Fecal Coliform Bacteria TMDL for Bone Hill Creek and Tributaries in Stutsman and LaMoure Counties, North Dakota

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1.0 INTRODUCTION AND DESCRIPTION OF THE WATERSHED

Bone Hill Creek and its watershed are located within the Upper James River basin. The watershed extends from extreme southern Stutsman county to southeast of Dickey in LaMoure county, North Dakota. The watershed is approximately 453 square kilometers (km^2) or 111,939 acres. Table 1 summarizes the geographical, hydrological and physical characteristics, while Figure 1 shows the location of Bone Hill Creek and the Bone Hill Creek watershed.

Bone Hill Creek is a Class III stream (NDDoH, 2006). As a class III stream, assigned beneficial uses include aquatic life, recreation, agriculture (e.g., irrigation and stock watering), and industrial uses (e.g., cooling, wash water) (Table 1). Based on water quality assessment information compiled in the Assessment Database (ADB) and summarized in the 2008 Integrated Section 305(b) Water Quality Assessment Report (NDDoH, 2008), agricultural and industrial uses are assessed as fully supporting and recreation is not supporting. Aquatic life uses have not been assessed due to a lack of adequate data available to make a use attainment decision.

Table 1. General Characteristics of Bone Hill Creek and the Bone Hill Creek Watershed.

Legal Name	Bone Hill Creek
Major Drainage Basin	James River - Missouri River
Nearest Municipality	Alfred and Dickey
Assessment Unit ID	ND 10160003-025-S_00
Counties	Stutsman and LaMoure
Water Quality Standards Classification and Benficial Uses (NDDoH, 2006)	Class III - Aquatic Life, Recreation, Agriculture, and Industrial
Ecoregion	Drift Plains(46i) and Missouri Coteau (42a) level IV ecoregions and Northern Glaciated Plains level III ecoregion
Watershed Area	111,939 acres
River Miles	39.33 miles
Tributaries	Unnamed Tributary
Outlet	James River

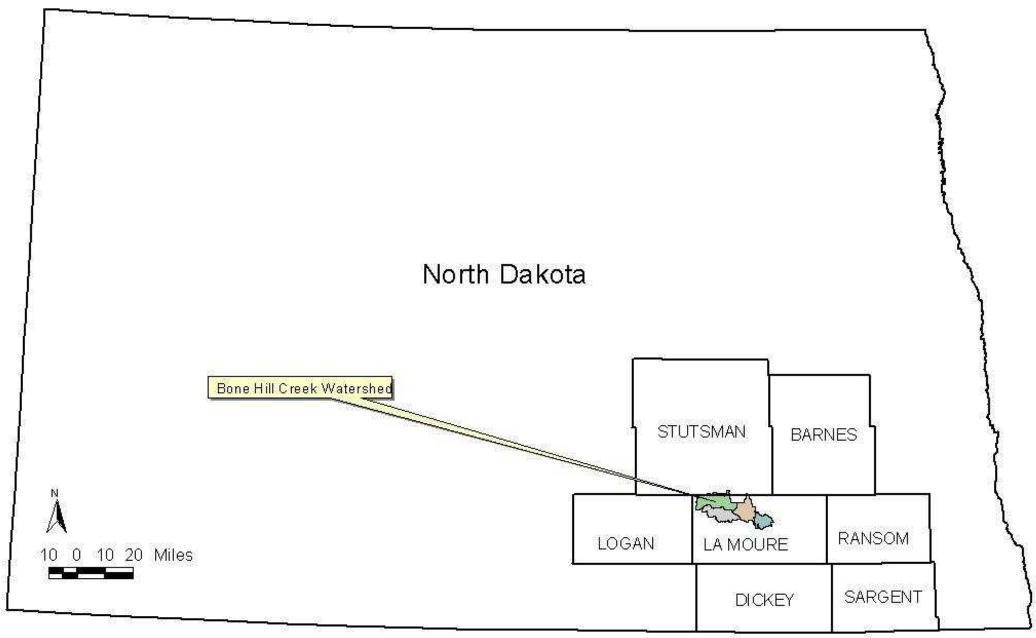

Figure 1. General Location of the Bone Hill Watershed in North Dakota.

1.1 Clean Water Act Section 303(d) Listing Information

As part of the 2008 Clean Water Act Section 303(d) Total Maximum Daily Load (TMDL) listing process (NDDoH, 2008), the North Dakota Department of Health (NDDoH) has identified the Bone Hill Creek and its tributaries as impaired (Table 2, Figure 2). The NDDoH assessed this waterbody as not supporting the beneficial use of recreation. While additional data are available through 2008, this assessment is based on fecal coliform bacteria data collected from 2002 - 2003.

Table 2. Section 303(d) TMDL Listing Information for Bone Hill Creek Waterbody ND-10160003-025-S_00 (NDDoH, 2008).

Assessment Unit ID	ND 10160003-025-S_00
Waterbody Description	Bone Hill Creek downstream to its confluence with the James River.
Size	39.33 miles
Designated Uses Impaired	Recreation
Use Support	Not supporting
Impairment	Fecal Coliform Bacteria
TMDL Priority	High

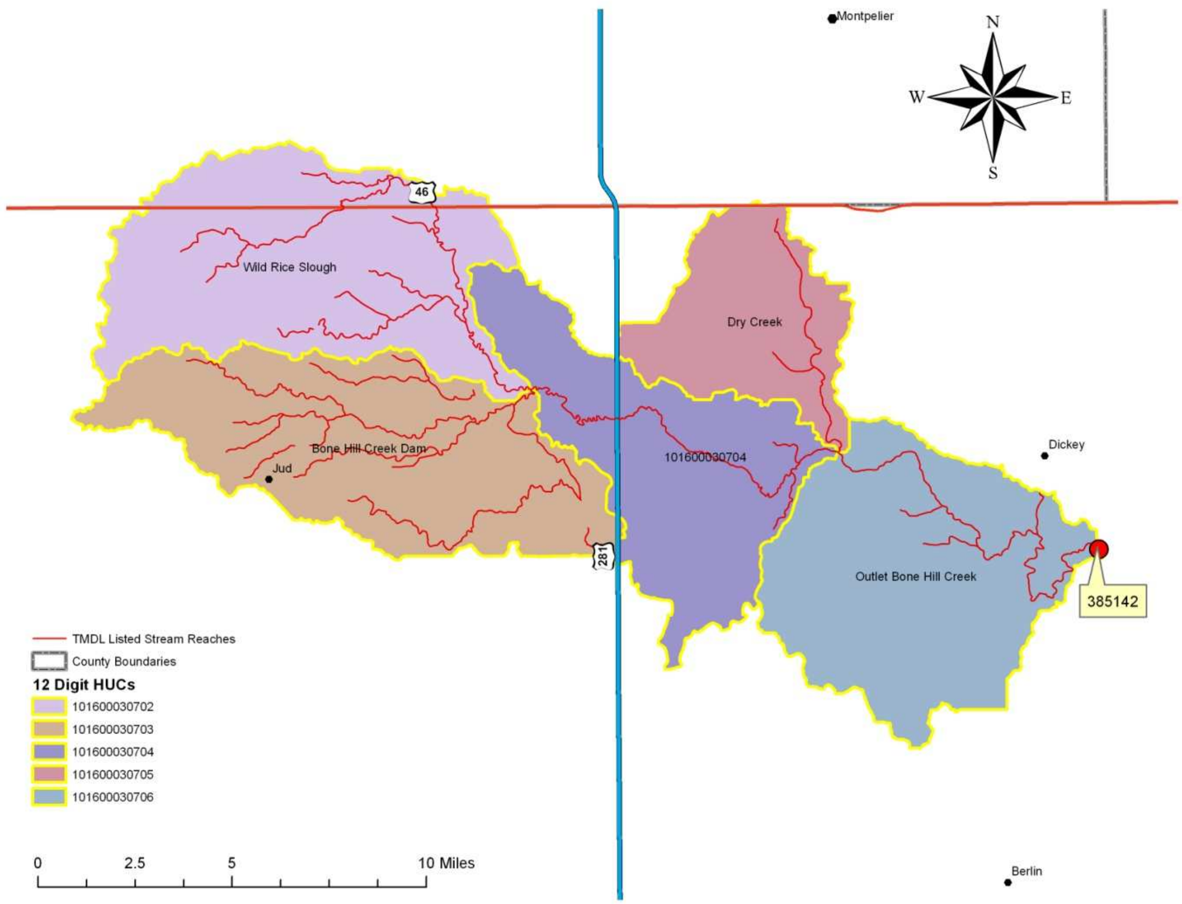

Figure 2. Bone Hill Creek Subwatersheds, Sampling Site and Section 303(d) Listed Waterbody.

1.2 Topography

The watershed lies primarily within the Drift Plains level IV ecoregion (46i) of the Northern Glaciated Plains level III ecoregion with a minor portion of the headwaters in the Missouri Coteau level IV ecoregion (42a) of the Northwestern Glaciated Plains level III ecoregion (Figure 3). The Drift Plains ecoregion is characterized by generally flat to occasionally rolling topography with a thick layer of glacial till left behind by the Wisconsinan glaciers. The Drift Plain grasslands, prior to cultivation, were a mixture of tall grass and short grass prairie. Seasonal and temporary wetlands are common within this ecoregion as opposed to the semi-permanent and permanent wetlands that are common in the Missouri Coteau ecoregion. The Missouri Coteau ecoregion is characterized by rolling knolls of glacial till with numerous depression or pothole wetlands and very little stream drainage (Bryce, 1998).

