the site. A simple linear regression relationship was developed for the site using the flows measured at site 385268 by the Stutsman County SCD during the watershed restoration project implementation sampling period (2003-2007) paired with the corresponding flow at the USGS site for the same day. Using the daily flow record for the USGS site as the dependent variable a corresponding daily flow was estimated for each site.

Flows used in the load duration curve for the remaining ungauged TMDL listed segment, assessment unit ID ND-10160002-013-S_00, were estimated using the Drainage-Area Ratio Method developed by the USGS (Ries et. al, 2000). The Drainage-Area Ratio Method assumes that the streamflow at an ungauged site is hydrologically similar (same per unit area) to the stream gauging station used as an index. This assumption is justified since the ungauged sites are nested within the same 8-digit HUC as the gauged site. Drainage area for the ungauged site and the index station (06469400) were determined through GIS using digital elevation models (DEMs). Streamflow data for the index station (06469400) was obtained from the USGS Water Science Center website. The index station (06469400) streamflow data were then divided by the drainage area to determine streamflows per unit area at the index station. Those values are then multiplied by the drainage area for the ungauged site to obtain estimated flow statistics for the ungauged site.

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 (USEPA, 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 10). 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 10, a flow duration interval of 8 percent, associated with a stream flow of 10 cfs, implies that 8 percent of all observed mean daily discharge values equal or exceed 10 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 (fecal coliform bacteria in this case) (USEPA, 2007). As depicted by the example in Figure 10, the flow duration curve was divided into four zones, one representing high flows (0-4 percent), another for moist conditions (4-37 percent), one for dry conditions (37-70 percent) and one for low flows (70-81 percent). Based on the flow duration curve analysis, no flow occurred 19 percent of the time.

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 8). A secondary factor in determining the flow intervals used in the analysis is the number of fecal coliform observations available for each flow interval. Flow duration curves for all three TMDL listed segments are provided in Appendix D.

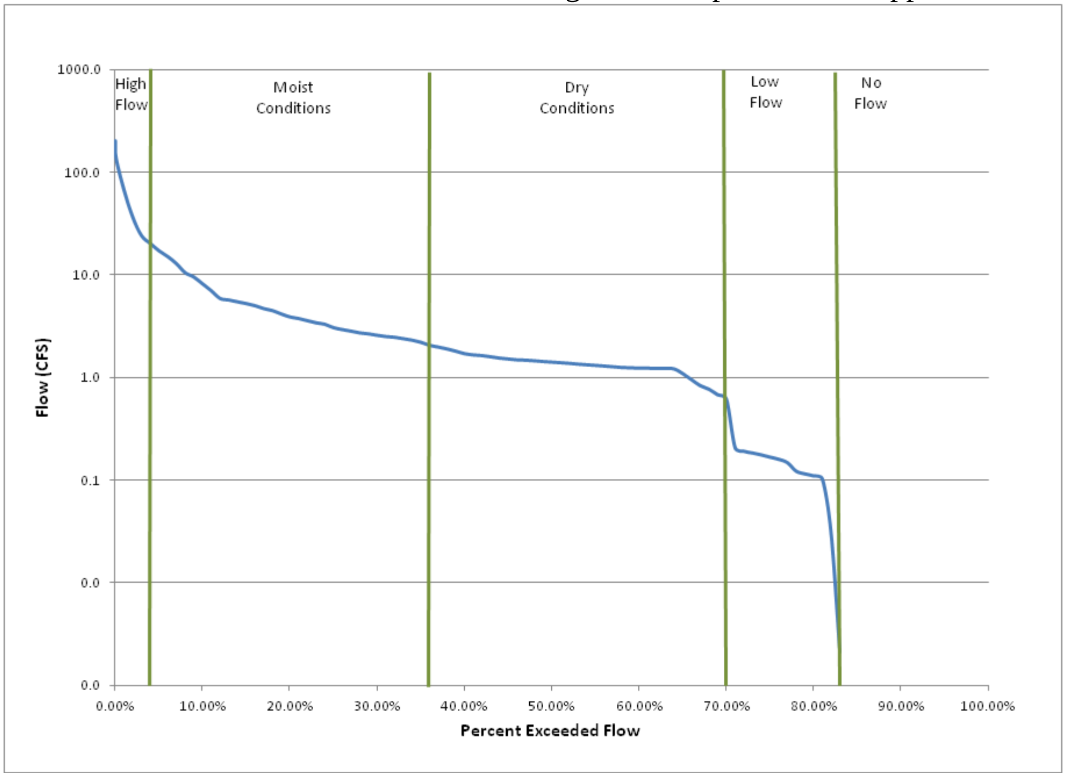

Figure 10. Flow Duration Curve for Pipestem Creek Monitoring Station 385206.

5.3 Load Duration 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 and the hydrology of the Section 303(d) TMDL listed segments, a load duration curve was developed for the listed segments of Pipestem Creek. The load duration curves were derived using the 200 CFU/100 mL previous State water quality standard and the flows generated as described in Sections 5.1 and 5.2. Additional load duration curves were also developed to comply with the current State water quality standard for E. coli bacteria of 126 CFU/100 mL.

Observed in-stream total fecal coliform bacteria data obtained from monitoring sites 380152, 385206, and 385268 (Appendix A) were converted to a pollutant load by multiplying total fecal coliform 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 (Figure 11). Points plotted above the 200 CFU/100 mL target curve exceed the previous State water quality target. Points plotted below the curve are meeting the previous State water quality target of 200 CFU/100 mL.

For each flow interval or zone, a regression relationship was developed between the samples which occur above the TMDL target (200 CFU/100 mL) curve and the corresponding percent exceeded flow. The load duration curve for site 385206, representing TMDL segment ND-10160002-012-S_00, depicting the regression relationship for each flow interval is provided in Figure 11 as an example. Fecal coliform and E. coli bacteria load duration curves for all TMDL listed segments are provided in Appendices C and D.

In the example below, the regression line for each flow interval was then used with the midpoint of the percent exceeded flow for that interval to calculate the existing total fecal coliform bacteria load for that flow interval. In the example provided in Figure 11, the regression relationship between observed fecal coliform bacteria loading and percent exceeded flow for the high flow interval (0-4 percent) is:

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

Where the midpoint of the high flow interval from 0 to 4 percent is 2.0 percent, the existing fecal coliform bacteria load is:

Fecal coliform bacteria load (10^7 CFUs/day) = antilog (5.17 + (-16.16*0.020))
= 145,802 x 10^7 CFUs/day

Where the midpoint of the moist condition interval from 8 to 37 percent is 22.5 percent, the existing fecal coliform bacteria load is:

Fecal coliform bacteria load (10^7 CFUs/day) = antilog (3.49 + (-0.96*0.225))
= 5,049 x 10^7 CFUs/day

Where the midpoint of the dry condition interval from 37 to 71 percent is 54 percent, the existing fecal coliform bacteria load is:

Fecal coliform bacteria load (10^7 CFUs/day) = antilog (3.46 + (-0.64*0.54))
= 1,297 x 10^7 CFUs/day

The midpoint for the flow intervals is also used to estimate the TMDL target load. In the case of the previous examples, the TMDL target load for the midpoints or 2.0, 22.5, and 54 percent exceeded flow derived from the 200 CFU/100 mL TMDL target curves are 32,969 x 10^7 CFUs/day, 1,704 x 10^7 CFUs/day, and 651 x 10^7 CFUs/day, respectively.

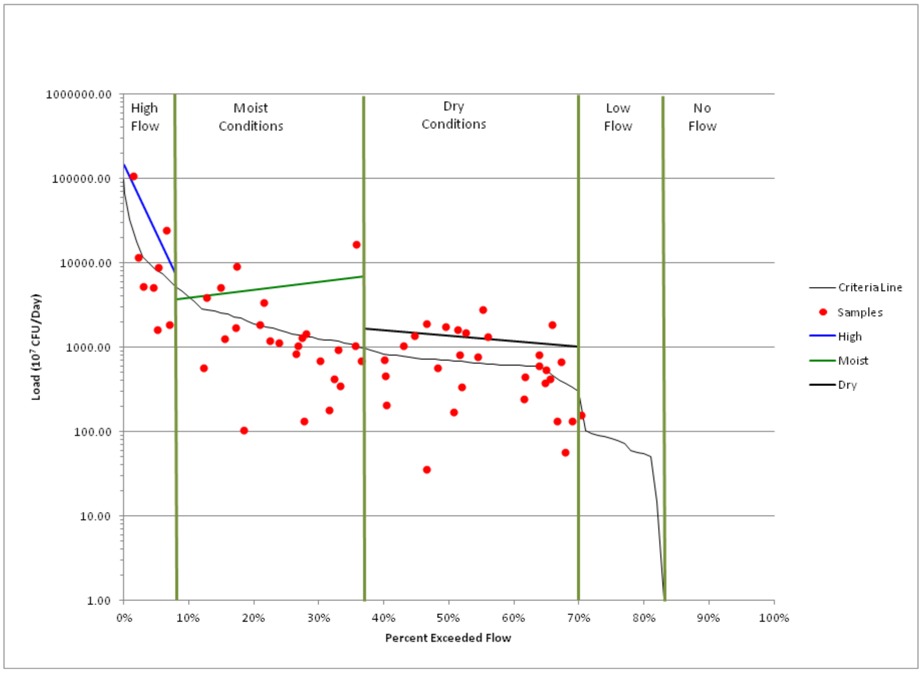

Figure 11. Fecal Coliform Bacteria Load Duration Curve for Assessment Unit ID ND-10160002-012-S_00, Sampling Station 385206.

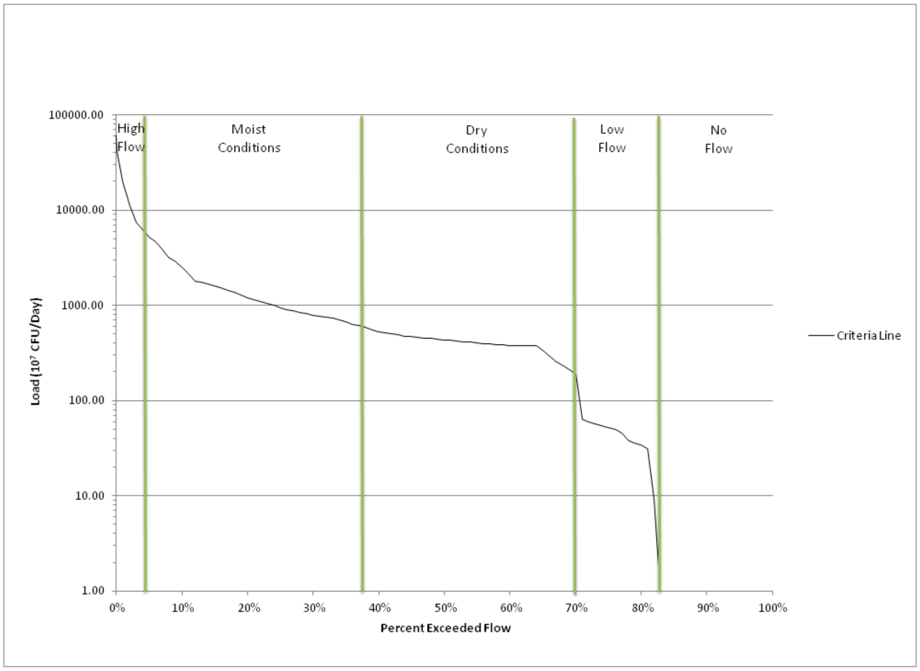

Figure 12. E. coli Bacteria Load Duration Curve for Assessment Unit ID ND-10160002-012-S_00, Sampling Station 385206.

