Fecal Coliform Bacteria TMDL for the Wintering River in McHenry and McLean Counties, North Dakota

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1.0 INTRODUCTION AND DESCRIPTION OF THE WATERSHED

Wintering River is located within the Mouse (Souris) River Watershed. The watershed is located in southwest McHenry and northeast McLean Counties, in north central North Dakota (Figures 1 and 2). The river is 207.8 miles long and its watershed has an area of 555,520 acres. The watershed flows northward and empties into the Mouse (Souris) River. Table 1 summarizes some of the geographical, hydrological and physical characteristics of Wintering River.

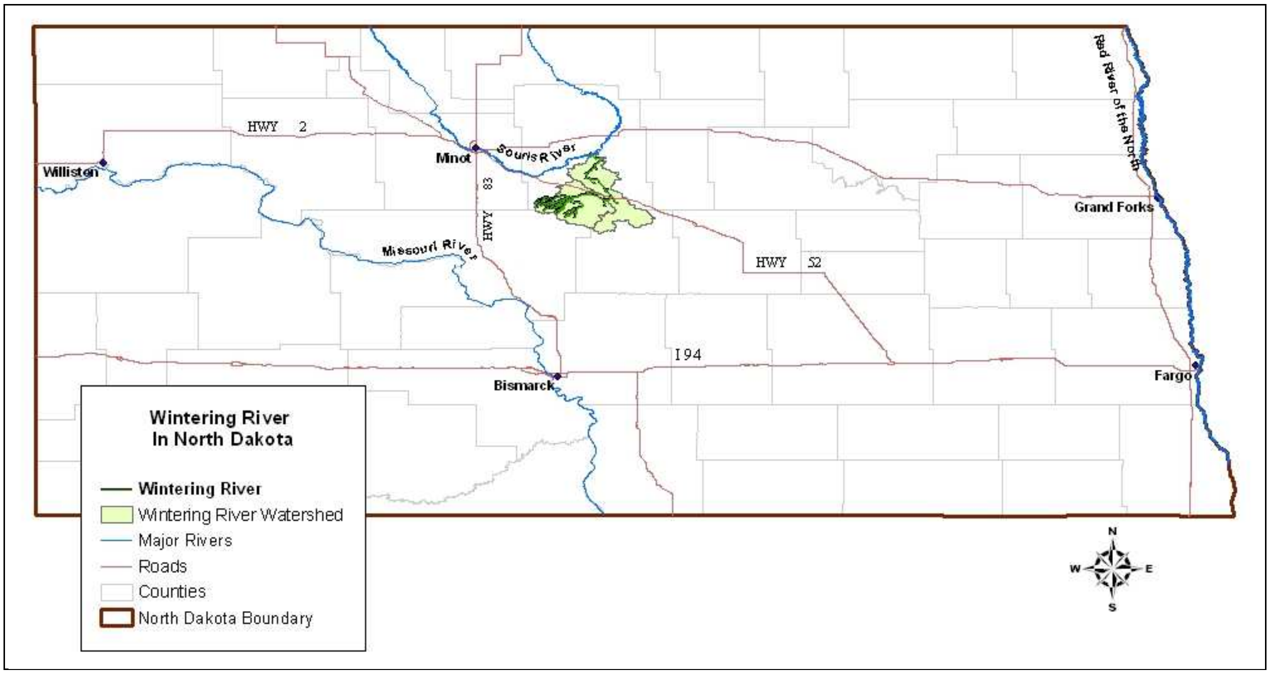

Figure 1. Location of Wintering River and Its Watershed in North Dakota.

Table 1. General Characteristics of Wintering River and its Watershed.

Legal Name	Wintering River
Stream Classification	Class III
Major Drainage Basin	Mouse (Souris) River[1]
Assessment Unit ID	ND-09010003-003-S_00
Nearest Municipality	Velva, ND
Counties	McHenry and McLean Counties, ND
Eco-region	Glacial Lake Delta and Drift Plains
Watershed Area	555,520 acres
River Miles	207.8 miles
Tributaries	Unnamed
Outlets	Souris River

[1] Recent local legislation passed that determined the river shall be called Mouse River on all identifiable signs. It is also known as the Souris River in Canada and to many state and federal agencies within North Dakota