The dominant soil association in the watershed is Barnes-Svea-Hamerly (81.9 percent) followed by Renshaw-LaMoure-Exline (8.9 percent), Buse-Barnes (5.3 percent), Barnes-Svea (2.2 percent), Buse-Eckman-Renshaw-LaPrairie (1.7 percent). The Barnes-Svea-Hamerly and Barnes-Svea associations are characterized by level to undulating glacial till plains with well-drained to somewhat poorly drained soils of medium texture (NRCS, 1993). The Renshaw-LaMoure-Exline association is characterized by nearly level and narrow glacial outwash with well-drained to poorly drained soils of medium to moderately fine texture. The Buse-Barnes association is characterized by steep to rolling moraine hills with well-drained to excessively drained soils of medium texture. The Buse-Eckman-Renshaw-LaPrairie association is characterized by steep to nearly level land adjacent to the James River with moderately well-drained to excessively soils of medium texture (NRCS, 1971).

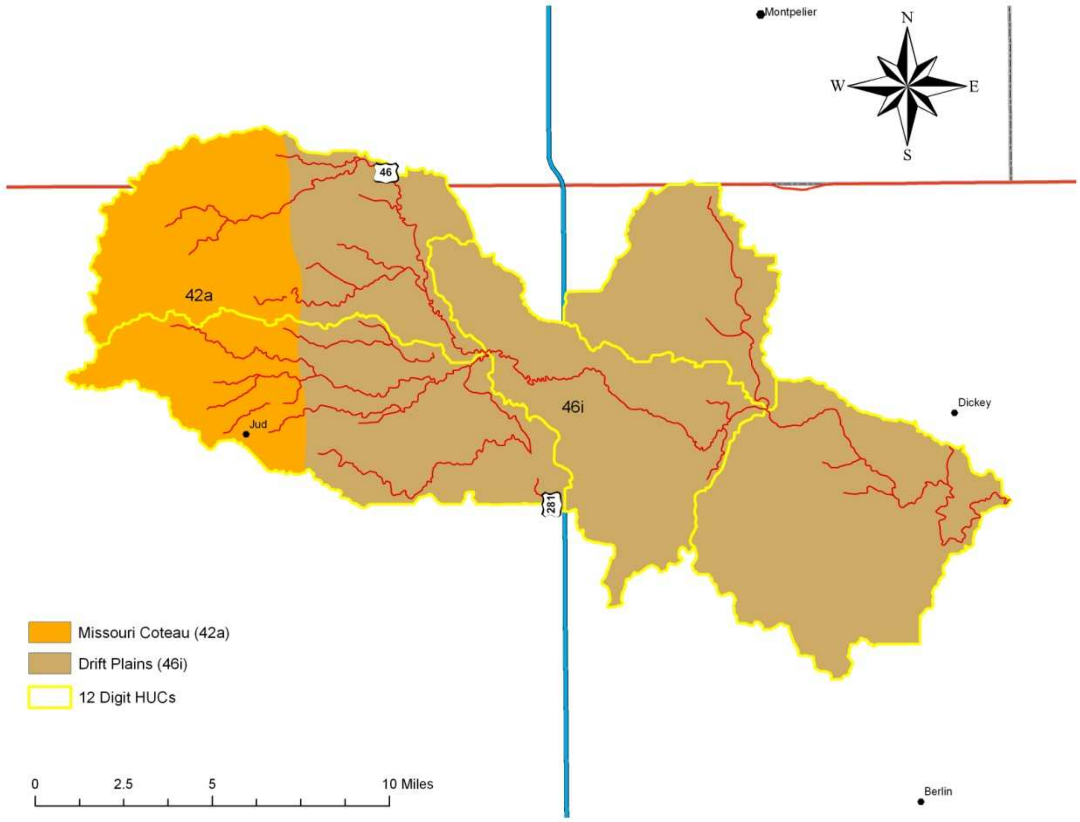

Figure 3. Level IV Ecoregions Included in the Bone Hill Creek Watershed.

1.3 Land Use/Land Cover

Cropland data from the North Dakota Agricultural Statistics Service (NASS) for the years of 2002 and 2007 show the changes in cropping practices (Table 3). These changes are partially dictated by the changes in commodity markets and conservation programs. The NASS data from 2002 indicated that the Bone Hill Creek watershed was dominated by spring wheat/winter wheat. In 2007, due to increased market prices, soybean acres were the most dominant with corn becoming the second most dominant crop. Comparisons between non-cropland acreages from 2002 and 2007 could not be made because the method of determining and classifying those acres was changed by NASS.

Table 3. Land Use/Land Cover (based on percentage) in the Bone Hill Creek Watershed in 2002 and 2007 (based on NASS Land Use/Cover Data).

Land Use/Land Cover	Cropping Year 2002	Cropping Year 2007
Corn	3.9	13.5
Dry Bean	2.0	0.1
Pasture/Idle Cropland/CRP	34.0	2.5
Grass/Pasture/Non-ag	NA[1]	19.0
Idle/Fallow	NA	2.5
Soybean	22.6	33.7
Wheat/Barley/Oats	NA	9.0
Spring Wheat/Winter Wheat	30.4	NA
Sunflower	4.1	0.1
Water/Wetlands	2.2	13.5
Developed	NA	5.3
Forest	0.8	0.8
Total	100.0	100.0

[1]NASS did not report this land use category.

1.4 Climate and Precipitation

The climate of the region varies significantly depending on the season. The Bone Hill Creek watershed does not have a climate station located in it, therefore, precipitation data for the climate stations near Montpelier and Edgeley, ND were reviewed. Data were available for the period of 1948 through 2008 and obtained from the High Plains Regional Climate Center (HPRCC). Both stations show a similar pattern in precipitation, typically occurring in the form of rainfall, with a majority falling the months of April through October (Figures 4 and 5).

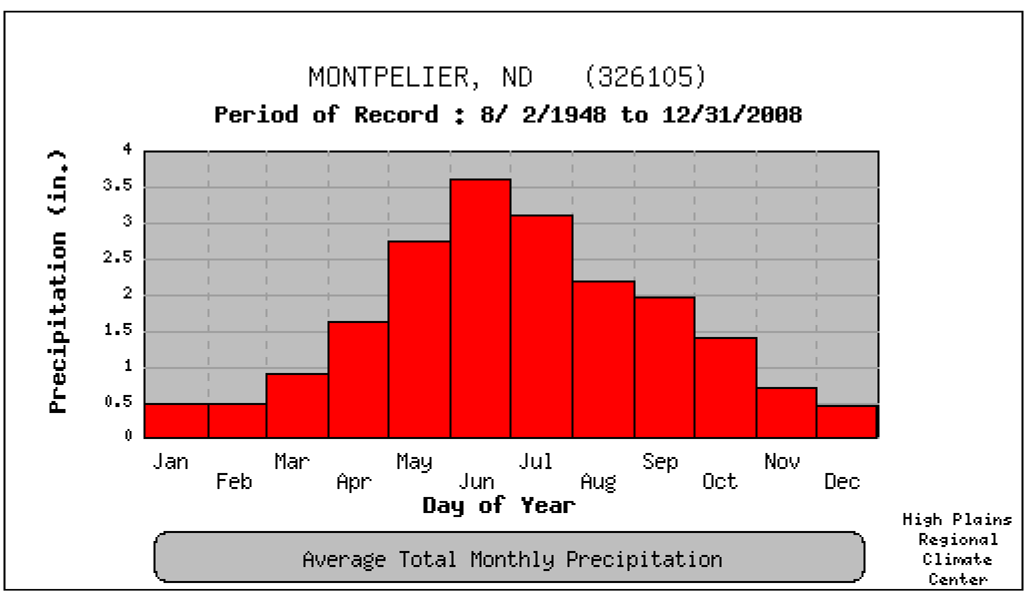

Figure 4. Average Monthly Precipitation at Montpelier, ND.

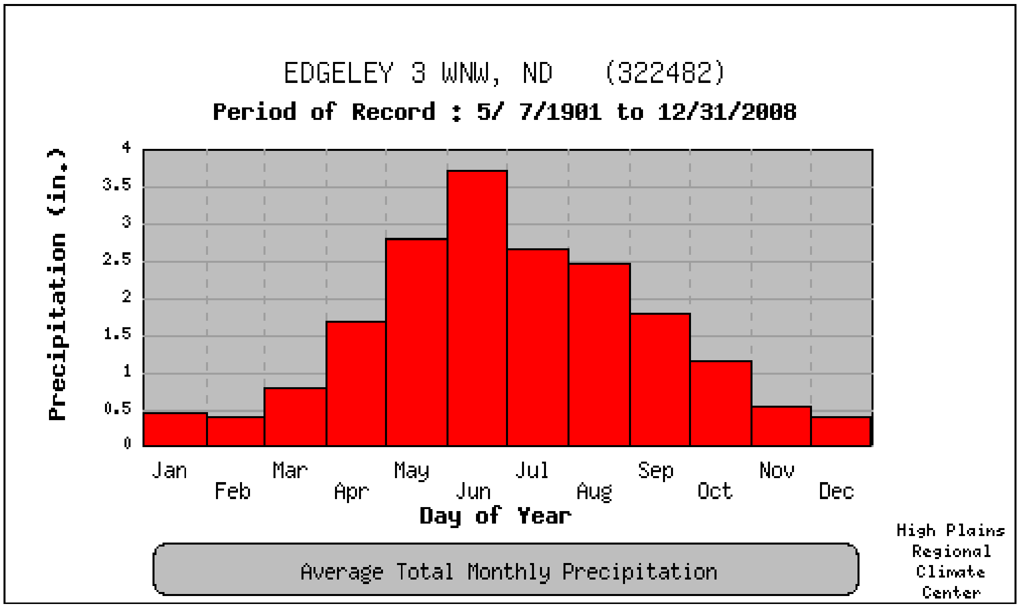

Figure 5. Average Monthly Precipitation at Edgeley, ND.