5.4 Loading Sources

The load reductions needed for the Pipestem Creek fecal coliform bacteria TMDL can generally be allotted to nonpoint sources. Based on the data available, the general focus of BMPs and load reductions for the listed Assessment Unit ID should be on unpermitted animal feeding operations and riparian grazing adjacent to or in close proximity to the Pipestem Creek.

Significant sources of total fecal coliform 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 Flow, Moist Conditions, Dry Conditions and Low Flow) were selected to represent the hydrology of the listed segment on the Pipestem Creek when applicable (Figure 10). As previously described, four flow regimes ((i.e., high flow, moist conditions, dry conditions, and low flow) were selected to represent the hydrology of the listed segments when applicable.

By relating runoff characteristics to each flow regime one can infer which sources are most likely to contribute to fecal coliform loading. Animals grazing in the riparian area contribute fecal coliform bacteria by depositing manure where it has an immediate impact on water quality. Due to the close proximity of manure to the stream or by direct deposition in the stream, riparian grazing impacts water quality at high flow or under moist and dry conditions (Table 13). 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 (Table 13). 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 total fecal coliform bacteria contamination.

Table 13. 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 200 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 200 CFU/100 mL standard and the curve using the 180 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 Pipestem Creek TMDL addresses seasonality because the flow duration curve was developed using 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 fecal coliform bacteria loads during the seasons covered by the standard.

7.0 TMDLs

Table 14 provides an outline of the critical elements for the fecal coliform bacteria TMDL for Pipestem Creek and its tributary. The TMDLs for Pipestem Creek (ND-10160002-010-S_00 and ND-10160002-012-S_00) and its unnamed tributary (ND-10160002-013-S_00) are presented in Tables 15-20. Load duration curves on which these TMDLs are based can be found in Appendix E. The TMDL summary provides an estimate of the existing daily load, an estimate of the average daily loads necessary to meet the primary E. coli water quality target and the secondary fecal coliform bacteria target (i.e. TMDL load). These TMDL loads include a load allocation from known nonpoint sources and a ten 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 14. TMDL Summary for Pipestem Creek.

Category	Description	Explanation
Beneficial Use Impaired	Recreation	Contact Recreation (i.e. swimming, fishing)
Pollutant	Fecal Coliform Bacteria E. coli Bacteria	See Section 2.1
Secondary Fecal Coliform Bacteria TMDL Target	200 CFU/100 mL	Based on the former state water quality standard for fecal coliform bacteria.
Primary E. coli Bacteria TMDL Target	126 CFU/100 mL	Based on the current state water quality standard for E. coli bacteria of 126 CFU/100 mL.
WLA	Point Source Contributions	There are no contributing point sources in the TMDL watersheds.
LA	Nonpoint Source Contributions	Loads are a result of nonpoint sources (i.e., rangeland, pasture land, etc.)
Margin of Safety (MOS)	Explicit	10 percent

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

TMDL = LC = WLA + LA + MOS, where

LC = loading capacity, or the greatest loading a Assessment Unit ID 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 15. Fecal Coliform Bacteria TMDL (10^7 CFU/day) for Pipestem Creek Assessment Unit ID ND-10160002-012-S_00 as Represented by Site 385206 (Based on Previous State Water Quality Standards).

	Flow Regime			
	High Flow	**Moist Conditions**	**Dry Conditions**	**Low Flow**
Existing Load	32,969	5,049	1,297	
TMDL	9,822	1,704	651	78[1]
WLA	0	0	0	
LA	8,840	1,534	586	
MOS	982	170	65	

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

Table 16. E. coli Bacteria TMDL (10^7 CFU/day) Based on New State Water Quality Standards for Pipestem Creek Assessment Unit ID ND-10160002-012-S_00.

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
TMDL	6,195	1,609	409	49
WLA	0	0	0	0
LA	5,576	1,449	379	45
MOS	619	160	40	4

Table 17. Fecal Coliform Bacteria TMDL (10^7 CFU/day) for Pipestem Creek Assessment Unit ID ND-10160002-010-S_00 as Represented by Site 380152 (Based on Previous State Water Quality Standards).

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
Existing Load		38,384	6,095	
TMDL	196,295[1]	15,660	1,123	54[1]
WLA		0	0	
LA		14,004	1011	
MOS		1,556	112	

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

Table 18. E. coli Bacteria TMDL (10^7 CFU/day) Based on New State Water Quality Standards for Pipestem Creek Assessment Unit ID ND-10160002-010-S_00.

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
TMDL	138,591	9,558	740	29
WLA	0	0	0	0
LA	124,732	8,603	666	27
MOS	13,859	955	74	2

Table 19. Fecal Coliform Bacteria TMDL (10^7 CFU/day) for Pipestem Creek Assessment Unit ID ND-10160002-013-S_00 as Represented by Site 385268 (Based on Previous State Water Quality Standards).

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
Existing Load		27,337	3,219	
TMDL	167,431[1]	15,703	1,245	60[1]
WLA		0	0	
LA		14,133	1,121	
MOS		1,570	124	

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

Table 20. E. coli Bacteria TMDL (10^7 CFU/day) Based on New State Water Quality Standards for Pipestem Creek Assessment Unit ID ND-10160002-013-S_00.

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
TMDL	164,022	9,893	751	38
WLA	0	0	0	0
LA	147,620	8,904	676	35
MOS	16402	989	75	3

8.0 ALLOCATION

There are no known point sources impacting the 303(d) listed segments in the watershed. Therefore the entire total fecal coliform bacteria load for this TMDL was allocated to nonpoint sources in the watersheds. 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, waste management). 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 best management practices through non-regulatory approaches. "Best management practices" (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," (USEPA, 2001). This TMDL plan is put forth as a recommendation for what needs to be accomplished for the Pipestem Creek and 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.

Table 21. Management Practices and Flow Regimes Affected by Implementation of BMPs.

Management Practice	Flow Regime and Expected Reduction		
	High Flow-70%	Moderate Flow-80%	Low Flow-74%
Livestock Exclusion From Riparian Area	X	X	X
Water Well and Tank Development	X	X	X
Prescribed Grazing	X	X	X
Waste Management System	X	X	
Vegetative Filter Strip		X	
Septic System Repair		X	X

Nonpoint source pollution is the sole contributor to elevated total fecal coliform bacteria levels in the Pipestem Creek watershed. The fecal coliform bacteria samples and load duration curve analysis of the impaired reaches identified the flow regimes that fecal coliform exceedences for the 200 CFU/100 mL target occurred. To reduce NPS pollution specific BMPs are described in Section 8.1 that will mitigate the effects of total fecal coliform bacteria loading to the impaired reaches.

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 total fecal coliform bacteria loading to Pipestem

Creek. The following describe in detail those BMPs that will reduce total fecal coliform bacteria levels in Pipestem Creek.

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 fecal coliform bacteria loading to surface water. Precipitation, plant cover, number of animals, and soils are factors that affect the amount of bacteria delivered to a Assessment Unit ID because of livestock. These specific BMPs are known to reduce nonpoint source pollution from livestock. These BMPs include:

<u>Livestock exclusion from riparian areas</u>- 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.

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

<u>Prescribed grazing</u>- 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 USEPA (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 22) 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 22. Bacterial Water Quality Response to Four Grazing Strategies (Tiedemann et al., 1988).

Grazing Strategy		Geometric Mean Fecal Coliform 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 fecal coliform bacteria loading originating from confined animal feeding areas (Table 23). 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 23. 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 Coliform (%)
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, waste treatment lagoons.

8.2 Other Recommendations

Vegetative filter strip- Vegetated 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 to streams. The effectiveness of filter strips and other BMPs in removing fecal coliform bacteria is quite successful. Results from a study by Pennsylvania State University (1992a) as presented by USEPA (1993) (Table 10), suggest that vegetative filter strips are capable of removing up to 55 percent of fecal coliform loading to rivers and streams (Table 23). 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 coliform 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 (USEPA, 2002).

9.0 PUBLIC PARTICIPATION

To satisfy the public participation requirement of this TMDL, a hard copy of the TMDL for Pipestem Creek and a request for comment was mailed to participating agencies, partners, and to those who request a copy. Those included in the mailing of a hard copy were as follows:

- Foster, Kidder, Stutsman, and Wells County Soil Conservation Districts;
- Foster, Kidder, Stutsman, Wells County Water Resource Boards;
- Natural Resource Conservation Service (State Office); and
- U.S. Environmental Protection Agency, Region VIII

In addition to mailing copies of this TMDL for Pipestem Creek to interested parties, the TMDL 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 wasl also published in the Jamestown Sun (Stutsman County), Steele Ozone and Kidder County Press (Kidder County), Foster County Independent (Foster County), and Herald-Press (Wells County).

As part of the public comment period and at the request of the Stutsman County Soil Conservation District (SCD), Mike Ell (Program Manager for the Surface Water Quality

Management Program, Division of Water Quality) met with the SCD during their monthly SCD board meeting on September 13, 2011. The SCD board had some general questions regarding the TMDL report, but no specific comments. The questions asked by the SCD board and the Department's response are provided in Appendix E.

In addition to the questions posed by the Stutsman County SCD, comments were received from US EPA Region 8, which were provided as part of their normal public notice review (Appendix F). The NDDoH's response to these comments is provided in Appendix G.

10.0 MONITORING

As stated previously, 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.

To insure that the best management practices (BMPs) and technical assistance that were implemented as part of the Section 319 Pipestem Creek Watershed Restoration Project were successful in reducing both fecal coliform and E. coli bacteria loadings to levels prescribed in this TMDL, post-project water quality monitoring will be conducted in accordance with an approved Quality Assurance Project Plan. While the Section 319 project ended in 2009, post-project implementation monitoring will continue through 2013 and will include monitoring for both fecal coliform and E. coli bacteria.

11.0 TMDL IMPLEMENTATION STRATEGY

In response to the 2003 Pipestem Creek Watershed Assessment, local sponsors successfully applied for and received Section 319 funding for the Pipestem Creek Watershed Project. Beginning in 2005, local sponsors provided technical assistance and implemented BMPs designed to reduce fecal coliform bacteria loadings and to help restore the beneficial uses of Pipestem Creek (i.e., recreation). A QAPP (NDDoH, 2002) was developed as part of this watershed restoration project that detailed the how, when and where monitoring would be conducted to gather the data needed to document success in meeting the project implementation goal(s). As the data were gathered and analyzed, watershed restoration tasks were adapted, if necessary, to place BMPs where they would have the greatest benefit to water quality and in meeting the project's water quality goal(s).

Also, as part of the watershed project implementation plan, it was recommended that the permitted point sources (i.e., 10 AFO/CAFOs) in the watershed be inspected to ensure that they are being operated in compliance with their permit conditions, and to verify that they aren't significant fecal coliform sources. Currently, all permitted CAFOs (greater than or equal to 1000 animal units) are inspected annually by the NDDoH. Permitted AFOs (<1000 animal units) in the Pipestem Creek watershed are inspected on an as needed basis.