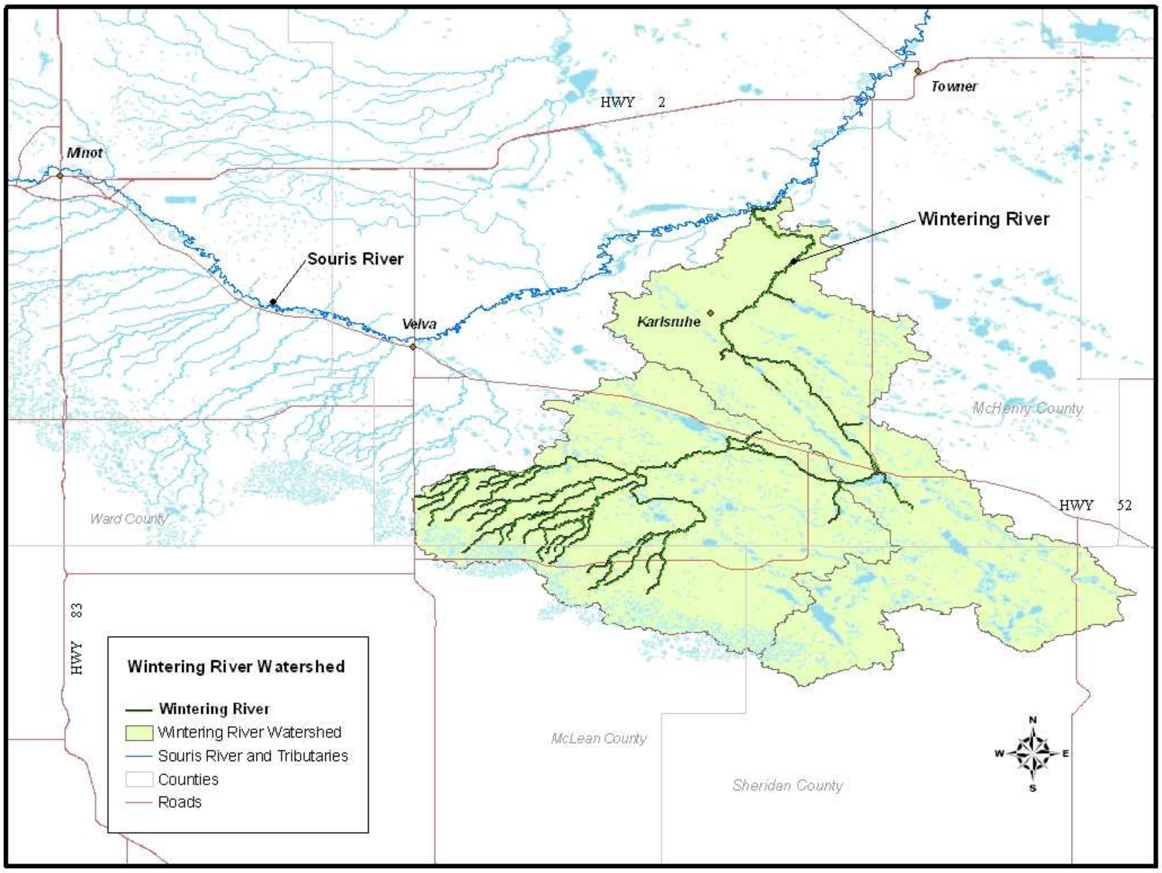

Figure 2. Location of Wintering River and its Watershed.

1.1 Clean Water Act Section 303(d) Listing Information

Based on the 2008 Section 303(d) list of impaired waters needing TMDLs, the North Dakota Department of Health (NDDoH) has identified the Wintering River as not supporting for recreational beneficial use due fecal coliform bacteria. Aquatic life use is also assessed as fully supporting, but threatened, for dissolved oxygen, which will be addressed in a separate TMDL report.

Table 2. 2008 Section 303(d) TMDL Listing Information for the Wintering River.

Assessment Unit ID	ND-09010003-003-S_00
Waterbody Description	Wintering River, including all tributaries. Located in SW McHenry County and NE McLean County
Size	207.8 miles
Impaired Designated Uses	Recreation
Use Support	Not Supporting
Impairment	Total Fecal Coliform Bacteria
Priority	High

1.2 Topography

The Wintering River begins at Wintering Lake, southwest of Bergen, ND and flows east then north to the Mouse (Souris) River. Approximately 87 percent of the Wintering River watershed lies within the Drift Plains level IV ecoregion (46i), with ten percent in the Glacial Lake Deltas ecoregion (46d), and about three percent in the Missouri Coteau (42a). These all belong to the Northern Glaciated Plains level III ecoregion (Figure 3).

The Drift Plains are characterized by generally flat to occasionally rolling topography with a thick layer of glacial till left behind by the Wisconsinan glaciers. Prior to cultivation, the Drift Plain grasslands were a mixture of tall grass and short grass prairie. There are a good proportion of temporary and seasonal wetlands throughout the watershed. The Glacial Lake Deltas were deposited by rivers entering glacial lake basins (e.g., Glacial Lake Souris). The heaviest sediments, mostly sand and fine gravel, formed delta fans at the river inlets. As the lake floors were exposed during withdrawal of the glacial ice, wind reworked the sand in some areas into dunes. In contrast to the highly productive, intensively tilled glacial lake plains, the dunes in the delta areas have a thin vegetative cover and a high risk for wind erosion. These areas are used mainly for grazing or irrigated agriculture. The small portion of the Missouri Coteau ecoregion is within the watershed. It consists of a glaciated, hummocky, rolling stagnation moraine. Stream drainage is absent or uncommon and there are numerous pothole wetlands between mounds of glacial till. Soils consist of thick glacial till over Tertiary sandstone and shale (USGS, 2006).

The soils present belong to the Order Mollisols and are typically Barnes, Svea, Hamerly, and Parnell. Though the till soil is very fertile, agricultural success is subject to annual climatic fluctuations. (USEPA, et al. 1998)