1.5 Available Data

1.5.1 Fecal Coliform Bacteria Data

Fecal coliform bacteria data used for this report were collected at one location as part of the pre-project assessment (2002-2003) and throughout the implementation of a Section 319 Nonpoint Source Pollution reduction project (2005-2008) (Figure 2). Fecal coliform data are provided in Appendix A.

Table 4 provides a summary of the monthly geometric mean fecal coliform concentrations, the percentage of samples exceeding 400 CFU/100 mL, and the current recreational use assessment for site 385142 (near Dickey). Following the procedures and methods outlined in the NDDoH's Beneficial Use Assessment Methodology (NDDoH, 2007), the data were pooled across years (2002, 2003, 2005, 2006, 2007 and 2008) and the geometric mean concentration of fecal coliform bacteria and the percent of samples over 400 CFU/100 mL were calculated for each month during the recreational period of May 1 through September 30. For each month, May through August, both the geometric mean as well as the percent of samples exceeding 400 CFUs/100 mL exceeded the state water quality standard. Therefore, for the months May-August, recreational use is assessed as not supporting.

Table 4. Summary of Fecal Coliform Data for Site 385142, Bone Hill Creek near Dickey (2002-2003 and 2005-2008).

Month	N	Geometric Mean Concentration (CFU/100 mL)	Percentage of Samples Exceeding 400 CFU/100 mL	Recreational Use Assessment
May	33	304	45.5%	Not Supporting
June	25	406	40.0%	Not Supporting
July	12	774	66.7%	Not Supporting
August	6	457	66.7%	Not Supporting
September	3	218	0.0%	NA[1]

[1] Based on the NDDoH's Beneficial Use Assessment Methodology (NDDoH, 2007) a minimum of 5 samples is required for assessment.

1.5.2 Hydraulic Discharges

There are no USGS flow gaging stations in the Bone Hill Creek watershed, therefore mean daily flow data were collected at site 385142 for the period 2002-2003 and 2005-2008 as part of the watershed assessment and implementation projects, respectively. Table 5 provides a summary of the data collected. In general, flow data were collected from ice out in April until ice up in the fall or until flows in the river ceased.

Table 5. Summary of Daily Flow Data at Site 385142, Bone Hill Creek near Dickey.

Year	Period of Record	Daily Observations	Minimum Flow (cfs)	Maximum Flow (cfs)
2002	June 28 – October 14	106	0	67
2003	April 9 – August 28	141	0	317
2005	April 19 – October 17	182	0	1097
2006	April 5 – July 5	92	0	18
2007	April 8 – September 28	174	0	835
2008	April 22 – November 12	170	0	34

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 nonpoint sources and natural background” such that the capacity of the waterbody to assimilate pollutant loadings is not exceeded. The purpose of a TMDL is to identify the pollutant load reductions or other actions that should be taken so that impaired waters will be able to attain water quality standards. TMDLs are required to be developed with seasonal variations and must include a margin of safety that addresses the uncertainty in the analysis. Separate TMDLs are required to address each pollutant or cause of impairment (i.e., 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 water quality standards are listed below (NDDoH, 2008).

- 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 waters; 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 a biological goal for all surface waters in the State. The goal states that “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, 2006).

2.2 Numeric Water Quality Standards

Bone Hill Creek is a Class III stream which carries the following definition:

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

Numeric criteria have been developed for Class III streams for fecal coliform bacteria (Table 6). The fecal coliform bacteria standard applies only during the recreation season, May 1 to September 30.

Table 6. North Dakota Fecal Coliform Bacteria Standards for Class III Streams.

Parameter	Water Quality Standard	
	Geometric Mean[1]	Maximum[2]
Fecal Coliform Bacteria	200 CFU/100 mL	400 CFU/100 mL

[1] **Expressed as a geometric mean of representative samples collected during any consecutive 30-day period.**

[2] **No more than 10 percent of samples collected during any consecutive 30-day period shall individually exceed the standard.**

3.0 TMDL TARGET

A TMDL target is the value that is measured to judge the success of the TMDL effort. TMDL targets must be based on state water quality standards, but can also include site-specific values when no numeric criteria are specified in the standard. The following TMDL target for Bone Hill Creek is based on the North Dakota fecal coliform bacteria standard for Class III streams.

3.1 Bone Hill Creek Bacteria TMDL Target

Bone Hill Creek and its tributaries are not supporting recreational use due to fecal coliform bacteria counts exceeding the North Dakota water quality standard. The North Dakota water quality standard for fecal coliform bacteria is a 30-day geometric mean of 200 CFU/100 mL during the recreation season which is from May 1 to September 30. In addition, no more than 10 percent of the samples collected within the 30-day period may exceed 400 CFU/100 mL. Therefore, the TMDL target for this report is the fecal coliform standard expressed as the 30-day geometric mean 200 CFUs/100 mL. While the standard is intended to be expressed as the 30-day geometric mean, the target is expressed as the daily average fecal coliform bacteria concentration based on a single grab sample. Expressing the target in this way will ensure the TMDL will result in both components of the standard being met and recreational uses are restored.

4.0 SIGNIFICANT SOURCES

4.1 Point Sources

Within the Bone Hill Creek watershed, there are no municipal point sources permitted through the North Dakota Pollutant Discharge Elimination System (NDPDES) Program

There are four (two small and two medium) permitted CAFOs/AFOs in the watershed, however, they are zero discharge facilities and are not deemed a significant source of fecal coliform bacteria loadings to Bone Hill Creek.

4.2 Nonpoint Sources

Based on data collected during the Bone Hill Creek watershed assessment in 2002-2003 (NDDoH, 2004) and through subsequent water quality improvement project (2005-2008), the primary nonpoint sources for fecal coliform bacteria in the Bone Hill 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 Bone Hill Creek by grazing livestock; and
- Background levels associated with wildlife.

Animal feeding areas within the Bone Hill Creek watershed were identified as part of data collection effort for the AGNPS model (NDDoH, 2004). The identified feeding areas contained almost exclusively cattle with a few containing sheep and horses. The AGNPS model assigns each animal feeding area a rating score based primarily on the number of animals and their setting in the landscape. The ratings scores for 49 identified animal feeding areas within the Bone Hill Creek watershed ranged from 0 to 46 and averaged 23.1 (Table 7). The ten animal feeding areas within the lower Bone Hill Creek subbasin had the highest average rating score at 27.5 followed by the 12 animal feeding areas within the middle Bone Hill Creek subbasin at 26.3, the 11 animal feeding areas within the southwest branch subbasin at 21.8, and the 16 animal feeding areas within the Minneapolis Flats subbasin at 18.9 (Table 7).

Table 7. The Number of Animal Feeding Areas and Animals Located within Each Sub-watershed of the Bone Hill Creek Watershed, as well as the Average AGNPS Rating Scores for those Animal Feeding Areas (NDDoH, 2004).

Sub-watershed	Number of Animal Feeding Areas	Number of Animals	Average AGNPS Rating Score
Southwest Branch	11	565	21.8
Minneapolis Flats	16	718	18.9
Middle Bone Hill Creek	12	960	26.3
Lower Bone Hill Creek	10	1010	27.5
Total	49	3253	23.1

Failing septic systems or direct discharge sewage systems which contribute to fecal coliform bacteria contamination may also be located within the watershed. While their specific location and potential for fecal coliform loading are unknown, these systems may be associated with isolated single-family dwellings and farmsteads located throughout the watershed or within small towns located within the watershed that do not have a centralized sewer system (e.g., Jud and Nortonville).

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. total fecal coliform bacteria) to determine the load reduction needed to meet the target. To determine the cause-and-effect relationship between the water quality target and the identified source, the "load duration curve" methodology was used. The loading capacity or TMDL is the amount of pollutant (e.g. total 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 load allocation and the load allocation reductions necessary to achieve the water quality standards target of 200 CFU/100 mL plus a margin of safety.

5.1 Mean Daily Stream Flows

In south-central North Dakota, rain events are variable, occurring during the months of April through October. Rain events can be sporadic and heavy or light, occurring over a short duration or over several days. 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 moderate 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 open water period during the years 2002, 2003, 2005, 2006, 2007 and 2008 were used in the development of the flow duration curves and load duration curves for site 385142 (Bone Hill Creek near Dickey, ND) (Figure 2).