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Appendix A
Fecal Coliform Bacteria Data Collected
2003–2007 and 2009

Fecal Coliform Bacteria Data

2000	Date	385043 Lake Hiawatha Outlet Near Sykeston	385041 Pipestem Creek SW Of Carrington	385268 Pipestem Creek NW Of Melville	385269 Little Pipestem Creek SW Of Carrington	385206 Unnamed Trib to Pipestem Creek NW Of Pingree	380152 Pipestem Creek - W Of Pingree
	20-Mar-00	10	10				10
	23-Mar-00	10	10				20
	27-Mar-00	10	10				30
	29-Mar-00	10	10				10
	03-Apr-00	10	10				50
	06-Apr-00	10	10				10
	10-Apr-00	10	10				10
	13-Apr-00	10	10				10
	17-Apr-00	10	10				10
	19-Apr-00	10	10				10
	24-Apr-00	10	20				10
	01-May-00	10	30				10
	08-May-00	20	200				40
	07-Jun-00		30				200
	15-Jun-00	800	800				330
	12-Jul-00	800	280				520
	15-Aug-00	40	10				30
	17-Aug-00						
	17-Aug-00						
	26-Sep-00	10	10				140
(05/01-09/30) Geometric Mean		61	63	#NUM!	#NUM!	#NUM!	92
Count Total		6	7	0	0	0	7
Count >400		2	1	0	0	0	1
Percentage >400		33%	14%	#DIV/0!	#DIV/0!	#DIV/0!	14%

2003	Date	385043 - Lake Hiawatha Outlet Near Sykeston	385041 - Pipestem Creek SW Of Carrington	385268 - Pipestem Creek NW Of Melville	385269 - Little Pipestem Creek SW Of Carrington	385206 - Unnamed Trib to Pipestem Creek NW Of Pingree	380152 - Pipestem Creek - W Of Pingree
	01-May-03	10	10	20	10		10
	05-May-03	10	40	350	330		10
	07-May-03	10	30	60	50	400	10
	13-May-03	10	40	10	20	60	40
	15-May-03	30	20	30	20	150	50
	19-May-03	10	60	220	40	280	180
	22-May-03	10	40	60	60	150	10
	28-May-03	10	160	350	80	70	30
	03-Jun-03	220	260	380	10	420	60
	12-Jun-03		800	800	80	370	150
	19-Jun-03	10	800	540	60	100	200
	01-Jul-03	20	800	890	100	240	280
	08-Jul-03	10	800	200	80		400
	14-Jul-03	10	220	340	40		170
	23-Jul-03	10	140	100	60	880	800
	28-Jul-03	10	790	130	390		270
	05-Aug-03	10	170	800	800		30
	13-Aug-03		50	620			130
(05/01-09/30) Geometric Mean		14	128	179	63	210	73
Count Total		16	18	18	17	11	18
Count >400		0	5	5	1	2	1
Percentage >400		0%	28%	28%	6%	18%	6%

2004	Date	385043 - Lake Hiawatha Outlet Near Sykeston	385041 - Pipestem Creek SW Of Carrington	385268 - Pipestem Creek NW Of Melville	385269 - Little Pipestem Creek SW Of Carrington	385206 - Unnamed Trib to Pipestem Creek NW Of Pingree	380152 - Pipestem Creek - W Of Pingree
	03-May-04	10	40	80	10	120	10
	10-May-04	10	90	300	30	140	10
	19-May-04	10	440	340	10	50	20
	25-May-04	10	100	250	60	240	190
	02-Jun-04	10	70	100	20	270	330
	09-Jun-04	10	50	70	20	200	150
	16-Jun-04	10	60	10	40	80	120
	22-Jun-04	10	130	160	40	220	120
	29-Jun-04	20	330	140	70	160	140
	06-Jul-04	20	1040	60	160	470	580
	14-Jul-04	10	530	90	60	200	1100
	21-Jul-04	20	840	110	360	510	430
	27-Jul-04	10	660	800	250	440	370
	04-Aug-04			210	120		60
	11-Aug-04			140			130
	18-Aug-04						60
	24-Aug-04			800			800
	26-Aug-04			500		800	440
	31-Aug-04			110		200	10
	08-Sep-04			50		170	40
	13-Sep-04			260		530	50
	20-Sep-04			220		190	40
	27-Sep-04			90	690	380	250

(05/01-09/30) Geometric Mean	12	191	147	61	229	112
Count Total	13	13	22	15	19	23
Count >400	0	5	3	1	5	5
Percentage >400	0%	38%	14%	7%	26%	22%

2005	Date	385043 - Lake Hiawatha Outlet Near Sykeston	385041 - Pipestem Creek SW Of Carrington	385268 - Pipestem Creek NW Of Melville	385269 - Little Pipestem Creek SW Of Carrington	385206 - Unnamed Trib to Pipestem Creek NW Of Pingree	380152 - Pipestem Creek - W Of Pingree
	02-May-05	5	5	5	5	5	5
	05-May-05	5	5	10	5	50	5
	09-May-05	5	20		700	150	40
	12-May-05	5	10	40	60	90	30
	16-May-05	5	10	5	10	5	5
	23-May-05	10	40	40	10	20	70
	01-Jun-05	20	340	220	100	160	210
	08-Jun-05	60	200			140	
	15-Jun-05	5	80	120	20	60	540
	22-Jun-05	10	990	160	50	30	110
	30-Jun-05	10	10	190	90	130	50
	06-Jul-05	5	50	110	190	140	
	13-Jul-05	5	20	160	200	140	
	21-Jul-05	10	40	50	30	80	
	28-Jul-05	5	30	220	30	70	20
	02-Aug-05	40					80
	08-Aug-05			610			30
	16-Aug-05						40
	23-Aug-05						20
	31-Aug-05						100
	07-Sep-05			430			5
	15-Sep-05			10			10
	21-Sep-05						30
	27-Sep-05						10
(05/01-09/30) Geometric Mean		9	35	67	41	57	30
Count Total		16	15	16	14	15	20
Count >400		0	1	2	1	0	1
Percentage >400		0%	7%	13%	7%	0%	5%

2006	Date	385043 - Lake Hiawatha Outlet Near Sykeston	385041 - Pipestem Creek SW Of Carrington	385268 - Pipestem Creek NW Of Melville	385269 - Little Pipestem Creek SW Of Carrington	385206 - Unnamed Trib to Pipestem Creek NW Of Pingree	380152 - Pipestem Creek - W Of Pingree
	02-May-06	5	20	170	80	870	10
	09-May-06	5	60	800	10	330	10
	16-May-06	5	30	240	20	110	5
	24-May-06		100	770	20	150	100
	01-Jun-06	5	550	250	80	3200	100
	05-Jun-06	5	130	130	60	170	160
	22-Jun-06	10	440	320	60	720	210
	29-Jun-06	5			160		320
	05-Jul-06		4000	130			2800
	12-Jul-06						
(05/01-09/30) Geometric Mean		6	161	276	44	407	81
Count Total		7	8	8	8	7	9
Count >400		0	3	2	0	3	1
Percentage >400		0%	38%	25%	0%	43%	11%

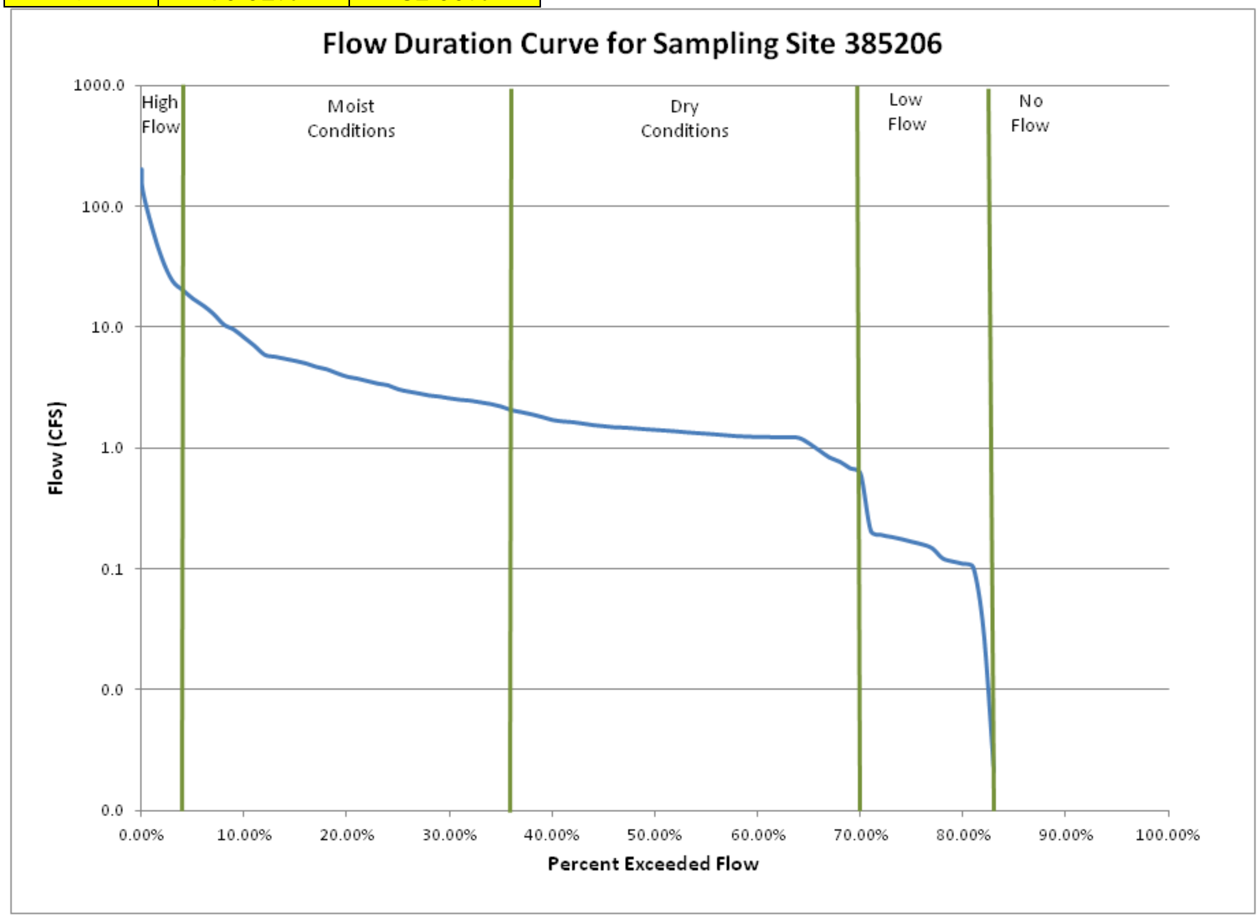
2007	Date	385043 - Lake Hiawatha Outlet Near Sykeston	385041 - Pipestem Creek SW Of Carrington	385268 - Pipestem Creek NW Of Melville	385269 - Little Pipestem Creek SW Of Carrington	385206 - Unnamed Trib to Pipestem Creek NW Of Pingree	380152 - Pipestem Creek - W Of Pingree
	02-May-07	5	5	30	5	40	30
	09-May-07	10	110	160	10	220	70
	16-May-07	170	30	30	20	110	10
	21-May-07			40	80	40	6400
	30-May-07	10	30	210	60	200	780
	05-Jun-07	10	100	20	10	30	190
	12-Jun-07	5	120	120	30	60	110
	21-Jun-07	40	100	90	170	100	70
	27-Jun-07	5	140	210	10	110	360
	11-Jul-07	5	220	120		270	740
	16-Jul-07	30		120	870		30
	24-Jul-07			190			290
	01-Aug-07			120		60	170
	07-Aug-07	80	430	510	310	110	150
	14-Aug-07	110	40	210	190	80	240
	21-Aug-07	30	130	140	530		
	29-Aug-07	20	150	240			
	04-Sep-07	20	50	140			370
	11-Sep-07	10	70	100			130
	18-Sep-07	5	40	250			420
	26-Sep-07	10	10	510			500
(05/01-09/30) Geometric Mean		16	66	125	57	89	191
Count Total		18	17	21	13	13	19
Count >400		0	1	2	2	0	5
Percentage >400		0%	6%	10%	15%	0%	26%