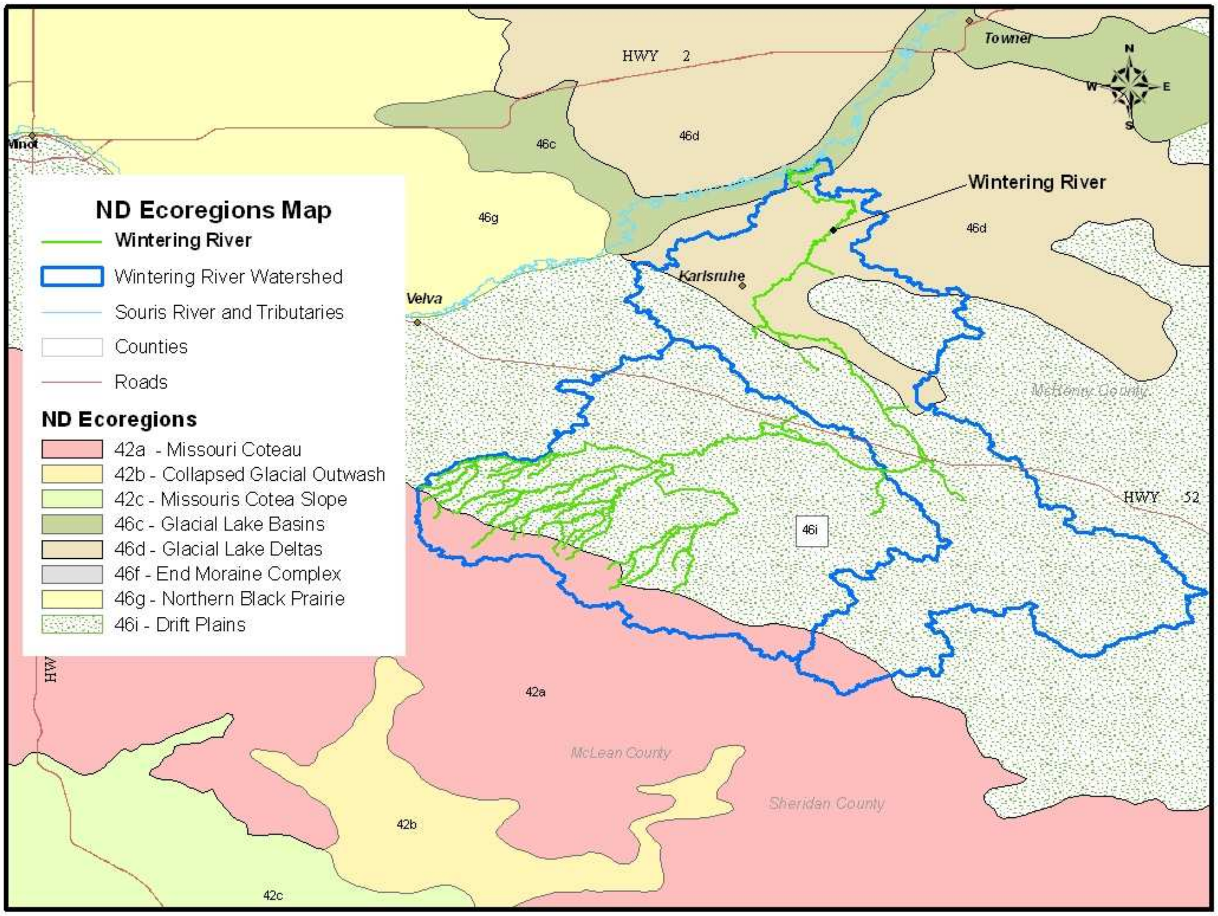

Figure 3. Level IV Ecoregions of the Wintering River Watershed.

1.3 Land Use/Land Cover in the Watershed

Land use data from the North Dakota Agricultural Statistics Service (NASS) indicates that the watershed is primarily agricultural (84.6 percent), consisting of crop production and livestock grazing. Forty-three (43) percent of the agricultural land is actively cultivated, tilled mainly for durum, spring wheat, other small grains (e.g., rye, oats), and a variety of other crops (Table 4). Forty-one (41) percent of the watershed is pasture/range/haylands. Four (4) percent is low density urban development, while water and woods make up almost ten (10) percent of the watershed (Tables 3 and 4, Figure 4). There are no confined animal feeding operations (CAFOs) within the contributing drainage. There are 14 animal feeding operations (AFOs), of which two have undergone the State permitting process (Figure 5). The non-permitted animal feeding operations are not mapped at the request of the local Soil Conservation District. While all CAFOs must obtain a permit, only those AFOs that have the potential to impact water quality are required to obtain a permit. For more details on operations requiring a permit, please refer to North Dakota State Century Code, Chapter 33-16-03.1-05.

Table 3. Land Use by Major Category in the Wintering River Watershed.

Major Category	Acres	Percent of Watershed
Agriculture/Cultivated	241,682.5	43.50
Pasture/Range/Hay	228,311.6	41.10
Urban/Barren	23,397.1	4.21
Water	46,507.2	8.37
Woods	9,683.5	1.74
No Data	5,938.1	1.07

Table 4. Land Use by Type in the Wintering River Watershed.

Land Use Type	Acres	Percent of Watershed
Winter Wheat	804.62	0.15
Durum/SpringWheat	130,451.86	23.48
Rye/Oats/Other Small Grains	5,636.78	1.01
Beans/Peas/Lentils	62,195.10	11.20
Sunflowers	10,730.78	1.93
Corn	16,373.51	2.95
Potatoes	410.06	0.07
Mustard Seed	110.93	0.02
Flax	3,879.63	0.69
Canola/Safflower	11,149.20	2.01
Idle/CRP/Hayland	118,107.74	21.26
Pasture/Range	48,333.08	8.70
Alfalfa	61,870.83	11.14
Water	46,507.24	8.37
Woods	9,683.45	1.74
Urban	22,078.44	3.97
Barren	1,318.70	0.24
No Data	5,938.05	1.07
TOTAL	**555,520**	**100**

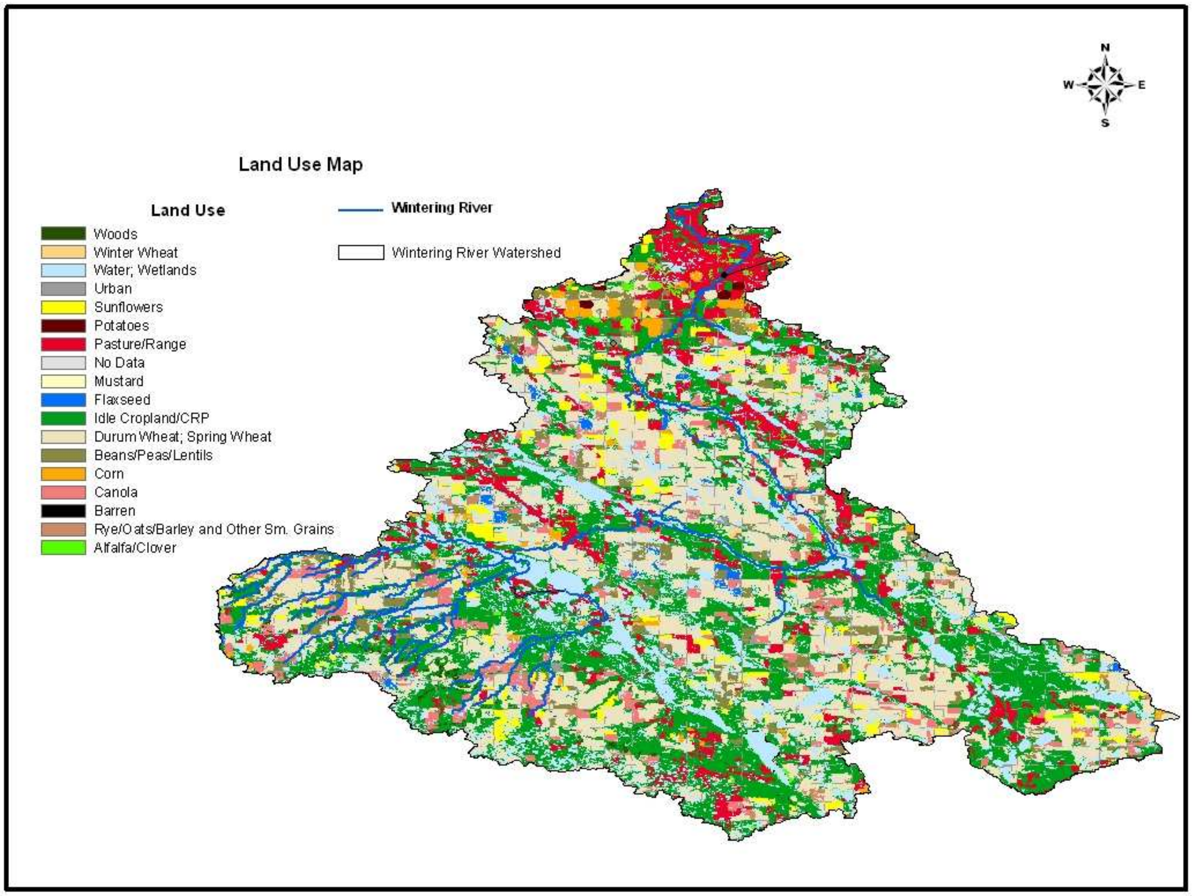

Figure 4. Land Use Map for the Wintering River Watershed (NASS, 2006).