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. 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 6). Using this approach, flow duration intervals are expressed as a percentage, with zero corresponding to the highest flows in the record (i.e., flood conditions) and 100 to the lowest flows in the record (i.e., drought). Therefore, as depicted in Figure 6, a flow duration interval of thirty (30) percent, associated with a stream flow of 9.1 cfs, implies that 30 percent of all observed mean daily discharge values equal or exceed 9.1 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 in Figure 6, the flow duration curve was divided into three zones, one representing high flows (0-10 percent), another for moderate flows (10-50 percent), and one for low flows (50-59 percent). Based on the flow duration curve analysis, no flow occurred 41 percent of the time (59-100 percent). 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 (Figure 6). A secondary factor in determining the flow intervals used in the analysis is the number of fecal coliform observations available for each flow interval.

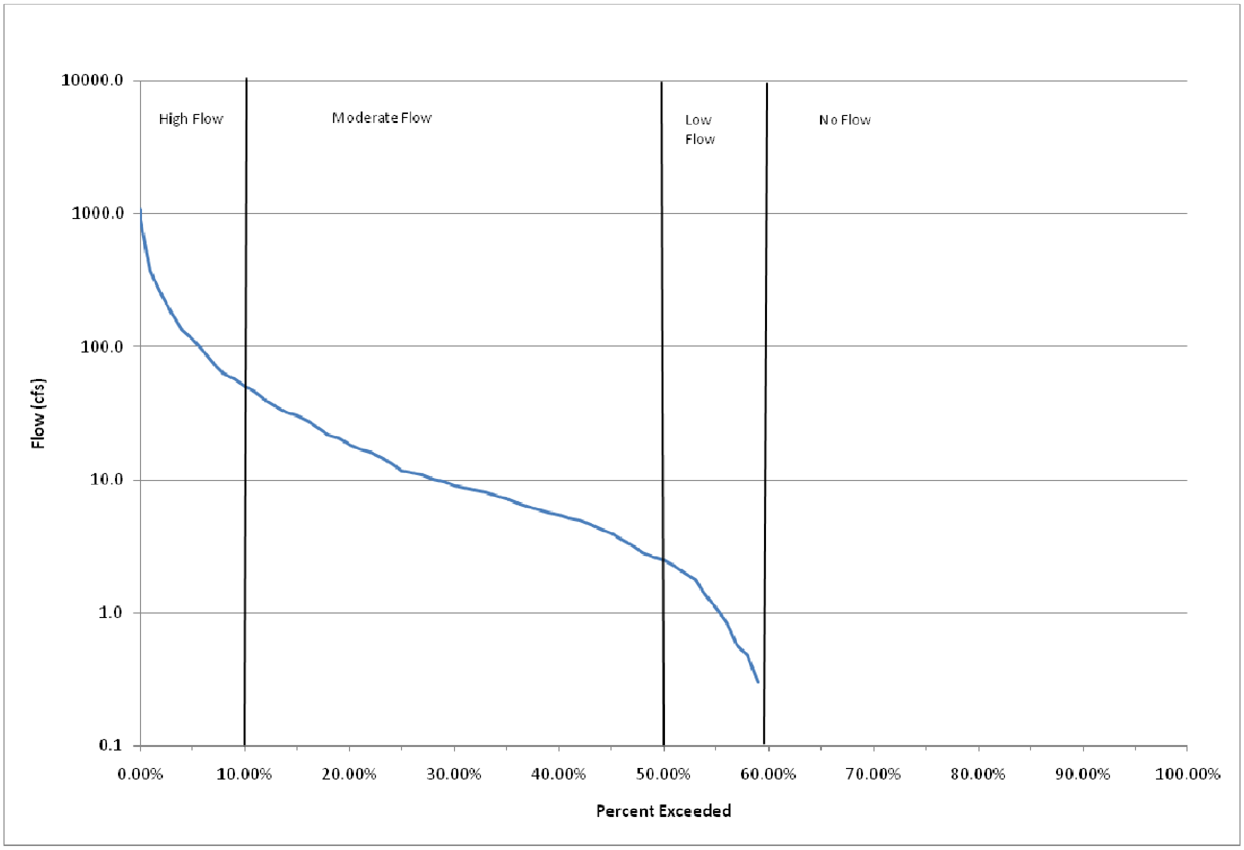

Figure 6. Flow Duration Curve for Bone Hill Creek Site 385142 (near Dickey).

5.3 Load Duration Curve Analysis

An important factor in determining NPS pollution loads is variability in stream flows and loads associated with high and moderate to low flow. To better correlate the relationship between the pollutant of concern and hydrology of the 303(d) listed segment, a load duration curve was developed for the listed segment in the Bone Hill Creek watershed. The load duration curve was derived using the 200 CFU/100mL target (i.e. state water standard) and the flows generated as described in Section 5.1.

Observed in-stream total fecal coliform bacteria concentrations from monitoring site 385142 were converted to pollutant loads by multiplying fecal coliform bacteria concentrations by the flow and a conversion factor. These loads are plotted against the percent exceeded of the flow on the day of sample collection (Figure 7). Points plotted above the 200 CFU/100 mL target curve exceed the TMDL target. Points plotted below the curve are meeting the target of 200 CFU/100 mL.

For each flow interval or zone (i.e., high, moderate, low), 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 385142 depicting the regression relationship for each flow interval is provided in Figure 7 and Appendix C. 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. For example, in the example provided in Figure 7, the regression relationship between observed fecal coliform bacteria loading and percent exceeded flow for the high flow interval (0-10 percent) is:

Fecal coliform load (expressed as 10^7 CFUs/day) = antilog (5.76 + (-7.2*Percent Exceeded Flow))

Where the midpoint of the flow interval from 0 to 10 percent is 5 percent, the existing fecal coliform load is:

Fecal coliform load (10^7 CFUs/day) = antilog (5.76 + (-7.2*0.05))
= 251,189

The midpoint for the flow interval is also used to estimate the TMDL target load. In the case of the previous example, the TMDL target load for the midpoint or 5 percent exceeded flow derived from the 200 CFU/100 mL TMDL target curve is 56,288 x 10^7 CFUs/day (Figure 7).

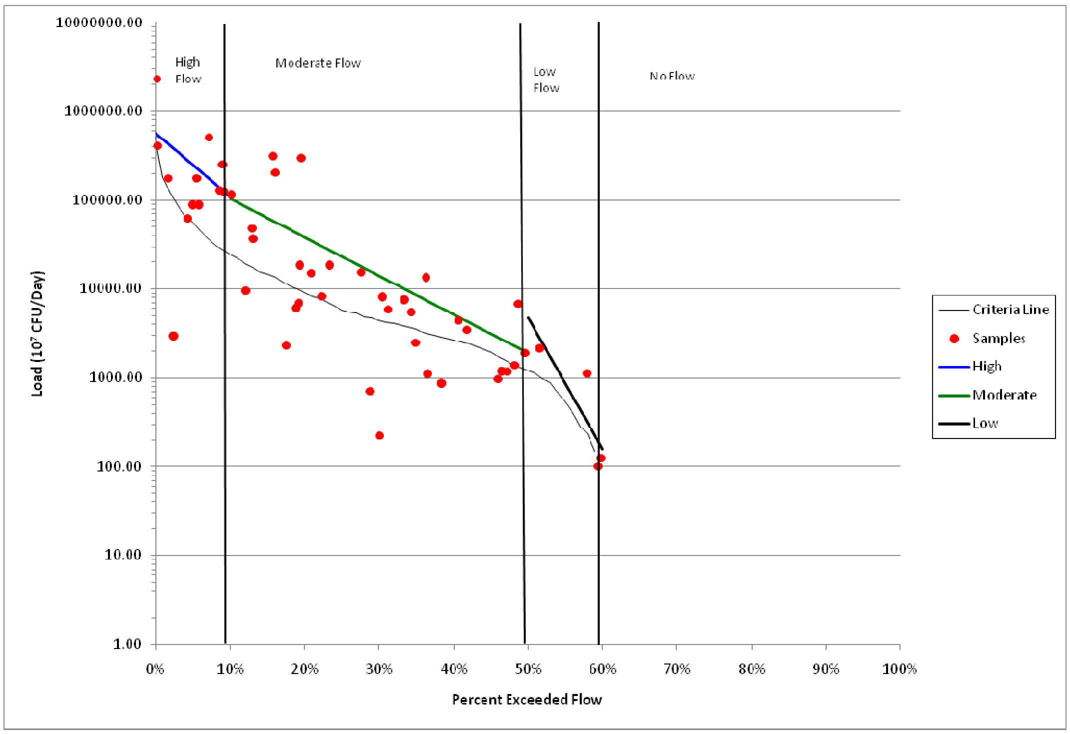

Figure 7. Load Duration Curve for Bone Hill Creek Site 385142 (near Dickey).

5.4 Loading Sources

The load reductions can be generally allotted to nonpoint sources. Based on the data available, the general focus of BMPs and load reductions for the TMDL listed waterbody should be on unpermitted animal feeding areas and critical pasture areas described in the assessment report. Higher priority should be given to the unpermitted animal feeding areas located in close proximity to Bone Hill Creek.

Significant sources of fecal coliform 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). TMDLs were developed for three flow regimes (i.e., high, moderate and low) for the Bone Hill Creek watershed (waterbody ID ND-10160003-025-S_00).