2009	Date	385043 - Lake Hiawatha Outlet Near Sykeston	385041 - Pipestem Creek SW Of Carrington	385268 - Pipestem Creek NW Of Melville	385269 - Little Pipestem Creek SW Of Carrington	385206 - Unnamed Trib to Pipestem Creek NW Of Pingree	380152 - Pipestem Creek - W Of Pingree
	5/4/09	10					10
	5/11/09	10					30
	5/18/09	10	50	20	20	20	10
	5/27/09	10	80	40	40	130	30
	6/1/09	10	60	40	90	150	10
	6/10/09	20	70	170	40	70	30
	6/17/09	10	250	140	100	130	100
	6/23/09	10	800	160	230	90	130
	6/30/09	10	120	510	100	200	130
	7/7/09	30	110	800	240	800	780
	7/13/09	10	210	250	100	740	240
	7/22/09	20	100	30	90	230	70
	7/27/09	30	110	140	30		100
	8/4/09		20	120			30
	8/11/09		50	30			80
	8/17/09		70	40			240
	8/25/09		80	50			80
	9/1/09		60	120			20
	9/9/09		30	860			40
	9/16/09			190			10
	9/23/09			230			10
(05/01-09/30) Geometric Mean		13	87	116	75	156	48
Count Total		13	17	19	11	10	21
Count >400		0	1	3	0	2	1
Percentage >400		0%	6%	16%	0%	20%	5%

Appendix B
Flow Regimes and Flow Duration Curves for Sites 385206, and 380152, and 385268

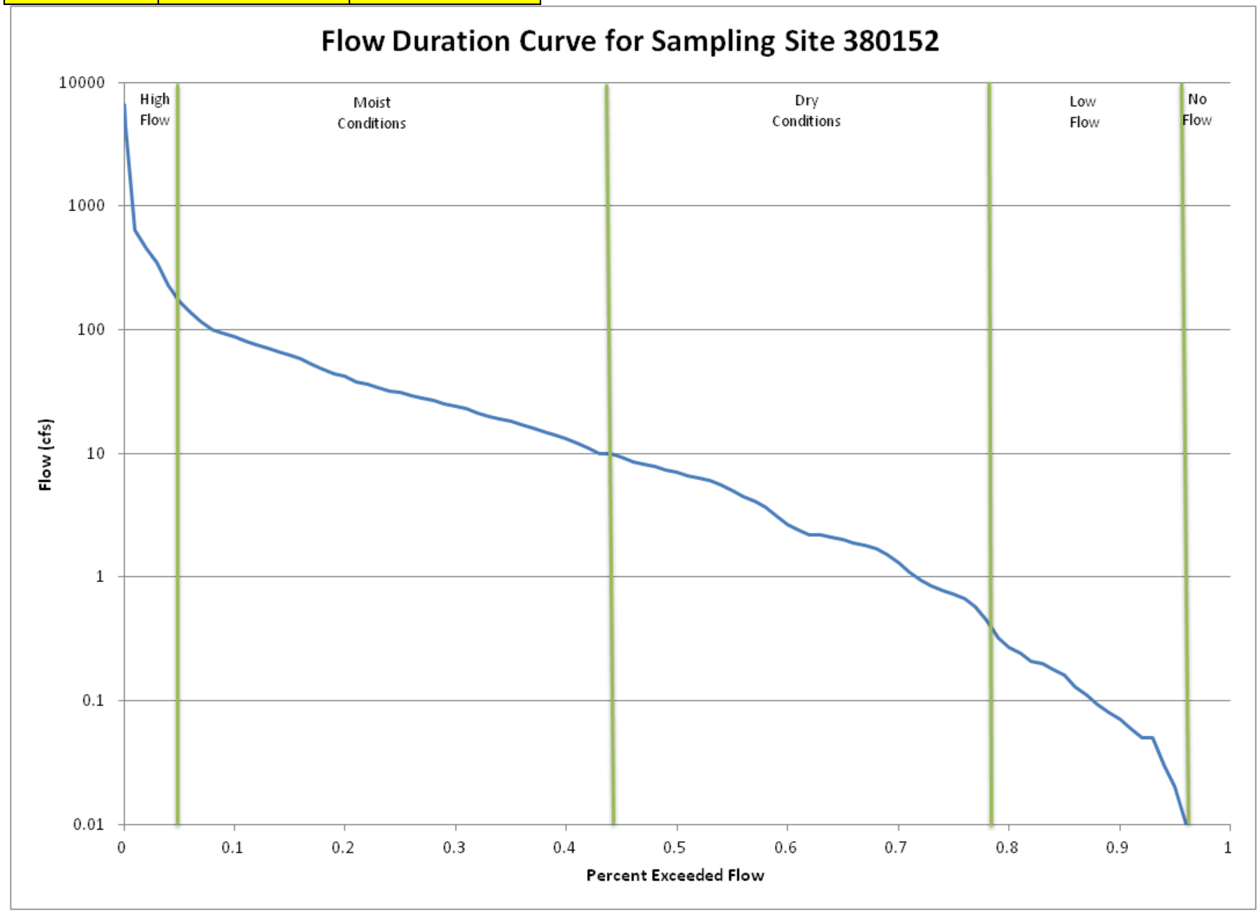
385206

Flow Regimes		
Name	**Start**	**End**
High	0.01%	8.00%
Moist	8.01%	37.00%
Dry	37.01%	70.00%
Low	70.01%	81.00%



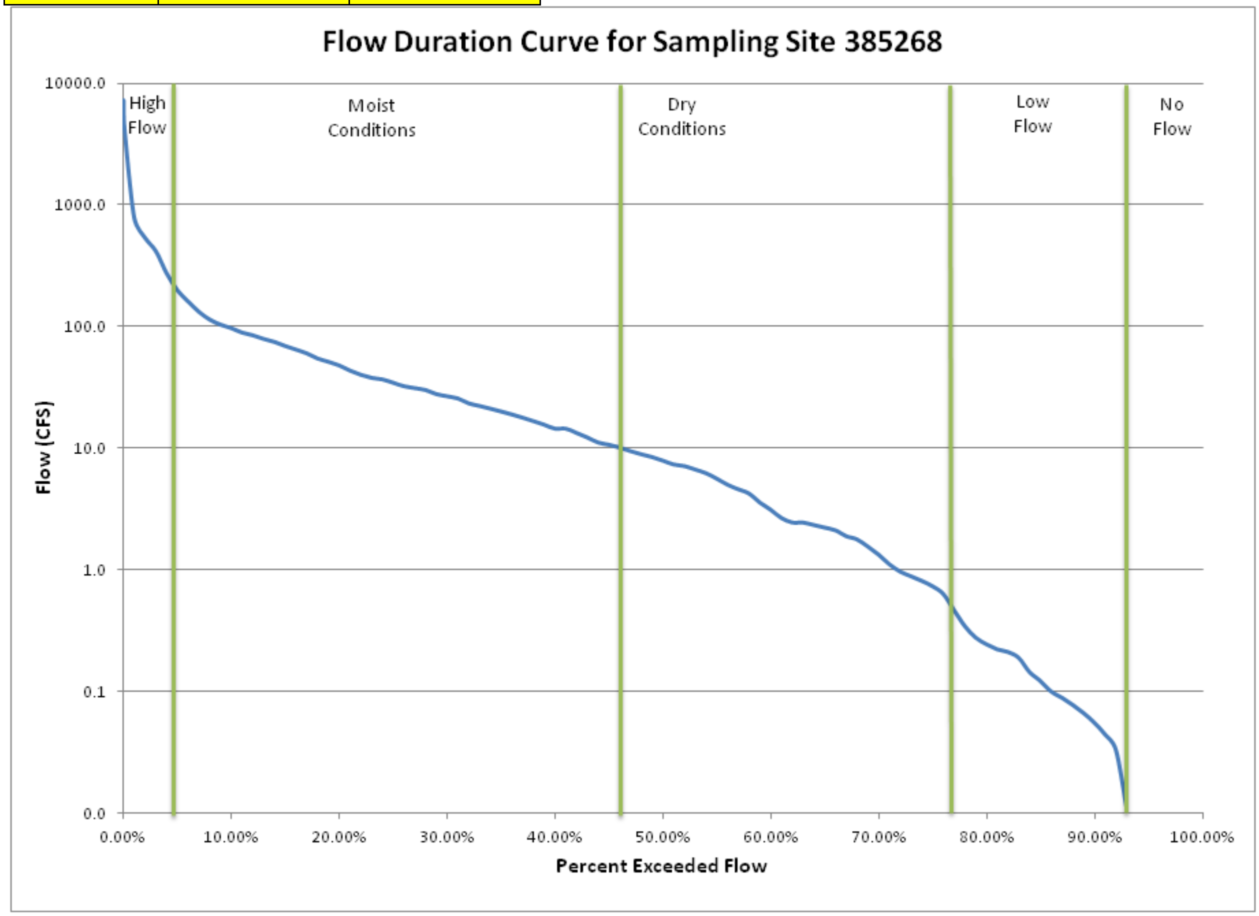
380152

Flow Regimes		
Name	**Start**	**End**
High	0.01%	5.00%
Moist	5.01%	43.00%
Dry	43.01%	78.00%
Low	78.01%	96.00%



385268

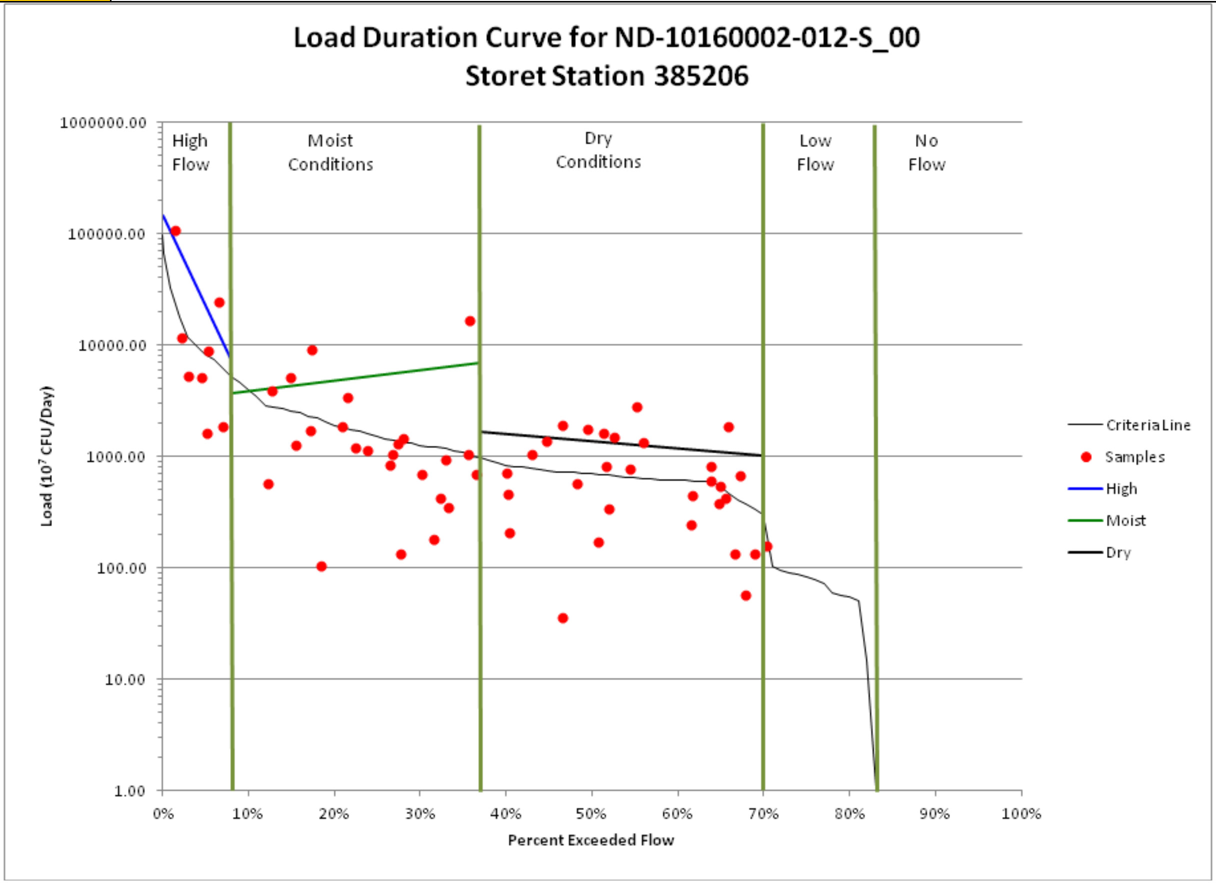
Flow Regimes		
Name	**Start**	**End**
High	0.01%	5.00%
Moist	5.01%	46.00%
Dry	46.01%	77.00%
Low	77.01%	93.00%