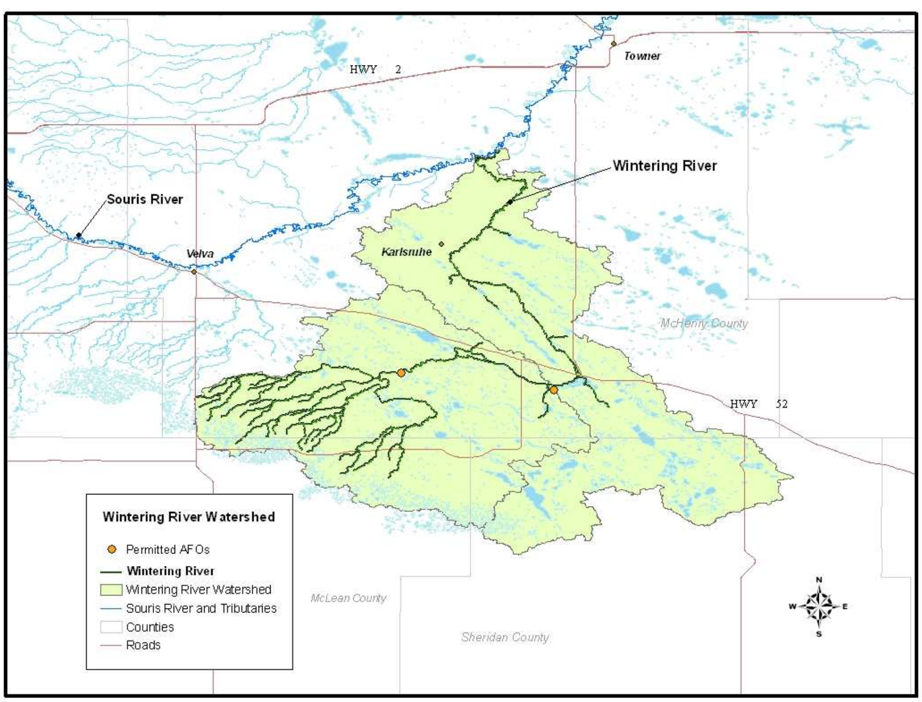

Figure 5. Permitted Animal Feeding Operations in the Wintering River Watershed.

1.4 Climate and Precipitation

North Dakota's climate is characterized by large temperature variation across all time scales, light to moderate irregular precipitation, plentiful sunshine, low humidity, and nearly continuous wind. Its location at the geographic center of North America results in a strong continental climate, which is exacerbated by the mountains to the west. There are no barriers to the north or south so a combination of cold, dry air masses originating in the far north and warm humid air masses originating in the tropical regions regularly overflow the state. Movement of these air masses and their associated fronts causes near continuous wind and often results in large day to day temperature fluctuations in all seasons. The average last freeze in spring occurs in late May. In the fall, the first 32 degree or lower temperature occurs between September 10th and 25th. However, freezing temperatures have occurred as late as mid-June and as early as mid-August. About 75 percent of the annual precipitation falls during the period of April to September, with 50 to 60 percent occurring between April and July (Figure 6). Most of the summer rainfall is produced during thunderstorms, which occur on an average of 25 to 35 days per year. On the average, rains occur once every three or four days during the summer. Winter snowpack, although persistent from December through March, only averages around 15 inches (Enz, 2003).

Average annual air temperatures at the Karlsruhe, North Dakota Agricultural Weather Network (NDAWN) station, located within the Wintering River watershed were 44^{o} F in 2006 and 46^{o} F in 2007, with an average annual wind speed of 11.2 mph. Total annual precipitation was 10.27 inches in 2006 and 9.58 inches in 2007 (Figure 7). November through February averages about 0.50 inches of precipitation per month, occurring mostly as snow. Measurable precipitation (0.01 inch or more) occurs an average of 65 to 100 days during the year with over 50 percent of these events producing less than 0.10 inch (NDAWN, 2008).

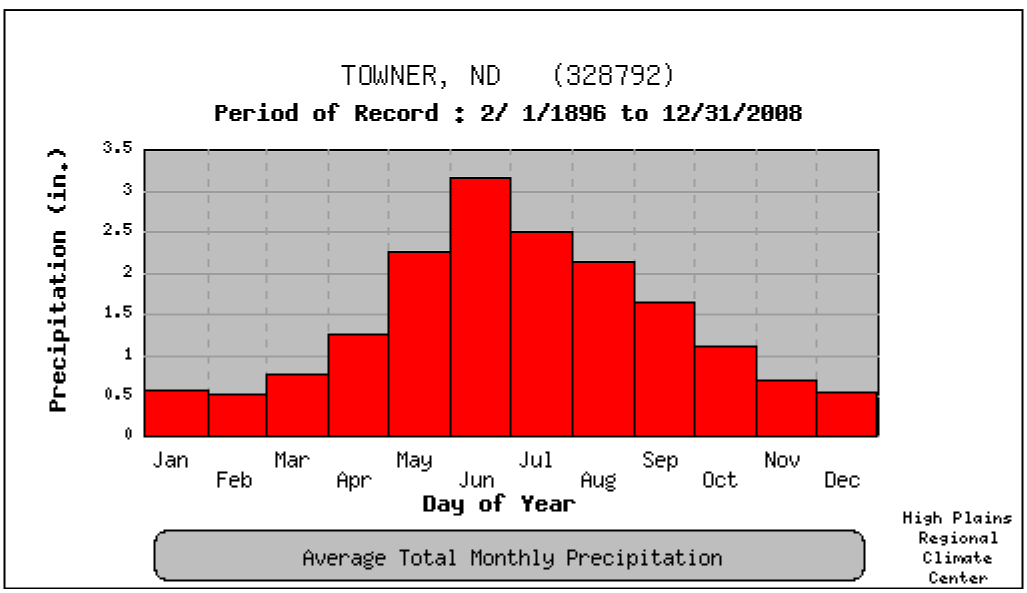

Figure 6. Average Total Monthly Precipitation Data for the High Plains Regional Climate Center Station at Towner, North Dakota (328792) from 1896 – 2008.