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 total 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, medium and low flows (Table 8). In contrast, intensive grazing of livestock in the upland and not in the riparian area has a high potential to impact water quality at high flows and medium impact at moderate flows (Table 8). 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 fecal coliform bacteria contamination.

Since there are no point sources (see Section 4.1) impacting the fecal coliform loading in the watershed, sources exceeding the target curve in the medium flow regime and those in the high flow regime indicate nonpoint source pollution. Specific nonpoint sources of pollution and their potential to contribute fecal coliform bacteria loads under high, medium and low flow regimes in the Bone Hill Creek watershed are described in Table 8.

Table 8. Nonpoint Sources of Pollution and Their Potential to Pollute at a Given Flow Regime.

Nonpoint Sources	Flow Regime		
	High Flow	Medium Flow	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 importance of nonpoint source area to contribute fecal coliform 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's (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 as 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 10 percent explicit margin of safety was used for this TMDL. The MOS was calculated as 10 percent of the TMDL. In other words 10 percent of the TMDL is set aside from the load allocation as a MOS. The 10 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 Bone Hill Creek TMDL addresses seasonality because the flow duration curve was developed using a water quality standard that 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 TMDL

The TMDL can be described by the following equation**:** TMDL = LC = WLA + LA + MOS where:

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

Table 9 provides an outline of the critical elements for the waterbody specific fecal coliform bacteria TMDL located within the Bone Hill Creek watershed. The TMDL for waterbody ND-10160003-025-S_00 is presented in Table 10. For each flow regime (high, moderate and low) the TMDL summary provides an estimate of the existing daily load, an estimate of the average daily loads necessary to meet water quality target (i.e. TMDL load). This TMDL load includes a load allocation from known nonpoint sources and a 10 percent margin of safety. It should be noted that the TMDL loads, load allocations, and the MOS are estimated based on available data and reasonable assumptions and are to be used as a guide for implementation. The actual reduction needed to meet the applicable water quality standards may be higher or lower depending on the results of future monitoring.

Table 9. TMDL Summary for the Bone Hill Creek Watershed .

Category	Description	Explanation
Beneficial Use Impaired	Recreation	Contact Recreation (i.e. swimming, fishing)
Pollutant	Fecal Coliform Bacteria	See Section 2.1
TMDL Target	200 CFU/100 mL	Based on North Dakota water quality standards
WLA		There are no contributing point sources in the watershed.
LA	Nonpoint Source Contributions	Loads are a result of nonpoint sources (i.e., rangeland, pasture land, etc.)
Margin of Safety (MOS)	Explicit	10 percent

Table 10. Fecal Coliform Bacteria TMDL (10^7 CFUs/day) for Bone Hill Creek Waterbody Assessment Unit ID ND-10160003-025-S_00 (represented by site 385142).

	Flow Regime		
	High Flow	Moderate Flow	Low Flow
Existing Load	251,189	13,944	869
TMDL	56,288	4,450	539
WLA	0	0	0
LA	50,659	4,005	485
MOS	5,629	445	54

8.0 ALLOCATION

There are no point sources within the watershed, therefore, the entire fecal coliform load for this TMDL is allocated to nonpoint sources in the watershed. Three flow regimes (high, medium, and low flows) were identified for the TMDL.

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, upland grazing). To achieve the TMDL targets identified in the report will require the wide spread support and voluntary participation of landowners and residents in the immediate watershed as well as those living upstream. 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 should be considered an adaptive management plan and is put forth as a recommendation for what needs to be accomplished for Bone Hill Creek, its tributaries and associated watershed to restore and maintain its recreational uses. Water quality monitoring should continue to assess the effects of the recommendations made in this TMDL. Monitoring may indicate that BMP implementation and/or the loading capacity recommendations should be adjusted.

Controlling nonpoint sources is a difficult undertaking requiring extensive financial and technical support. Provided that technical and financial assistance is available to stakeholders, these BMPs have the potential to significantly reduce total fecal coliform loading to the Bone Hill Creek. The following describe in detail those BMPs that will reduce total fecal coliform bacteria levels in the Bone Hill 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 and erosion from poorly managed grazing land and riparian areas can be a significant source of loading to surface water. Precipitation, plant cover, number of animals, and soils are factors that affect the amount of bacteria delivered to a waterbody as a result of livestock. These specific BMPs are known to reduce NPS pollution from livestock.

<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 environment.

<u>Prescribed grazing</u> – This practice provides increased ground cover and ground stability by rotating livestock throughout multiple fields. Grazing with a specified rotation minimizes overgrazing and resulting erosion. The Natural Resources 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 show 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.

<u>Waste management system</u> - Waste management systems can be effective in controlling up to 90 percent of the loading originating from confined animal feeding areas. A waste management system is made up of various components designed to control NPS pollution from concentrated animal feeding operations (CAFOs) and animal feeding operations (AFOs). Diverting clean

water around the feeding area and detaining dirty water from the feeding area in a pond are typical practices of a waste management system. Manure handling and application procedures are also integral to the waste management system. The application of manure is designed to be adaptive to environmental, soil, and plant conditions to minimize the probability of contamination of surface water.

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 reducing fecal coliform bacteria can be quite successful. Results from a study by Pennsylvania State University (1992) as presented by USEPA (1993), suggest that vegetative filter strips are capable of removing up to 55 percent of fecal coliform bacteria loading to rivers and streams (Table 11). The ability of the filter strip to reduce 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).

Table 11. Relative Gross Effectiveness[a] of Confined Livestock Control Measures (Pennsylvania State University, 1992).

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

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

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 Bone Hill Creek and request for comment was mailed to participating agencies, partners, and to those requesting a copy. Those included in the hard copy mailing were:

- Stutsman County Soil Conservation District;
- LaMoure County Soil Conservation District;
- Stutsman County Water Resource Board;
- LaMoure County Water Resource Board;
- US EPA - Region VIII; and
- USDA-NRCS (State Office).

In addition to the mailed copies, the TMDL for Bone Hill Creek 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_Comment.htm . A 30 day public notice soliciting comment and participation was also published in the following newspapers:

- Jamestown Sun; and
- LaMoure Chronicle.

Comments were only received from US EPA Region 8, which were provided as part of their normal public notice review (Appendix D). The NDDoH's response to these comments are provided in Appendix E.

10.0 MONITORING STRATEGY

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 are implemented as part of the Section 319 Bone Hill Creek Watershed Restoration Project are successful in reducing fecal coliform bacteria loadings to levels prescribed in this TMDL, water quality monitoring is being conducted in accordance with an approved Quality Assurance Project Plan (QAPP). As prescribed in the QAPP (NDDoH, 2003), weekly monitoring is being conducted at four sites for fecal coliform and E. coli bacteria. Sampling began in October 2005 and will continue through June 2010.

11.0 RESTORATION STRATEGY

In response to the Bone Hill Creek Watershed Assessment and in anticipation of this completed TMDL, local sponsors successfully applied for and received Section 319 funding for the Bone Hill Creek Watershed Restoration Project. Beginning in October 2003, local sponsors have been providing technical assistance and implementing BMPs designed to reduce fecal bacteria loadings and to help restore the beneficial uses of the Bone Hill Creek (i.e., recreation). As the watershed restoration project progresses, water quality data are collected to monitor and track the effects of BMP implementation as well as to judge overall success of the project in reducing fecal coliform bacteria loadings. A QAPP (NDDoH, 2003) has also been developed as part of this watershed restoration project that details the how, when and where monitoring will be conducted to gather the data needed to document success in meeting the TMDL implementation goal(s). As the data are gathered and analyzed, watershed restoration tasks will be adapted, if necessary, to place BMPs where they will 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 is recommended that the permitted point sources (i.e., CAFOs, AFOs) 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 Bone Hill Creek watershed are inspected on an as needed basis.