Appendix C
Load Duration Curve, Estimated Loads, TMDL Targets, and Percentage of Reduction Required for Sites 385206, 380152 and 385268

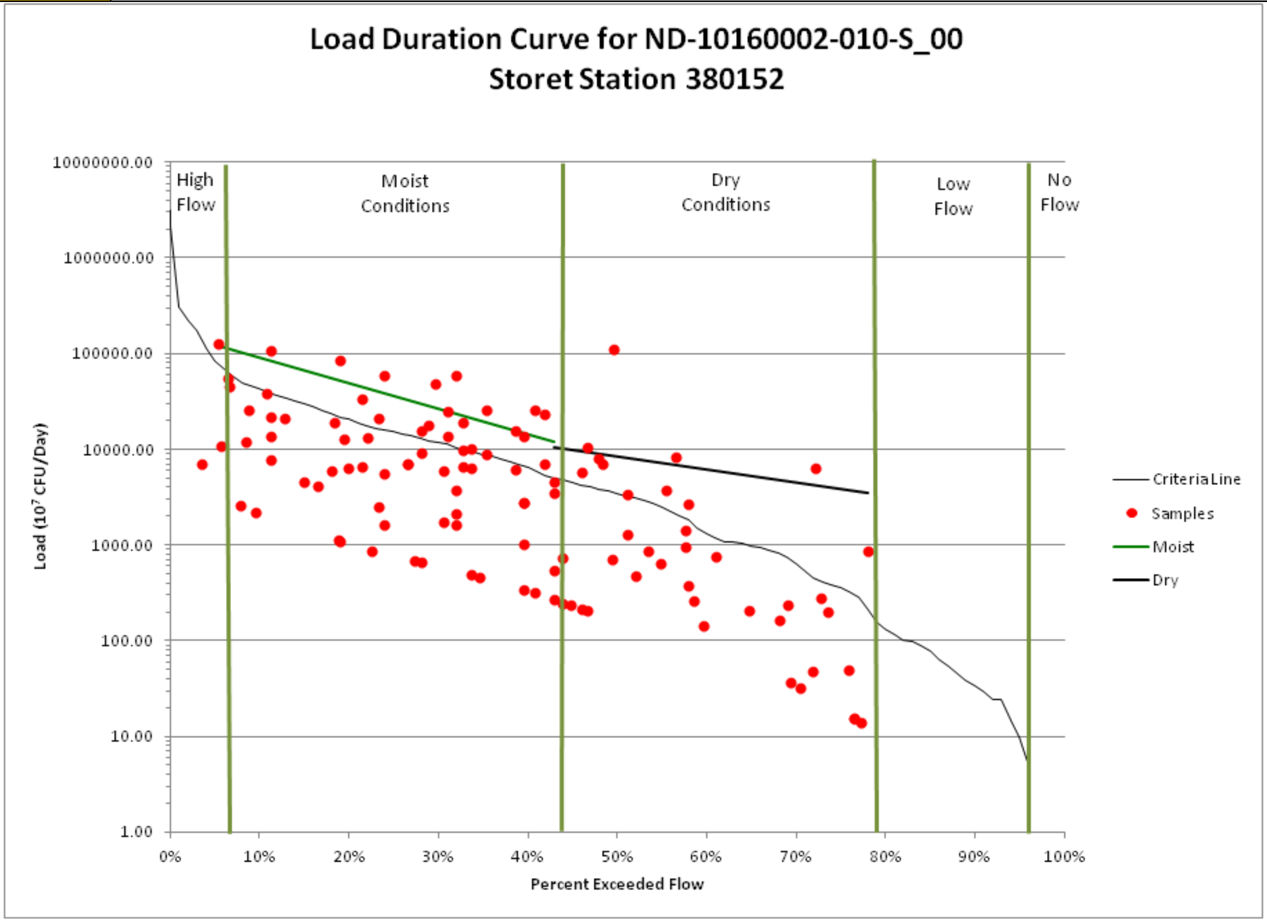
Assessment Unit ID ND-10160002-012-S_00
Storet Station 385206

	Load (10^7 CFUs/Day)				Load (10^7 CFUs/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
High	4.01%	32969.48	9822.13	29.16	961505.44	286447.72	70.21%
Moist	22.51%	5049.41	1703.85	105.81	534296.12	180290.61	66.26%
Dry	53.51%	1296.51	650.88	120.41	156117.88	78374.15	49.80%



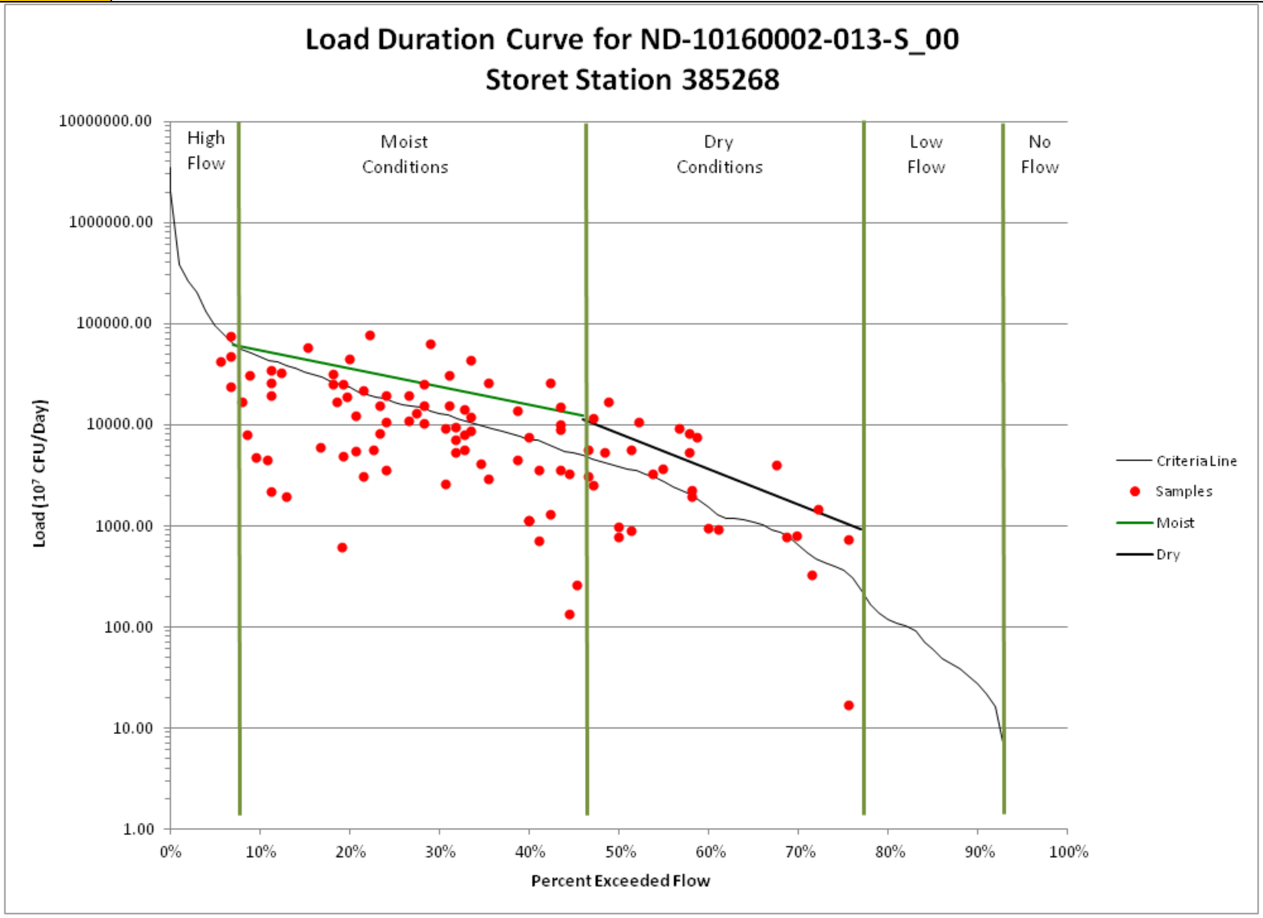
Assessment Unit ID ND-10160002-010-S_00
Storet Station 380152

	Load (10^7 CFUs/Day)				Load (10^7 CFUs/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
Moist	24.01%	38383.53	15660.15	138.66			
Dry	60.51%	6095.95	1223.45	127.71	778535.64	156251.00	79.93%