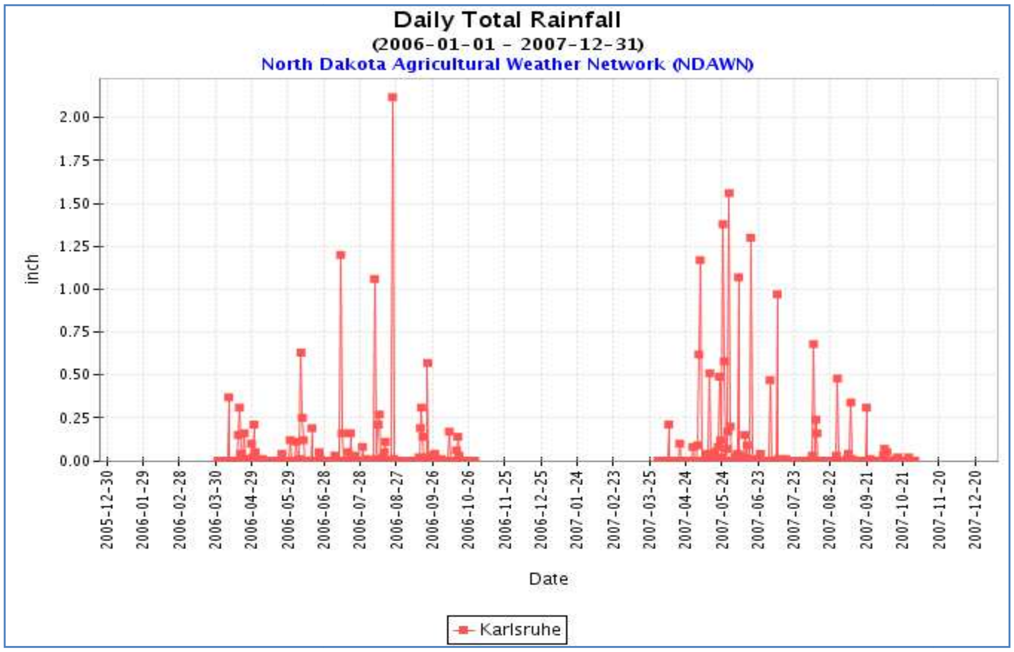

Figure 7. Rainfall Amounts at the Karlsruhe NDAWN Weather Station, 2006-2007.

1.5 Available Data

Wintering River has three distinct regions. The upstream third of the river is ephemeral. As a result, over the two years water samples were taken (2006 and 2007), only five flow measurements were recorded. This is insufficient to construct a load duration curve. The middle third, identified by site 385386 (Figure 8), is functionally a large wetland with almost no flow, except for very large rain events. Twenty-six (26) fecal coliform bacteria samples were taken and no results were over the State standards. The final section functions as a typical stream and has springs which provide flow to this portion almost all year round. There is a USGS gauging station (05120500) collocated with sampling station 384107. This site, 384107, had exceedances of the fecal coliform bacteria standard (Appendix A). Because the entire Wintering River is listed as impaired, and because this final station provided the most useful data, both fecal coliform bacteria and flow, and is located very near the downstream extent of the watershed, the load duration curves were developed based on data gathered at this station.