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Appendix A

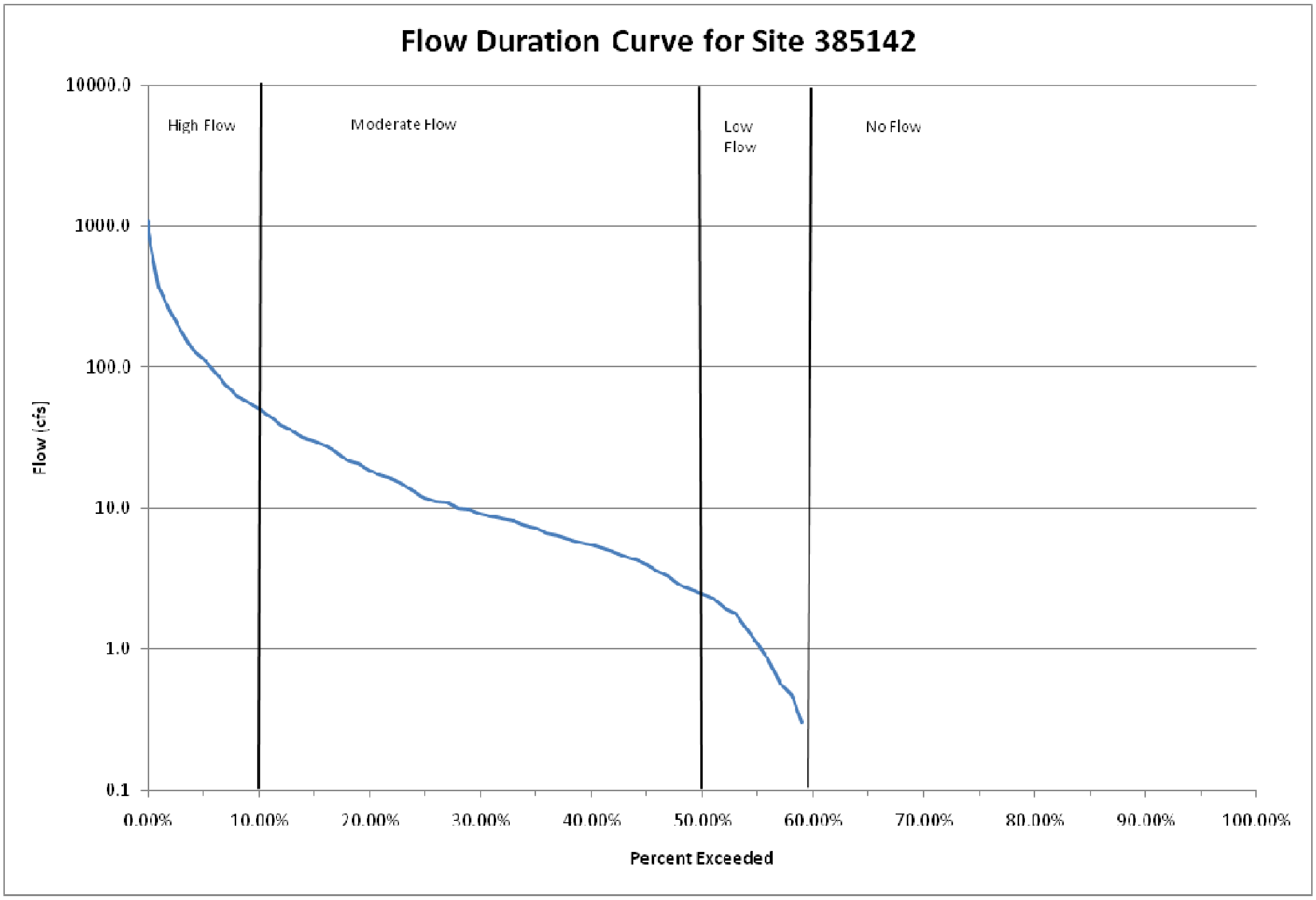
Fecal Coliform Bacteria Data Collected
At Site 385142 (Bone Hill Creek near Dickey, North Dakota)

Date	Result
5/2/2002	30
5/7/2002	430
5/9/2002	900
5/16/2002	220
5/20/2002	340
5/23/2002	140
5/28/2002	140
5/30/2002	100
6/4/2002	280
6/11/2002	140
6/18/2002	70
6/24/2002	1600
7/10/2002	1600
7/18/2002	1600
7/24/2002	360
8/12/2002	340
9/12/2002	220
5/5/2003	1800
5/8/2003	900
5/12/2003	960
5/14/2003	540
5/19/2003	150
5/21/2003	200
5/28/2003	600
6/2/2003	900
6/9/2003	640
6/16/2003	810
6/23/2003	1600
6/30/2003	120
7/14/2003	1000
8/11/2003	530
5/3/2005	10
5/10/2005	380
5/17/2005	960
5/31/2005	1000
6/7/2005	310
6/9/2005	40
6/14/2005	380
6/21/2005	200
6/28/2005	200
7/5/2005	230
7/12/2005	100
7/19/2005	360
8/22/2005	190
9/6/2005	360
9/20/2005	130
5/3/2006	200
5/10/2006	340
5/17/2006	1500
5/24/2006	400
5/31/2006	1100
6/7/2006	2800
6/14/2006	4500

Date	Result
6/21/2006	6400
5/2/2007	230
5/8/2007	710
5/15/2007	550
5/22/2007	3000
6/13/2007	840
6/20/2007	110
6/26/2007	160
7/2/2007	900
7/11/2007	750
7/18/2007	560
7/25/2007	2800
8/1/2007	850
8/15/2007	610
8/29/2007	510
5/5/2008	210
5/20/2008	60
5/20/2008	5
5/27/2008	380
5/27/2008	300
6/2/2008	170
6/2/2008	300
6/9/2008	300
6/18/2008	280
6/25/2008	420
7/7/2008	5700

Appendix B

Flow Duration Curve Analysis for Site 385142



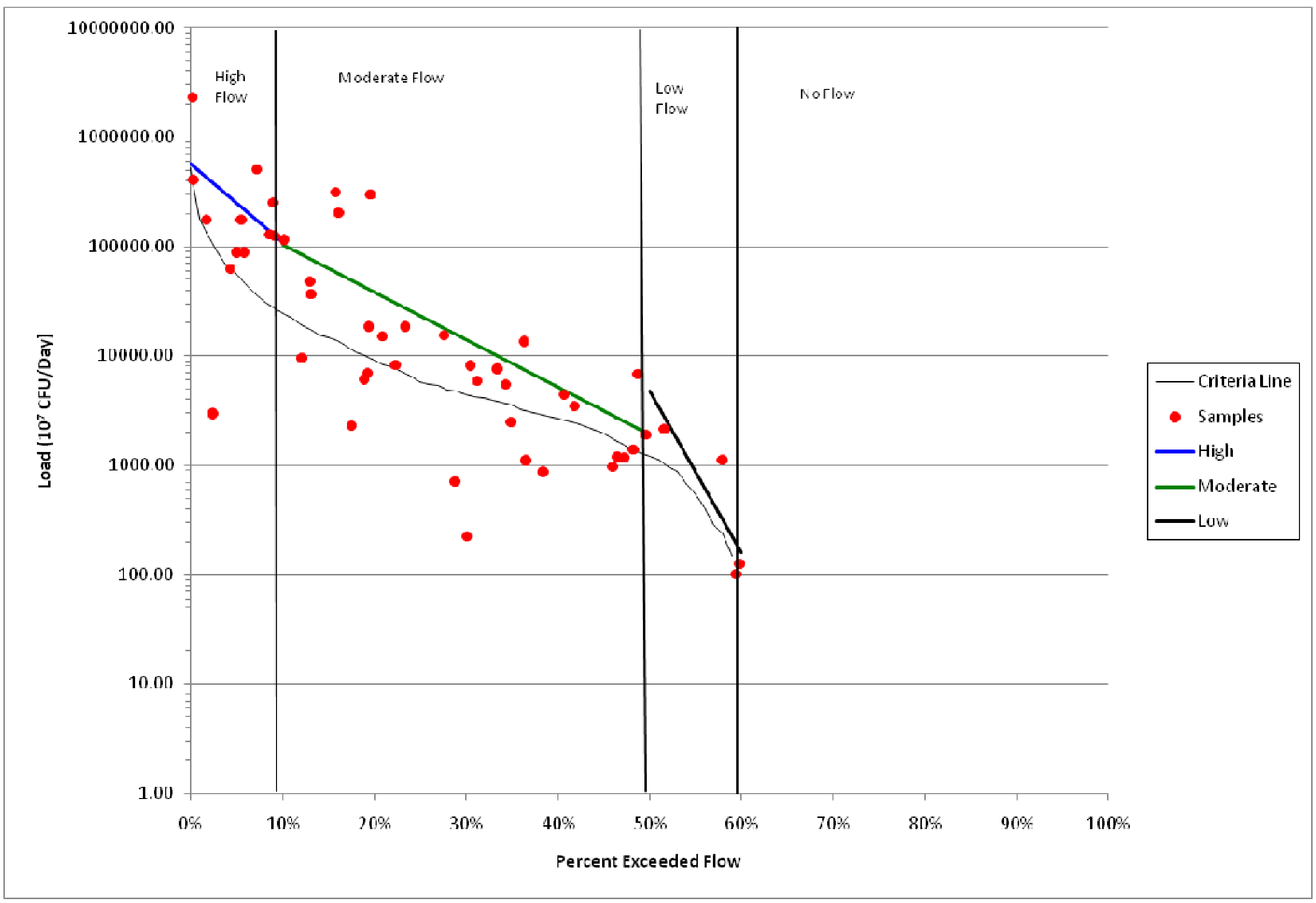
Flow Duration Curve for Site 385142
10000.0
1000.0
100.0
10.0
1.0
0.1
Flow (cfs)
High Flow
Moderate Flow
Low Flow
No Flow
0.00%
10.00%
20.00%
30.00%
40.00%
50.00%
60.00%
70.00%
80.00%
90.00%
100.00%
Percent Exceeded

Appendix C

Estimated Load, TMDL Target, Percentage Reduction Required and Load Duration Curve for Site 385142

385142 Bonehill Creek near Dickey

	Load (10^7 CFU/Day)				Load (10^7 CFU/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
High	5.00%	251188.64	56288.46	36.50	9168385.36	2054528.65	77.59%
Moderate	30.01%	13944.28	4450.20	145.96	2035355.40	649567.46	68.09%
Low	55.01%	868.97	539.48	36.46	31685.56	19671.48	37.92%
			Total	219	11235426	2723768	75.76%



Appendix D
US EPA Region 8 Public Notice Review and Comments

EPA REGION VIII TMDL REVIEW

TMDL Document Info:

Document Name:	**Fecal Coliform Bacteria TMDL for Bone Hill Creek and Tributaries in Stutsman and LaMoure Counties, North Dakota**
Submitted by:	**Mike Ell, North Dakota Department of Health**
Date Received:	**August 18, 2009**
Review Date:	**September 10, 2009**
Reviewer:	**Sandie Spence / Vern Berry, EPA**
Rough Draft / Public Notice / Final?	**Public Notice Draft**
Notes:	

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

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

Approval Notes to Administrator:

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

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

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

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

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

1. Problem Description

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

1.1 TMDL Document Submittal Letter

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

Minimum Submission Requirements.