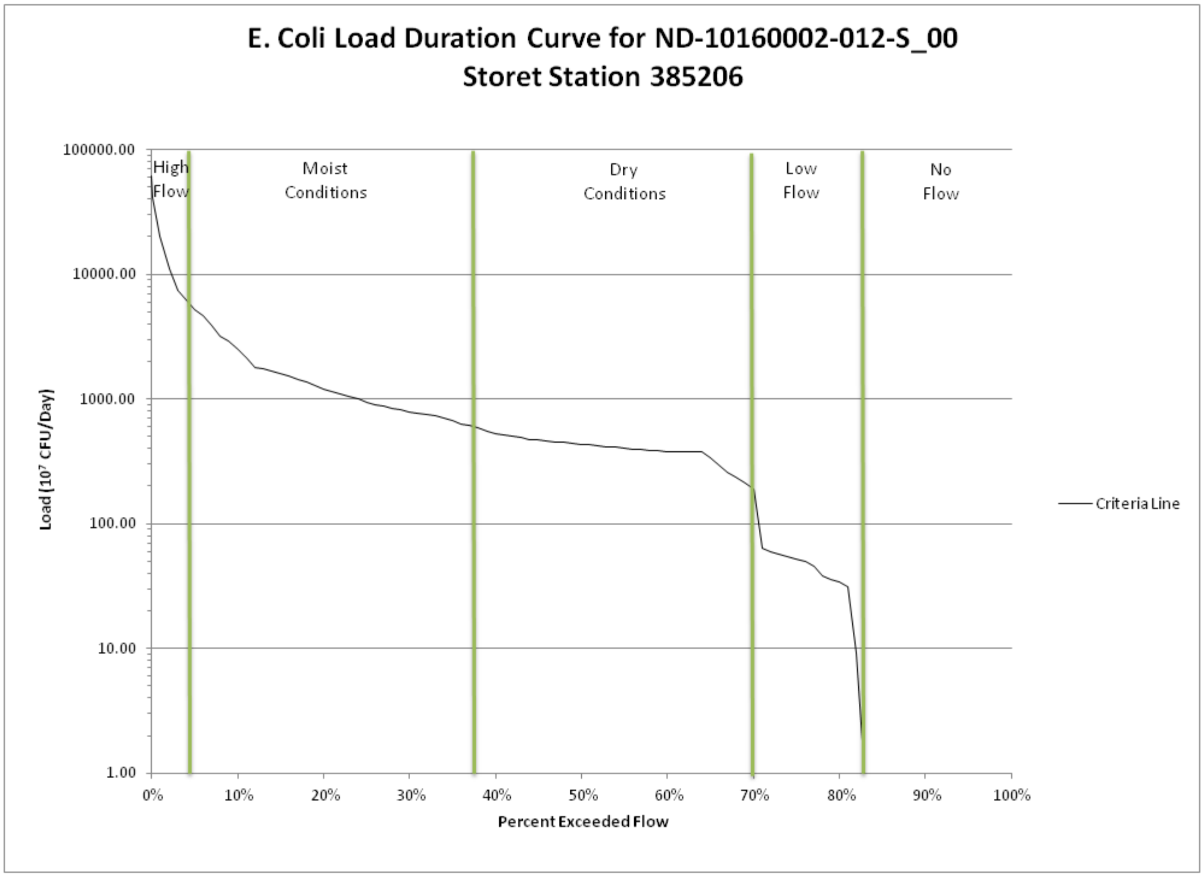


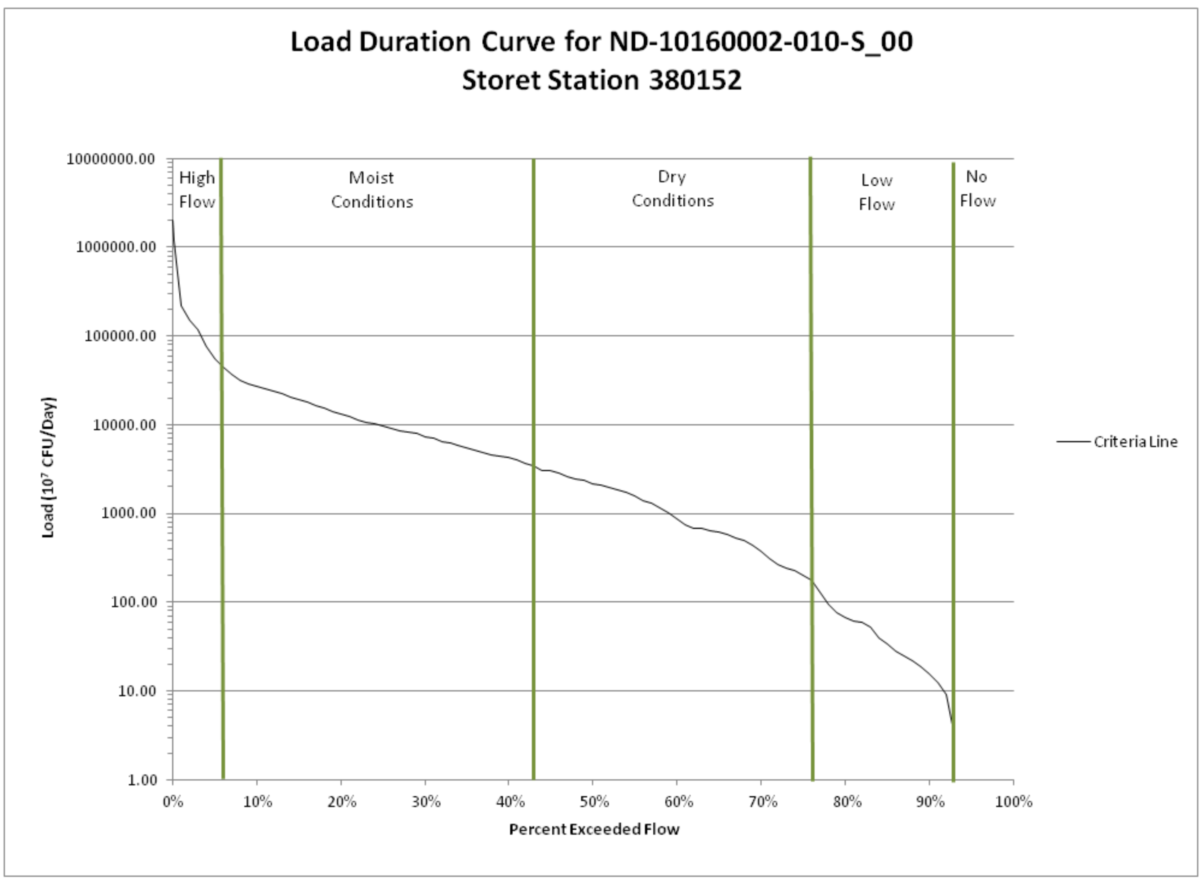
Assessment Unit ID ND-10160002-013-S_00
Storet Station 385268

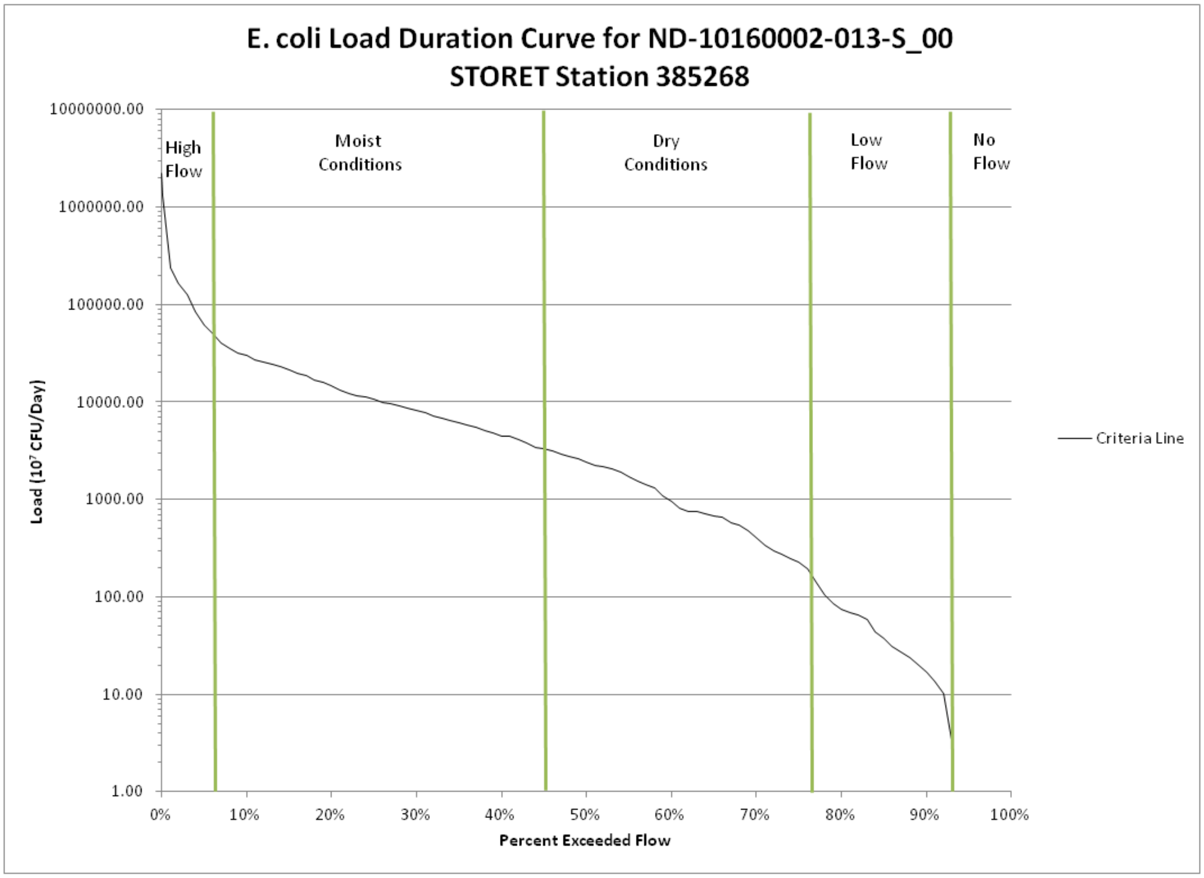
	Load (10^7 CFUs/Day)				Load (10^7 CFUs/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
Moist	26.51%	27336.60	15703.46	142.31			
Dry	61.51%	3218.59	1245.45	113.11	364065.98	140876.87	61.30%



Appendix D
Load Duration Curves for Monitoring Sites 385206, 380152 and 385268 using the Current State Water Quality Standards for E. coli Bacteria (126 CFU/100 mL)


E. Coli Load Duration Curve for ND-10160002-012-S_00
Storet Station 385206
High Flow
Moist Conditions
Dry Conditions
Low Flow
No Flow
Load (10^7 CFU/Day)
Percent Exceeded Flow
Criteria Line
100000.00
10000.00
1000.00
100.00
10.00
1.00
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%


Load Duration Curve for ND-10160002-010-S_00
Storet Station 380152
High Flow
Moist Conditions
Dry Conditions
Low Flow
No Flow
Load (10^7 CFU/Day)
Percent Exceeded Flow
Criteria Line
10000000.00
1000000.00
100000.00
10000.00
1000.00
100.00
10.00
1.00
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%



E. coli Load Duration Curve for ND-10160002-013-S_00
STORET Station 385268
High Flow
Moist Conditions
Dry Conditions
Low Flow
No Flow
Load (10^7 CFU/Day)
10000000.00
1000000.00
100000.00
10000.00
1000.00
100.00
10.00
1.00
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent Exceeded Flow
Criteria Line

Appendix E
Questions asked by the Stutsman County Soil Conservation District in a September 13, 2011 Meeting with the NDDoH and the NDDoH's Response

Stutsman County Soil Conservation District
1301 Business Loop East - Jamestown, ND 58401 - Phone (701) 252-2521, Ext. 3 or 252-1920, Ext.3
Fax 701-252-9439

Mike Ell, Manager
Surface Water Quality Management Program
North Dakota Department of Health
918 East Divide Avenue
Bismarck, ND 58501-1947

Dear Mr. Ell:

We have appreciated the opportunity to discuss the Fecal Coliform Bacteria TMDL for Pipestem Creek with you. Below is a listing of the questions/comments that were asked during our meeting with you. Again these questions/comments are a result of both the Stutsman County Water Resources Board and the Stutsman County Soil Conservation District Board.

1) What is the plan for monitoring fecal coliform bacteria for this TMDL in the future and who will be performing this task?

2) If any month during monitoring is found to be not supporting the uses is that considered fully not supporting?

3) Is there any separate number known for wildlife contributions? What is this background and is it factored in?

4) What would EPA's response be to any AFO's not permitted in this area in the future? Would the response be changed from having a TMDL or not? We have concerns about maintaining voluntary participation in animal waste management.

I believe this is a full list of questions, feel free to contact me or the SCD staff for any comments/questions at the numbers listed in the letterhead. Thank you.

Sincerely,

Gloria Jones, Chairperson
Stutsman County Soil Conservation District

NDDoH Response to Question 1: Monitoring was conducted as part of both watershed assessment and Section 319 watershed implementation project activities. Watershed project implementation monitoring ended in 2009 when the implementation project ended. Since many of the BMPs that were implemented as part of the project did not occur until years 3, 4 and 5 of the project, it is likely that the full water quality effect of these BMPs were not measured. It would be helpful if post implementation project monitoring were conducted for a few more years to fully assess the effects of the project. As the Section 319 watershed project sponsor it would be natural for the Stutsman County SCD to take the lead in any post-project monitoring. (Note: As a follow-up to our discussion, the SCD said they would be will to conduct post-project monitoring as directed by the NDDoH.)