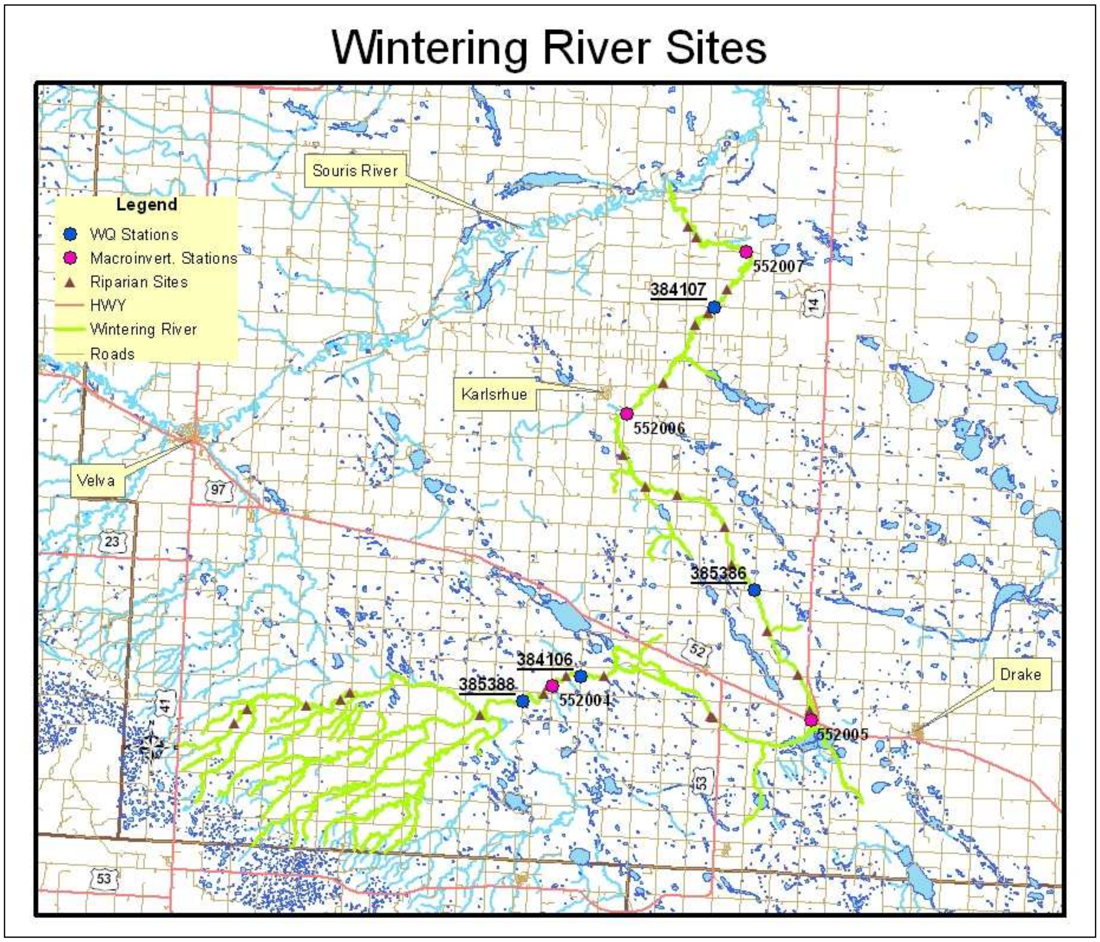

Figure 8. Sampling Site Locations on the Wintering River

1.5.1 Fecal Coliform Bacteria Data

Table 5 provides a summary of monthly geometric mean fecal coliform bacteria concentrations, the percentage of samples exceeding 400 CFU/100mL, and the recreational use assessment for site 384107. The data were pooled across years (2006 and 2007) and the geometric mean concentration of fecal coliform bacteria and the percent of samples over 400 CFU/100mL were calculated for each month during the recreational period of May 1 through September 30. For the month of May, based on State water quality standards, recreational use was fully supported. For the months of June and July, both geometric mean as well as the percent of samples exceeding 400 CFUs/100mL exceeded the State water quality standards. For the months of August and September there was no flow in Wintering River, therefore no samples were taken. Since in two out of the three months of flow Wintering River was not supporting the recreational use, the entire TMDL listed segment of Wintering River is assessed as not supporting recreational use.

Table 5. Summary of Fecal Coliform Bacteria Data for Site 384107, Wintering River near Karlsruhe (2006-2007).

Month	N	Geometric Mean Concentration (CFU/100mL)	Percentage of Samples Exceeding 400 CFU/100mL	Recreational Use Assessment
May	12	54	8.33%	Fully supporting
June	9	310	44.44%	Not Supporting
July	8	371	37.50%	Not Supporting
August	0[1]	-	-	-
September	0[1]	-	-	-

[1] No flow in Wintering River during these months. No samples were collected.

Fecal coliform bacteria interpretation includes the entire open water period, but TMDL interpretation is restricted to the period between May 1 and September 30, to match the State's water quality standard.

<u>1.5.2 Hydraulic Discharges</u>

A continuous discharge record was constructed for Wintering River, based on USGS measurements for site 05120500 collected from 1996 – 2007. This site is collocated with STORET sampling site 384107 (Figure 8).

<u>1.5.3 Other Data</u>

Other data were also collected in addition to the water chemistry data throughout the watershed. A riparian assessment was conducted with the help of the Natural Resources Conservation Service using the Riparian Health Assessment Protocol (Appendix C). Twenty-three sites were chosen based on a random sampling method provided by the US EPA. Each site was scored based on numerous ranking questions including those on stream bank vegetative cover and livestock caused bare ground/hummocking. This tool is useful in determining where livestock may be contributing to the fecal coliform bacteria load. Total points possible are 57. A summary of the assessment is provided in Table 6. Of the 23 sites sampled (Figure 8), 17 scored in the Healthy range, five scored in the range of Healthy with Problems, and only one scored in the Unhealthy range. The sites closer to the Unhealthy range were mostly located in the downstream portion of the watershed.

Table 6. Riparian Health Assessment Summary for the Wintering River.

Points	Percent of Total	Conditions Status	Number of Sites
57/57	100	Healthy	3
52/57	91		7
46/57	80		7
40/57	70	Healthy with Problems	2
37/57	65		3
34/57	60		0
32/57	56	Unhealthy	1
29/57	51		0
23/57	40		0
17/57	30		0

A Rapid Geomorphic Assessment (Appendix D) was also conducted to determine stream channel stability and stage of channel evolution. Areas identified in this assessment as having high stream bank erosion and instability are good indicators of where livestock are present in the riparian area and may be contributing to the fecal load. The seven sites assessed corresponded to the three water quality sites and four macroinvertebrate sampling sites. Scores of 0-15 were ranked as stable, and 15-30 were ranked as unstable. Only one site (Site 552007) ranked as unstable at 23.5 points. This site is located furthest downstream in the watershed (Figure 8).

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 general water quality standards are listed below (NDDoH, 2006).

- 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

Wintering River 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 7). The fecal coliform bacteria standard applies only during the recreation season of May 1 to September 30.

Table 7. North Dakota Fecal Coliform Bacteria Standards for Class III Streams.

	Water Quality Standard	
Parameter	**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 Wintering River is based on the North Dakota water quality standard for fecal coliform bacteria. If the target is met, the recreation beneficial use will be fully supported.

3.1 Fecal Coliform Bacteria Target

Wintering River and its tributaries are not supporting recreation use due to fecal coliform bacteria counts which exceed 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 ten percent of the samples collected may exceed 400 CFU/100 mL. Therefore, the TMDL target for this report is the fecal coliform bacteria 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 that recreational uses are restored.

4.0 SIGNIFICANT SOURCES

4.1 Point Sources

Within the Wintering River watershed there are no point sources permitted through the North Dakota Pollutant Discharge Elimination System (NDPDES) Program. Towns located within the watershed utilize septic waste systems.

There are no confined animal feeding operations (CAFOS) in the Wintering River watershed. There are two permitted AFOs in the watershed, however, they are zero discharge facilities and are not deemed a significant source for this report.

4.2 Nonpoint Sources

Land use data from the North Dakota Agricultural Statistics Service (NASS) indicates that the watershed is primarily agricultural (84.6 percent), consisting of crop production and livestock grazing. Forty-one (41) percent of the watershed is pasture/range/haylands. Based on the 2006 NASS data, an even larger percentage of the land area within an estimated 250 meter riparian buffer adjacent to the Wintering River is pasture/rangeland and grassland. With agriculture being the predominant land use, farms and ranches are located throughout the watershed. Livestock production is also exemplified as the dominant agricultural practice in McHenry and McLean Counties with an estimated livestock production of 113,000 cattle in the two counties combined (NDASS, 2008).