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

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

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

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

SUMMARY: The public notice draft Bone Hill Creek fecal coliform TMDL was submitted to EPA for review during the public notice period via an email from Mike Ell, NDDoH on August 18, 2009. The email included the draft TMDL document and a public notice announcement requesting review and comment.

COMMENTS: None

1.2 Identification of the Waterbody, Impairments, and Study Boundaries

The TMDL document should provide an unambiguous description of the waterbody to which the TMDL is intended to apply and the impairments the TMDL is intended to address. The document should also clearly delineate the physical boundaries of the waterbody and the geographical extent of the watershed area studied.

Any additional information needed to tie the TMDL document back to a current 303(d) listing should also be included.

Minimum Submission Requirements:

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

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

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

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

SUMMARY: The Bone Hill Creek watershed is located in Stutsman and LaMoure Counties, in southeast North Dakota. Bone Hill Creek is part of the larger James River basin in the lower James River sub-basin (HUC 10160003). The watershed is approximately 111,939 acres in size. Table 1 provides a summary of the location characteristics of the waterbody and Table 2 provides a summary of the impairment status. It is listed as high priority for TMDL development.

The designated use for the listed segments of the Bone Hill Creek and its tributaries are based on the Class III stream classification in the ND water quality standards (NDCC 33-15-02.1-09). The Bone Hill Creek and its tributaries (ND-10160003-025-S_00) were included on the ND 2008 303(d) list for fecal coliform bacteria which is impairing primary contact recreation uses.

Table 1. General Characteristics of Bone Hill Creek and the Bone Hill Creek Watershed.

Legal Name	Bone Hill Creek
Stream Classification	Class III
Major Drainage Basin	James River - Missouri River
Nearest Municipality	Alfred and Dickey
Assessment Unit ID	ND 10160003-025-S_00
Counties	Stutsman and LaMoure
Ecoregion	Drift Plains(46i) and Missouri Coteau (42a) level IV ecoregions and Northern Glaciated Plains level III ecoregion
Watershed Area	111,939 acres
River Miles	39.33 miles
Tributaries	Unnamed Tributary
Outlet	James River

Table 2. Section 303(d) TMDL Listing Information for Bone Hill Creek Waterbody ND-10160003-025-S_00 (NDDoH, 2008).

Assessment Unit ID	ND 10160003-025-S_00
Waterbody Description	Bone Hill Creek downstream to its confluence with the James River.
Size	39.33 miles
Designated Uses Impaired	Recreation
Use Support	Not supporting
Impairment	Fecal Coliform Bacteria
TMDL Priority	High

The ecoregion in which the waterbody is located consists of flat to rolling topography underlain by glacial till. Prior to cultivation, the area supported tall and short grass prairies and seasonal and temporary wetlands are still common in the area. At present the watershed supports agricultural uses that are dominated by soybean crops. Other lesser crops include spring/winter wheat, pasture/grass, etc. The major crop under cultivation over the last decade has varied depending upon the market demands.

Weather data are not available in the watershed; however, weather data from Montpelier and Edgeley stations show rainfall patterns of increasing volume from April – October with the peak rainfall occurring in June. This pattern is expected to approximate that of the Bone Hill Creek watershed.

Fecal coliform data collected at one sampling location (site 385142) in the watershed from 2002-2003 and 2005-2008 show geometric mean values (pooled monthly across years) that exceed state standards for class III recreational use. NDDoH assessed this waterbody as not supporting this use and the waterbody was placed on the State's 2008 303(d) list. The data from this location form the basis of the TMDL analysis of this submittal.

COMMENTS: It would be helpful for NDDoH to include a brief description of the waterbody's other uses and provide a determination as to its attainment status for those uses. If the additional uses have not been assessed, NDDoH is asked to state that as well.

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 Bone Hill Creek segment addressed by this TMDL is impaired based on fecal coliform concentrations for primary contact recreational uses. Bone Hill Creek is a Class III stream that must be protected for agricultural and industrial uses. Class III streams generally have low flow and prolonged dry periods and hence secondary contact recreational uses and standards are applied. Numeric criteria for fecal coliforms in Class III streams have been established and are presented in the excerpted Table 6 shown below. Discussion of additional applicable water quality standards for Bone Hill Creek can be found on pages 6 and 7 of the TMDL.

Table 6. North Dakota Fecal Coliform Bacteria Standards for Class III Streams.

Parameter	Water Quality Standard	
	Geometric Mean[1]	Maximum[2]
Fecal Coliform Bacteria	200 CFU/100 mL	400 CFU/100 mL

[1] **Expressed as a geometric mean of representative samples collected during any consecutive 30-day period.**

[2] **No more than 10 percent of samples collected during any consecutive 30-day period shall individually exceed the standard.**

COMMENTS: None.

2. Water Quality Targets

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

Minimum Submission Requirements:

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

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

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

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

SUMMARY: The water quality targets for this TMDL are based on the numeric water quality standards for fecal coliform bacteria based on the primary contact recreational beneficial use for Bone Hill Creek and its tributaries. The target for the Bone Hill Creek segment included in the TMDL document is the fecal coliform standard expressed as the 30-day geometric mean of 200 CFU/100 mL. While the standard is 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 the acute (single sample value) and chronic (geometric mean of 5 samples) standards.

COMMENTS: None.

3. Pollutant Source Analysis

A TMDL analysis is conducted when a pollutant load is known or suspected to be exceeding the loading capacity of the waterbody. Logically then, a TMDL analysis should consider all sources of the pollutant of concern in some manner. The detail provided in the source assessment step drives the rigor of the pollutant load allocation. In other words, it is only possible to specifically allocate quantifiable loads or load reductions to each 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, Table 3, includes the landuse breakdown in the watershed for 2002 and 2007. In 2002, approximately 78 percent of the landuse in the watershed was cropland under active cultivation, and 23 percent was pasture/rangeland, fallow, or water.

The following nonpoint sources were found to be the primary sources for fecal coliform bacteria in the watershed:

- Runoff of manure from crop and pasture lands;
- Runoff of manure from unpermitted animal feeding areas;
- Direct deposit of manure into Bone Hill Creek by grazing livestock; and
- Wildlife contributions of fecal material in the watershed.

There are no permitted sources of fecal coliforms in this watershed. However, there are CAFOs/AFOs in the watershed which have zero discharge requirements and are not deemed to be significant sources of fecal coliforms.

COMMENTS: The report states that data were collected at one location in the watershed and the report also states that through the 2002-2003 and 2005-2008 water quality assessments, it was determined that the above bulleted sources are the primary contributors of fecal coliforms in the watershed. As information regarding source identification efforts is not provided, it is not clear how these sources were found to be the major contributors. Are these the only potential sources beside the CAFOs/AFOs located in the watershed? How many permitted CAFOs/AFOs are located within the watershed? Additional information regarding how it was determined that these are the primary sources of fecal coliforms in the watershed would be helpful.

The potential pathogen contributions from septic systems should be considered and explained in the document. If the towns in the watershed do not have centralized wastewater collection systems, then septic systems can be potential contributors. Also, as part of the implementation plan for this TMDL we recommend that the permitted point sources (i.e., permitted CAFOs and AFOs) 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.

Also, the landuse breakdown in Table 3 may need to be revised. It shows a total landuse of 101.6 percent for 2002, and 61.5 percent for 2007. It is not clear why the 2007 numbers do not add up to a value closer to 100 percent.

4. TMDL Technical Analysis

TMDL determinations should be supported by a robust data set and an appropriate level of technical analysis**.** This applies to **<u>all</u>** of the components of a TMDL document. It is vitally important that the technical basis for **<u>all</u>** 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 Bone Hill Creek watershed TMDL describes how the fecal coliform loads were derived in order to meet the applicable water quality standards for the 303(d) impaired stream segments.

The 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 waterbody, a LDC was developed for Bone Hill Creek from data collected at monitoring site 385142. The LDC were derived using the 200 CFU/100 mL TMDL target (i.e., state water quality standard), the daily flow record from the site, and the observed fecal coliform data collected during 2002, 2003, 2005, 2006 and 2007.

Mean daily flows measured as part of the 2002-2003 and 2005-2008 studies were used to develop the load duration curves and in conversion of the fecal coliform concentration data into loading values. Three flow regimes were established on the curve including a high flow regime accounting for the 90^{th} percentile flows and above, a moderate flow regime including flows between the 50^{th} and 90^{th} percentiles, and a low flow regime including flow values at or below the 50^{th} percentile. The report states that no flow occurs 60 percent of the time at site 385142.

The load duration curve plots the allowable fecal coliform load (using the 200 CFU/100 ml standard) across the three 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 curve. Values falling above the curve indicate exceedance of the TMDL at that flow value while values falling below the curve indicate attainment of the TMDL 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 three flow regimes were determined using the linear regression line.