NDDoH Response to Question 2: Yes, the way the water quality standard is written and they way it is interpreted in the NDDoH's Asessment Methodology, if the geometric mean fecal coliform or E. coli bacteria concentration for any month or 30-day period exceeds the standard then recreation use is considered "not supporting".

NDDoH Response to Question 3: There are analytical techniques, like bacteria source tracking, that can be used to tease out relative contributions of fecal coliform and E. coli bacteria from different animal sources. The techniques are quit labor intensive and expensive, but would allow you to determine whether the source of the bacteria is from a livestock source (i.e., cattle, pigs, horses), human, and/or from wildlife (i.e., deer, geese, ducks). It should be noted that the standard for fecal coliform is 200 CFUs/100 mL and the standard for E. coli is 126 CFUs/100 mL and not zero, therefore there is some allowance for background concentrations. Knowing landuse and grazing practices along Pipestem Creek one can surmise that the primary source of bacteria is livestock.

NDDoH Response to Question 4: The NDDoH has the authority to implement Clean Water Act regulations in ND, although EPA does have oversight authority. It should be noted that all animal feeding operations (AFOs) must take the necessary steps to prevent water quality impacts as required in state law. It is unlikely that having a TMDL would bring any more or less attention to a watershed from EPA. TMDL implementation is still voluntary. There is nothing in the Clean Water Act or in EPA regulations requiring mandatory NPS controls. Whether a TMDL is completed or not producers are expected to comply with state and federal laws and regulations regarding AFOs. It is the NDDoH's hope that producers will take advantage of technical and cost-share assistance while it is still available in order to comply with these regulations before EPA steps in.

Appendix F
US EPA Region 8 Public Notice Review and Comments

EPA REGION VIII TMDL REVIEW

TMDL Document Info:

Document Name:	**Fecal Coliform Bacteria TMDLs and De-Listing for the Pipestem Creek and Unnamed Tributary in Foster, Kidder, Stutsman and Wells Counties, North Dakota**
Submitted by:	**Mike Ell, North Dakota Department of Health**
Date Received:	**August 5, 2011**
Review Date:	**August 26, 2011**
Reviewer:	**Vern Berry, EPA**
Rough Draft / Public Notice / Final?	**Public Notice**
Notes:	

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

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

Approval Notes to Administrator:

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

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

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

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

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

1. Problem Description

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

1.1 TMDL Document Submittal Letter

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

Minimum Submission Requirements.

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

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

SUMMARY: The public notice draft Pipestem Creek tributaries fecal coliform TMDLs were submitted to EPA for review via an email from Mike Ell, NDDoH on August 5, 2011. The email included the draft TMDL document and a request to review and comment on the TMDL document.

COMMENTS: None.

1.2 Identification of the Waterbody, Impairments, and Study Boundaries

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

Minimum Submission Requirements:

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

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

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

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

SUMMARY: The Pipestem Creek watershed is a 684,704 acre watershed located in Stutsman and portions of Wells, Foster and Kidder Counties, in east central North Dakota. Pipestem Creek flows from southeast Wells County to eastern Stutsman County where it confluences with the James River. The listed Pipestem Creek segments are: 1) Pipestem Creek from its beginning downstream to Sykeston Dam (Lake Hiawatha) (25.21 miles; ND-10160002-001-S_00); 2) Pipestem Creek from its confluence with Little Pipestem Creek downstream to Dam #4 (29.22 miles; ND-10160002-010-S_00); 3) Unnamed Tributary watershed to Pipestem Creek (40.74 miles; ND-10160002-012-S_00); and 4) Pipestem Creek from Dam #4 downstream to Pipestem Reservoir (21.0 miles; ND-10160002-013-S_00). The Pipestem Creek watershed is part of the larger James River basin in the Pipestem sub-basin (HUC 10160002). These segments are listed as impaired for fecal coliform bacteria and are a high priority for TMDL development. Monitoring results within the upper segment indicate that assessment unit ID ND-10160002-001-S_00 is meeting the previous state water quality standards for fecal coliform bacteria. Therefore, North Dakota has determined that it is meeting all of its beneficial uses and will be presented for de-listing in the next Section 303(d) listing cycle.

The designated uses for the Pipestem Creek segments are based on the Class IA stream classification in the ND water quality standards (NDCC 33-15-02.1-09).

COMMENTS: None.

1.3 Water Quality Standards

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

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

Minimum Submission Requirements:

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

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

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

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

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

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

SUMMARY: The Pipestem Creek segments addressed by the TMDL document are impaired based on fecal coliform concentrations impacting the recreational uses. All four segments are Class IA streams. The quality of the waters in Class I streams shall be suitable for the propagation or protection, or both, of resident fish species and other aquatic biota and for swimming, boating, and other water recreation. The quality of the waters shall be suitable for irrigation, stock watering, and wildlife without injurious effects. The quality of water in Class IA streams is similar for aquatic life and recreational uses except additional treatment may be necessary for drinking water uses. Numeric criteria for E. coli in North Dakota, Class IA streams have been established and are presented in the excerpted Table 11 shown below. Effective January 2011, the Department revised the state water quality standards. In these latest revisions the Department eliminated the fecal coliform bacteria standard, retaining only the E. coli bacteria standard for the protection of recreational uses. This standards change was recommended by the US EPA as E. coli is believe to be a better indicator of recreational use risk (i.e., incidence of gastrointestinal disease). Discussion of additional applicable water quality standards for the Pipestem Creek and its tributaries can be found on pages 10 – 11 of the TMDL.

Table 11. North Dakota Bacteria Water Quality Standards for Class IA Streams.

Parameter	Standard	
	Geometric Mean[1]	Maximum[2]
*Fecal Coliform Bacteria**	*200 CFU/100 mL*	*400 CFU/100 mL*
E. coli Bacteria	126 CFU/100 mL	409 CFU/100 mL

* Previous State water quality standard.

[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, embeddeness, stream morphology, up-slope conditions and a measure of biota).

Minimum Submission Requirements:

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

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

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

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

SUMMARY: The proposed water quality target for these TMDLs are based on the previous numeric water quality standards for fecal coliform bacteria based on the recreational beneficial use for the Pipestem Creek segments. The proposed fecal coliform target for the Pipestem Creek segments are the fecal coliform concentration of 200 CFU/100 mL during the recreation season from May 1 to September 30. While the previous standard was intended to be expressed as the 30-day geometric mean, the target was used to compare to values from single grab samples. This ensures that the reductions necessary to achieve the target will be protective of both of the previous acute (single sample value) and chronic (geometric mean of 5 samples) standard.

Effective January 2011, the Department revised the state water quality standards. In these latest revisions the Department eliminated the fecal coliform bacteria standard, retaining only the E. coli bacteria standard for the protection of recreational uses. This standards change was recommended by the US EPA as E. coli is believe to be a better indicator of recreational use risk (i.e., incidence of gastrointestinal disease).

COMMENTS: As noted in the TMDL document, the fecal coliform standard no longer exists in North Dakota's water quality standards. All TMDLs must be written to protect and maintain the applicable water quality standards in effect at the time the TMDL is written. The ***primary*** target for this TMDL needs to be expressed as the existing E. coli bacteria standard (e.g., 126 cfu/100mL). However, because the existing listing is for fecal coliform, we recommend that the fecal coliform target be retained as a ***secondary*** target for these TMDLs.

3. Pollutant Source Analysis

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

Minimum Submission Requirements:

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

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

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

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

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

SUMMARY: The TMDL document includes the landuse breakdown for the watershed based on the 2010 National Agricultural Statistics Service (NASS) data. The dominant land use in the Pipestem Creek watershed is cropland and grassland. According to the 2010 NASS land survey data, approximately 43 percent of the landuse in the watershed is cropland, 45 percent is grassland and pasture, and 12 percent is wetlands, water, woods, and urban. The majority of the crops grown consist of soybeans, spring wheat, and corn.

Within the three impaired segments of Pipestem Creek there are no permitted wastewater point source discharges. However, there are fourteen permitted animal feeding operations (AFOs) within the three listed segments (i.e., ND-10160002-010-S_00, ND-10160002-013-S_00 and ND-10160002-012-S_00). NDDoH has permitted eight medium (301-999 AUs) AFOs and six (6) small (< 300 AUs) to operate. All AFOs are zero discharge facilities and are not deemed a significant point source of fecal coliform or E. coli bacteria loadings to Pipestem Creek or its tributaries.

In the segment being proposed for delisting (ND-10160002-001-S_00) there is a permitted municipal point source located in Sykeston, ND. The Sykeston facility discharges infrequently for short periods of time (6-7 days) into Pipestem Creek and Lake Hiawatha. Discharges have been sampled since 1995, and have never exceeded the 200 colonies/100ml water quality standard for fecal coliform bacteria. This segment is being proposed for de-listing for fecal coliform bacteria, therefore the city of Sykeston will not be given a waste load allocation as part of the TMDL.

The data collected during the water quality assessment (NDDoH, 2000) and subsequent water quality improvement project indicate that the primary nonpoint sources for fecal coliform bacteria, and presumably E. coli bacteria, in the Pipestem Creek watershed are as follows:

- Runoff of manure from cropland and pastureland;
- Runoff of manure from unpermitted animal feeding areas;
- Direct deposit of manure into Pipestem Creek by grazing livestock; and
- Background levels associated with wildlife.

Animal feeding areas within the Pipestem Creek watershed were identified as part of data collection effort for the assessment project. The identified animal feeding areas contained almost exclusively beef or dairy cattle.

Dwellings located within the majority of the watershed utilize septic systems. Septic system failure might contribute to the fecal coliform and E. coli bacteria in Pipestem Creek. 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.

Wildlife may also contribute to the fecal coliform 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 a robust data set and an appropriate level of technical analysis**.** This applies to **all** of the components of a TMDL document. It is vitally important that the technical basis for **all** conclusions be articulated in a manner that is easily understandable and readily apparent to the reader.

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

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

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

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

Where:

TMDL = Total Pollutant Loading Capacity of the waterbody

LAs = Pollutant Load Allocations

WLAs = Pollutant Wasteload Allocations

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

Minimum Submission Requirements:

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

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

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

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

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

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

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

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

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

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

The TMDL loads and loading capacities were derived using the load duration curve (LDC) approach. To better correlate the relationship between the pollutant of concern and the hydrology of the Section 303(d) listed waterbodies, LDCs were developed for each of the tributary segments at monitoring sites 385085, 385086, 384114 and 384115. All sites were sampled weekly or when flow conditions were present during the recreation season. The LDCs were derived using the 200 CFU/100 mL TMDL target (i.e., state water quality standard), the daily flow records, and the observed fecal coliform data collected from each site (see Figure 7 of the TMDL document).

Flows for Pipestem Creek, Segments 010 and 012 were determined using stage and flow data collected by the Stutsman County SCD during the watershed project implementation sampling (2003-2007), and from stream stage and discharge data from 1974 to the present collected by the USGS at the gauging station near Pingree, ND.

Flows used in the load duration curve for Pipestem Creek, Segment 013, were estimated using the Drainage-Area Ratio Method developed by the USGS. The Drainage-Area Ratio Method assumes that the streamflow at an ungauged site is hydrologically similar (same per unit area) to the stream gauging station used as an index. This assumption is justified since the ungauged sites are nested within the same 8-digit HUC as the gauged site. Drainage area for the ungauged site and the index station (06469400) were determined through GIS using digital elevation models (DEMs). Streamflow data for the index station (06469400) was obtained from the USGS Water Science Center website. The index station (06469400) streamflow data were then divided by the drainage area to determine streamflows per unit area at the index station. Those values are then multiplied by the drainage area for the ungauged site to obtain estimated flow statistics for the ungauged site.