While there are no large (>1000 animal units) CAFOs within the contributing drainage, there are 14 smaller animal feeding operations (AFOs), of which two have undergone the State permitting process (Figure 5). There may be other AFOs in the TMDL sub-watersheds, however their location and size are unknown.

These data indicate that the primary nonpoint sources for fecal coliform bacteria in the Wintering River watershed are as follows:

- Runoff of manure from cropland and pasture if there is knowledge of manure being applied;
- Runoff of manure from unpermitted animal feeding areas;
- Direct deposit of manure into Wintering River by livestock; and
- Background levels associated with wildlife

This information along with results of the Riparian Health Assessment and the Rapid Geomorphic Assessment (see Section 1.5.3) also suggests that the primary contributors of fecal coliform bacteria for the sub-watersheds are unpermitted animal feeding areas located in close proximity to Wintering River and livestock grazing and watering directly in and adjacent to Wintering River.

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., Karlsruhe and Balfour).

5.0 TECHNICAL ANALYSIS

In TMDL development, the goal is to define the linkage between the water quality target and the identified source or sources of the pollutant (i.e. fecal coliform bacteria) to determine the load reduction needed to meet the 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. 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 Flow

In north-central North Dakota, rain events are variable, occurring during the months of April through August. 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 medium flow regime is represented by runoff that contributes to the stream over a longer duration. The low flow regime is characteristic of drought or precipitation events of small magnitude and do not contribute to runoff.

Mean daily flow data for the period of January 1996 through December 2007 used in the development of the flow duration curves and load duration curves for site 384107 were obtained from the USGS gauging site 05120500 located NE of Karlsruhe, ND, near the base of the watershed. This site is collocated with site 384107.

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 9). 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 9, a flow duration interval of fifty (50) percent, associated with a stream flow of 5.2 cfs, implies that 50 percent of all observed mean daily discharge values equal or exceed 5.2 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 9, the flow duration curve was divided into three zones, one representing high flows (0-15 percent) or flow which are equal to or greater than 44 cfs, another for moderate flows (15-80 percent) or flows between 1.4 and 44 cfs, and one for low flows (80-100 percent)or flows which are equal to or less than 1.4 cfs. 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 9). A secondary factor in determining the flow intervals used in the analysis is the number of fecal coliform observations available for each flow interval.

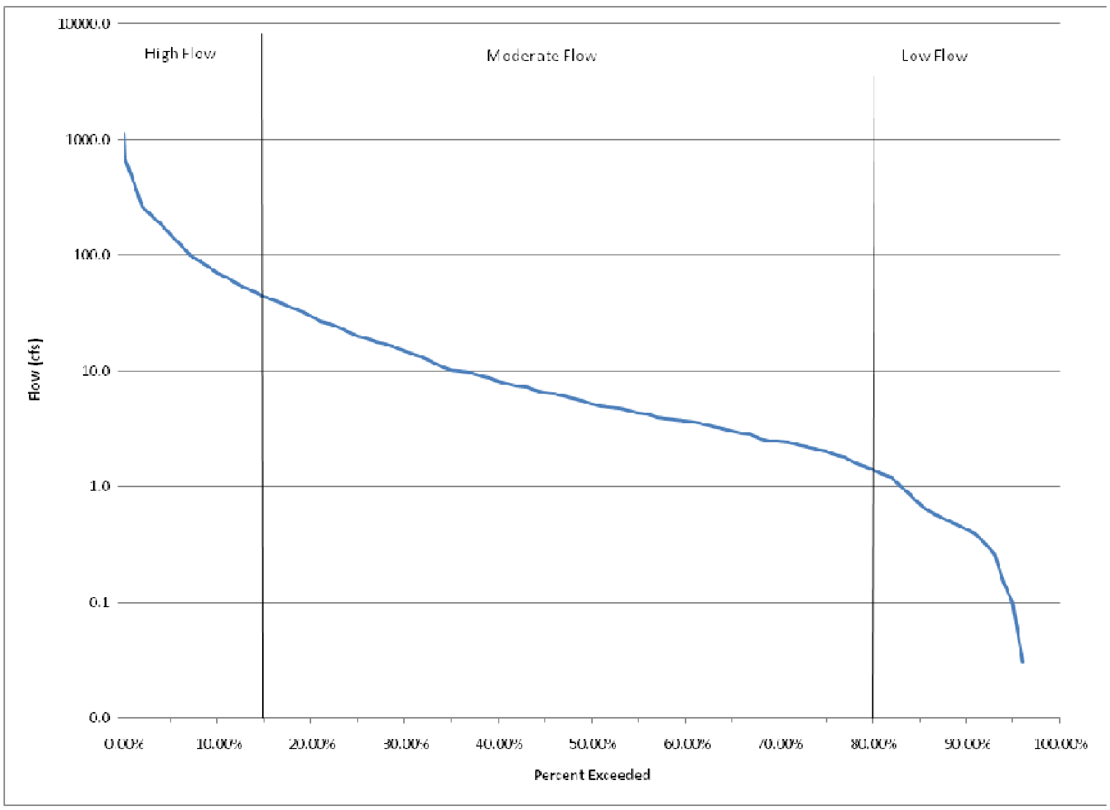

Figure 9. Flow Duration Curve for Wintering River Site 384107, Located near Karlsruhe, North Dakota (Collocated with USGS Site 05120500).

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 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 Wintering River. The load duration curve was derived using the 200 CFU/100mL target (i.e. State water quality standard) and the flows generated as described in Section 5.1.

Observed in-stream fecal coliform bacteria concentrations from monitoring site 384107 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 10). Points plotted above the 200 CFU/100 mL target curve exceed 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 384107 depicting the regression relationship for each flow interval is provided in Figure 10. 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 10, the regression relationship between observed fecal coliform bacteria loading and percent exceeded flow for the moderate flow interval (15-80 percent) is:

Fecal coliform load (expressed as 10^7 CFUs/day) = antilog (4.18 + (-1.82*Percent Exceeded Flow))

Where the midpoint of the flow interval from 15-80 percent is 47.5 percent, the existing fecal coliform load is:

Fecal coliform load (10^7 CFUs/day) = antilog (4.18 + (-1.82*0.475))
= 6,539

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 47.5 percent exceeded flow derived from the 200 CFU/100 mL TMDL target curve is 2,936 x 10^7 CFUs/day (Figure 10).