Table 9 in the submittal provides the TMDLs, WLAs, LAs, and MOS values for Bone Hill Creek as seen below.

Table 9. Fecal Coliform Bacteria TMDL (10^7 CFUs/day) for Bone Hill Creek Waterbody Assessment Unit ID ND-10160003-025-S_00 (represented by site 385142).

	Flow Regime		
	High Flow	Moderate Flow	Low Flow
Existing Load	239,935	13,944	869
TMDL	56,288	4,450	539
WLA	0	0	0
LA	50,659	4,005	485
MOS	5,629	445	54

COMMENTS: It is not clear why 3 flow zones were used in the LDC for this TMDL. Page 9 of the document explains ***how*** the flow regimes were defined, but no explanation is given for ***why*** 3 zones were used. A brief explanation of 3 flow zones were used (e.g., based on the shape of the curve, no flow at low end of curve, etc) should be added to the document.

From the information provided on page 9 of the document, it is not clear how the linear regression line is used in determining the required percent reductions needed for LDC. NDDoH is asked to clarify the information and include a description as to how the percent reduction calculation is made using the linear regression line.

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 Bone Hill Creek TMDL data description and summary are included tables throughout the document for the listed segment. A gage station for this watershed was not available for estimation of flows.

However, 865 individual flow measurements were available to establish the load duration curve and determine instantaneous fecal coliform loads from analytical results.

Seventy-nine fecal coliform data points were available to estimate the fecal coliform load in the watershed. These samples were collected in 2002-2003 and 2005-2008. Data were pooled across years for the months of collection and the monthly geometric mean values were compared to the standard for the attainment determination. For the TMDL analysis, individual data values were plotted on the load duration curve and required percent load reductions needed to achieve the TMDL were determined as described in Section 4.0 of this document.

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: There are no facilities with permitted fecal coliform discharges in the watershed. There are an unspecified number of permitted concentrated animal feeding operations (CAFOs) and permitted animal feeding operations (AFOs) in the watershed. Their permits require no discharge so they are not considered significant point sources in the TMDL document. Therefore, the WLA for this TMDL is zero.

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, Table 3, includes the following landuse breakdown in the watershed for 2002: approximately 78 percent of the landuse in the watershed was cropland under active cultivation, and 23 percent was pasture/rangeland, fallow, or water. The nonpoint source assessment identifies the significant contributor of the fecal coliform load in the watershed as primarily coming from the landuses where livestock grazing and feeding operations are located in the watershed. Many animal feeding areas were identified in the Bone Hill Creek watershed. Table 9 specifies the load allocations for the listed segment of the Bone Hill Creek, at 3 different flow regimes.

As there are no point sources contributing fecal coliforms in the watershed, the entire TMDL has been allocated to nonpoint sources as a load allocation (LA). 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 7. Nonpoint Sources of Pollution and Their Potential to Pollute at a Given Flow Regime.

Nonpoint Sources	Flow Regime		
	High Flow	Medium Flow	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 importance of nonpoint source 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 Bone Hill Creek TMDL includes an explicit MOS derived by calculating 10 percent of the loading capacity. The explicit MOS for the Bone Hill Creek watershed is included in Table 9 of the TMDL for each flow regime.

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 TMDL is 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 two 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: Implementation of best management practices (BMPs) are specified in the Section 319 Bone Hill Creek Watershed Restoration Project. To make sure those BMPs are successful in reducing fecal coliform bacteria loadings to levels prescribed in the TMDL document, water quality monitoring is being conducted in accordance with an approved Quality Assurance Project Plan (QAPP). As prescribed in the QAPP, weekly monitoring is being conducted at four sites for fecal coliform bacteria and E. coli. The sampling began in October 2005 and will continue through June 2010.

COMMENTS: The description of the restoration project and sampling plan is very similar to the language contained in the Maple River TMDL. Will weekly sampling at 4 sites be conducted for this watershed (seems odd when only one site was sampled during the assessment)?

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: In response to the Bone Hill Creek Watershed Assessment, and in anticipation of this completed TMDL, local sponsors successfully applied for and received Section 319 funding for the Bone Hill Creek Watershed Restoration Project. Beginning in October 2003, local sponsors have been providing technical assistance and implementing BMPs designed to reduce fecal bacteria loadings and to help restore the beneficial uses of the Bone Hill Creek (i.e., recreation). Water quality data has been collected to monitor and track the effects of BMP implementation as well as to judge overall success of the project in reducing fecal coliform bacteria loadings. A QAPP has also been developed as part of this watershed restoration project that details the how, when and where monitoring will be conducted to gather the data needed to document success in meeting the TMDL implementation goal(s). As the data are gathered and analyzed, watershed restoration tasks will be adapted, if necessary, to place BMPs where they will have the greatest benefit to water quality and in meeting the TMDL goal(s).

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 Bone Hill Creek fecal coliform TMDL document includes daily loads expressed as colonies per day for the listed segment in the watershed. The daily TMDL loads are included in TMDL section (Section 7.0) of the document.

COMMENTS: None.

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

EPA Region 8 Comment: It would be helpful for NDDoH to include a brief description of the waterbody's other uses and provide a determination as to its attainment status for those uses. If the additional uses have not been assessed, NDDoH is asked to state that as well.

NDDoH Response: A second paragraph was added to Section 1.0 which describes current assigned beneficial uses and their use attainment status.

EPA Region 8 Comment: The report states that data were collected at one location in the watershed and the report also states that through the 2002-2003 and 2005-2008 water quality assessments, it was determined that the above bulleted sources (Runoff of manure from crop and pasture lands; Runoff of manure from unpermitted animal feeding areas; Direct deposit of manure into Bone Hill Creek by grazing livestock; and Wildlife contributions of fecal material in the watershed) are the primary contributors of fecal coliforms in the watershed. As information regarding source identification efforts is not provided, it is not clear how these sources were found to be the major contributors. Are these the only potential sources beside the CAFOs/AFOs located in the watershed? How many permitted CAFOs/AFOs are located within the watershed? Additional information regarding how it was determined that these are the primary sources of fecal coliforms in the watershed would be helpful.

The potential pathogen contributions from septic systems should be considered and explained in the document. If the towns in the watershed do not have centralized wastewater collection systems, then septic systems can be potential contributors. Also, as part of the implementation plan for this TMDL we recommend that the permitted point sources (i.e., permitted CAFOs and AFOs) 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.

Also, the landuse breakdown in Table 3 may need to be revised. It shows a total landuse of 101.6 percent for 2002, and 61.5 percent for 2007. It is not clear why the 2007 numbers do not add up to a value closer to 100 percent.

NDDoH Response: Additional justification along with a table summarizing the number of AFOs identified as part of the AGNPS watershed model was added to Section 4.2. The basis for this additional information were data collected as part of the 2002-2003 watershed assessment and summarized in the 2004 Bone Hill Creek Watershed Assessment Report (NDDoH, 2004).

The following paragraph describing the potential for failed septic systems to contribute was also added to Section 4.2:

> "Failing septic systems or direct discharge sewage systems which contribute to fecal coliform bacteria contamination may also be located within the watershed. While their specific location and potential for fecal coliform loading are unknown, these systems may be associated with isolated single-family dwellings and farmsteads located throughout the watershed or within small towns located within the watershed that do not have a centralized sewer system (e.g., Jud and Nortonville)."

In addition, additional language dealing with the allocation to septic systems was added to Section 8.2. It read as follows:

> "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)."

The last paragraph of Section 11.0, Restoration Strategy, was rewritten to further describe how implementation will include the inspection of permitted facilities.

In response the last comment on the land use break down provided in Table 3, the 2002 data provided in the table has been revised to account for the rounding errors resulting in a total land use equaling 101.6 and the 2007 data was revised to included all land use categories, not just agricultural categories.

EPA Region 8 Comment: It is not clear why 3 flow zones were used in the LDC for this TMDL. Page 9 of the document explains ***how*** the flow regimes were defined, but no explanation is given for ***why*** 3 zones were used. A brief explanation of 3 flow zones were used (e.g., based on the shape of the curve, no flow at low end of curve, etc) should be added to the document.

From the information provided on page 9 of the document, it is not clear how the linear regression line is used in determining the required percent reductions needed for LDC. NDDoH is asked to clarify the information and include a description as to how the percent reduction calculation is made using the linear regression line.

NDDoH Response: An additional section was added to Section 5.0, Technical Analysis. This new section, added as Section 5.2, describes the flow duration curve analysis, which is a precursor to the load duration curve analysis. This new section describes how the flow intervals used in the load duration curve are selected.

Additional language was also added to the "Load Duration Curve Analysis" section, now 5.3, which describes with an example of how the existing and TMDL loads are calculated from the regression line and the TMDL target curve. This section also describes how the midpoint for the flow interval is selected.

EPA Region 8 Comment: The description of the restoration project and sampling plan is very similar to the language contained in the Maple River TMDL. Will weekly sampling at 4 sites be conducted for this watershed (seems odd when only one site was sampled during the assessment)?

NDDoH Response: Despite is similarity to the Maple River TMDL report, four sites are currently being monitored as part of the Bone Hill Creek Watershed Implementation Project QAPP. In addition to site 385142, three additional sites are being monitored weekly for fecal coliform and E. coli bacteria. These sites correspond to the sub-watersheds in the Bone Hill Creek watershed.