The load duration curves were divided into the following four flow zones: high flows (0-4 percent), moist conditions (4-37 percent), dry conditions (37-70 percent), and low flows (70-81 percent). Based on the curve analysis, no flow occurred 19 percent of the time. These flow 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. A secondary factor in determining the flow intervals used in the analysis is the number of fecal coliform observations available for each flow interval. Fecal coliform and E. coli load duration curves for all three impaired segments are provided in Appendices C and D of the TMDL document.

The load duration curves plot the allowable fecal coliform load (using the old 200 CFU/100 mL standard) across the four flow regimes. Single grab sample fecal coliform concentrations were converted to loads by multiplying by flow and a conversion factor to produce CFU/day values. Each value was plotted individually on the load duration curves. Additional load duration curves were also developed to comply with the current State water quality standard for E. coli bacteria of 126 CFU/100 mL. Values falling above the curves indicate exceedances of the TMDL at that flow value while values falling below the curves indicate attainment of the TMDLs at that flow.

To estimate the required percent reductions in loading needed to achieve the TMDL, a linear regression line through the fecal coliform 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.

The LDCs represent flow-variable TMDL targets across the flow regimes shown in the TMDL document. For the Pipestem Creek 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 the three impaired segments at each flow regime. Tables 15 - 20 show the loading capacity load (i.e., TMDL load) for the listed tributary segments of the Pipestem Creek.

COMMENTS: The comments above explain why the ***primary*** TMDL targets should be based upon the existing E. coli water quality standard, and the old fecal coliform standard be used as the basis for the ***secondary*** target. Therefore, we support the approach taken in the TMDL section to include the LDCs and TMDL load tables for both E. coli and fecal coliform. Since there is no E. coli data available for this watershed, the fecal coliform LDCs are a necessary part of the TMDL to use as an indicator of the flow zones where E. coli exceedances are likely to occur and to derive estimates of the relative pathogen reductions needed to meet the E. coli standard. Because there is a fair amount of uncertainty on whether or not the reductions needed to meet the old fecal coliform standard will be adequate to meet the current E. coli standard, we recommend additional monitoring for E. coli during the implementation and post-implementation phases of the restoration process.

The discussion of the flow curves (page 15) derived from the USGS gage data mention that the data was used to develop curves for segments 001 and 013, but we believe it should refer to segments 010 and 013. Also, the discussion of breaking the curve in different flow zones mentions **five** flow zones, but the actual curves only show **four** zones (unless you're counting no flow as a flow zone). Please correct those paragraphs as needed.

4.1 Data Set Description

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

Minimum Submission Requirements:

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

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

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

SUMMARY: The Pipestem Creek tributaries TMDL data description and summary are included in the Available Data section, in tables throughout the document and in the data tables in Appendix A. Recent water quality monitoring was conducted in 2003 - 2007 and 2009 at sites 385043, 385268, 385206 and

380152. The data set also includes 37 plus years of flow records from USGS gauging site 06469400. The flow data, along with the TMDL targets, were used to develop the fecal coliform and E. coli load duration curves for the impaired tributary segments of the Pipestem Creek.

COMMENTS: None.

4.2 Waste Load Allocations (WLA):

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

Minimum Submission Requirements:

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

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

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

SUMMARY: Within the three impaired segments of Pipestem Creek there are no permitted wastewater point source discharges. However, there are fourteen permitted animal feeding operations (AFOs) within the three impaired segments (i.e., Segments 010, 012 and 013). NDDoH has permitted eight medium (301-999 AUs) AFOs and six (6) small (< 300 AUs) to operate. All AFOs are zero discharge facilities and are not deemed a significant point source of fecal coliform or E. coli bacteria loadings to Pipestem Creek or its tributaries.

In the segment being proposed for delisting (ND-10160002-001-S_00) there is a permitted municipal point source located in Sykeston, ND. The Sykeston facility discharges infrequently for short periods of time (6-7 days) into Pipestem Creek and Lake Hiawatha. Discharges have been sampled since 1995, and have never exceeded the 200 colonies/100ml water quality standard for fecal coliform bacteria. This segment is being proposed for de-listing for fecal coliform bacteria, therefore the city of Sykeston will not be given a waste load allocation as part of the TMDL.

COMMENTS: None.

4.3 Load Allocations (LA):

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

Minimum Submission Requirements:

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

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

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

SUMMARY: The TMDL document includes the landuse breakdown for the watershed based on the 2010 National Agricultural Statistics Service (NASS) data. The dominant land use in the Pipestem Creek watershed is cropland and grassland. According to the 2010 NASS land survey data, approximately 43 percent of the landuse in the watershed is cropland, 45 percent is grassland and pasture, and 12 percent is wetlands, water, woods, and urban. The majority of the crops grown consist of soybeans, spring wheat, and corn. The TMDL listed segments of Pipestem Creek are experiencing fecal coliform bacteria pollution from nonpoint sources in the watershed. Agriculture is the predominant land use and livestock production is a dominant agricultural practice in the watershed. There are no known point sources impacting the 303(d) impaired segments in the watershed. Therefore the majority of the fecal coliform and E. coli bacteria loads for these TMDLs were allocated to nonpoint sources in the watersheds.

By relating runoff characteristics to each flow regime one can infer which sources are most likely to contribute to fecal coliform and E. coli bacteria loading. Animals grazing in the riparian area contribute 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, medium and low flows. 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 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 bacterial contamination.

Source specific data are limited so an aggregate LA is assigned to nonpoint sources with a ranking of important contributors under various flow regimes provided as seen in the following excerpted table.

Table 13. Nonpoint Sources of Pollution and Their Potential to Pollute at a Given Flow Regime.

Non-Point Sources	Flow Regime		
	High Flow	Moist/Dry Conditions	Low Flow
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 area to contribute fecal coliform 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).

Minimum Submission Requirements:

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

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

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

SUMMARY: The Pipestem Creek TMDLs for Segments 010, 012 and 013 include explicit MOSs for the listed segments derived by calculating 10 percent of the loading capacity. The explicit MOSs for the Pipestem Creek segments are included in Tables 15 - 20 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.

Minimum Submission Requirements:

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

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

SUMMARY: By using the load duration curve approach to develop the TMDL allocations, seasonal variability in fecal coliform loads are taken into account. Highest steam flows typically occur during late spring, and the lowest stream flows occur during the winter months. Also, the TMDLs are seasonal since the fecal coliform criteria are in effect from May 1 to September 30, therefore the TMDLs are only applicable during that period.

COMMENTS: None.

5. Public Participation

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

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

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

Recommendation:

☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The 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. Copies 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.

Minimum Submission Requirements:

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

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

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

SUMMARY: To insure that the best management practices (BMPs) and technical assistance that are implemented as part of the Section 319 Pipestem Creek Watershed Restoration Project are successful in reducing fecal coliform bacteria, as well as E. coli loadings, to levels necessary to meet water quality standards prescribed in this TMDL, water quality monitoring is being conducted in accordance with an approved Quality Assurance Project Plan (QAPP).

COMMENTS: It would be helpful to know how long monitoring will be conducted per the QAPP written in 2002. As mentioned in the comments above, due to lack of E. coli data and the uncertainty in whether the fecal coliform reductions will be enough to meet the E. coli standards, we recommend additional monitoring for E. coli.

7. Restoration Strategy

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

Minimum Submission Requirements:

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

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

SUMMARY: The Allocation section (Section 8.0) of the TMDL document includes a list of BMPs that are recommended to meet the TMDL loads. Local sponsors in the watershed have successfully applied for and received Section 319 funding for the Pipestem Creek Watershed Restoration Project. Beginning in 2005, local sponsors provided technical assistance and implemented BMPs designed to reduce fecal coliform bacteria loadings and to help restore the beneficial uses of Pipestem Creek (i.e., recreation). A QAPP was developed as part of this watershed restoration project that detailed the how, when and where monitoring would be conducted to gather the data needed to document success in meeting the TMDL implementation goal(s). As the data were gathered and analyzed, watershed restoration tasks were adapted, if necessary, to place BMPs where they would have the greatest benefit to water quality and in meeting the TMDL goal(s).
Also, as part of the implementation plan for this TMDL, it was recommended that the permitted point sources (i.e., AFO/CAFOs) in the watershed be inspected to ensure that they are being operated in compliance with their permit conditions, and to verify that they aren't significant fecal coliform sources. Currently, all permitted CAFOs (greater than or equal to 1000 animal units) are inspected annually by the NDDoH. Permitted AFOs (<1000 animal units) in the Pipestem Creek watershed are inspected on an as needed basis.

There are no significant permitted point sources in the impaired segments of Pipestem Creek that are contributing to the bacteria load. Therefore, it is not necessary to fully document reasonable assurance demonstrating that the nonpoint source load reductions are practicable.

COMMENTS: None.

8. Daily Loading Expression

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

Minimum Submission Requirements:

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

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

SUMMARY: The Pipestem Creek fecal coliform TMDL document includes daily loads expressed as colonies per day for the three impaired segments. The daily TMDL loads are included in TMDL section (Section 7.0) of the document.

COMMENTS: None.

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

US EPA Comment: As noted in the TMDL document, the fecal coliform standard no longer exists in North Dakota's water quality standards. All TMDLs must be written to protect and maintain the applicable water quality standards in effect at the time the TMDL is written. The ***primary*** target for this TMDL needs to be expressed as the existing E. coli bacteria standard (e.g., 126 cfu/100mL). However, because the existing listing is for fecal coliform, we recommend that the fecal coliform target be retained as a ***secondary*** target for these TMDLs.

NDDoH Response: Section 3.0, TMDL Targets, and Section 7.0, TMDLs, including the TMDL Summary Table 14, were re-written to include language describing the E. coli standard as the primary TMDL target and fecal coliform as the secondary target.

US EPA Comment: The comments above explain why the ***primary*** TMDL targets should be based upon the existing E. coli water quality standard, and the old fecal coliform standard be used as the basis for the ***secondary*** target. Therefore, we support the approach taken in the TMDL section to include the LDCs and TMDL load tables for both E. coli and fecal coliform. Since there is no E. coli data available for this watershed, the fecal coliform LDCs are a necessary part of the TMDL to use as an indicator of the flow zones where E. coli exceedances are likely to occur and to derive estimates of the relative pathogen reductions needed to meet the E. coli standard. Because there is a fair amount of uncertainty on whether or not the reductions needed to meet the old fecal coliform standard will be adequate to meet the current E. coli standard, we recommend additional monitoring for E. coli during the implementation and post-implementation phases of the restoration process.

The discussion of the flow curves (page 15) derived from the USGS gage data mention that the data was used to develop curves for segments 001 and 013, but we believe it should refer to segments 010 and 013. Also, the discussion of breaking the curve in different flow zones mentions **five** flow zones, but the actual curves only show **four** zones (unless you're counting no flow as a flow zone). Please correct those paragraphs as needed.

NDDoH Response: The Department agrees that since the TMDL report includes targets and TMDLs for both fecal coliform and E. coli, post-implementation monitoring should be conducted for both. While the Section 319 implementation project ended in 2009, the project sponsor has agreed to conduct post-project implementation monitoring through 2013. Weekly sampling will be conducted from May through September at three sites representative of the three TMDL segments for both fecal coliform and E. coli bacteria.

Changes were made to the segments reference on page 15 and five flow zones were changes to four.

US EPA Comment: It would be helpful to know how long monitoring will be conducted per the QAPP written in 2002. As mentioned in the comments above, due to lack of E. coli data and the uncertainty in whether the fecal coliform reductions will be enough to meet the E. coli standards, we recommend additional monitoring for E. coli.

NDDoH Response: See response to comment above. The Section 319 project sponsor agrees to conduct post-implementation monitoring through 2013.