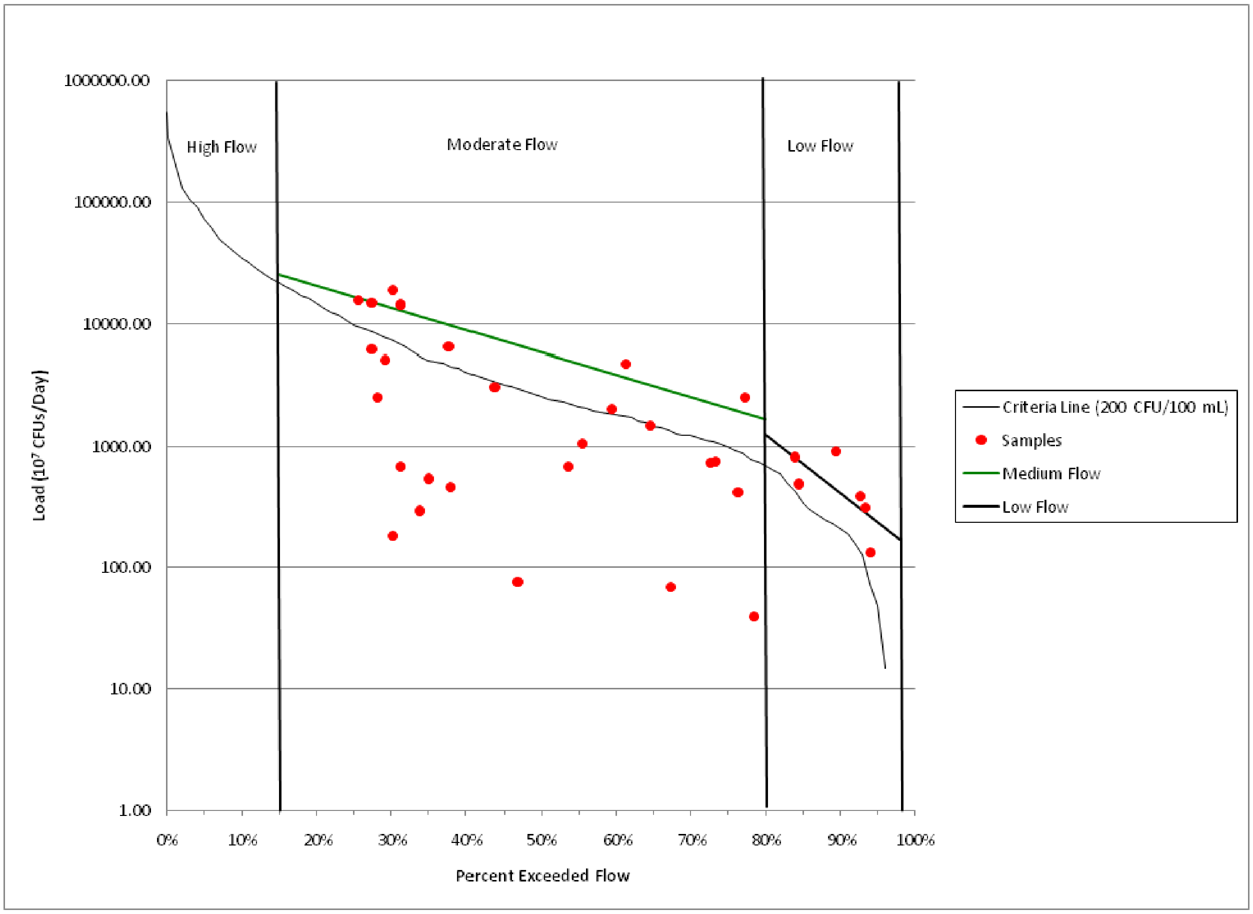

Figure 9. Load Duration Curve for Wintering River Site 384107, Located near Karlsruhe, North Dakota.

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 listed segment should be on unpermitted animal feeding areas, range/pastureland indicated in red in Figure 4, and riparian areas that are greatly disturbed as described in the two riparian surveys in Section 1.5.3. Higher priority should be given to the animal feeding areas rated higher or located in close proximity to Wintering River.

Significant sources of fecal coliform bacteria loading were defined as nonpoint source pollution originating from livestock. One of the more important concerns regarding nonpoint sources is variability in stream flows. Variable stream flows often cause different source areas and loading mechanisms to dominate (Cleland, 2003). TMDLs were developed for two flow regimes (i.e., medium and low), as samples indicated there were no exceedances at high flows. (Figure 9).

By relating runoff characteristics to each flow regime one can infer which sources are most likely to contribute to fecal coliform bacteria loading. Animals grazing in the riparian area contribute fecal coliform bacteria by depositing manure where it has an immediate impact on water quality. Due to the close proximity of manure to the stream or by direct deposition in the stream, riparian grazing impacts water quality at high, 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. 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 in the watershed (Section 4.1), loading sources exceeding the target curve in the medium and low flow regimes, between 0.2 cfs and 44 cfs 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 Wintering River 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 ten percent explicit margin of safety was used for this TMDL. The MOS was calculated as ten percent of the TMDL. In other words ten percent of the TMDL is set aside from the load allocation as a MOS. The ten percent MOS was derived by taking the difference between the points on the load duration curve using the 200 CFU/100 mL standard and the curve using the 180 CFU/100 mL.

6.2 Seasonality

Section 303(d)(1)(C) of the Clean Water Act and associated regulations require that a TMDL be established with seasonal variations. The Wintering River TMDL addresses seasonality because the flow duration curve was developed using 20 years of USGS gage data encompassing twelve months of the year. Additionally, the water quality standard is seasonally based on the recreation season from May 1 to September 30 and controls will be designed to reduce fecal coliform bacteria loads during the seasons covered by the Standard.

7.0 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 of the Wintering River fecal coliform bacteria TMDL. The TMDLs are presented in Table 10. This Table provides an estimate of the existing daily load and an estimate of the average daily loads necessary to meet the water quality target (i.e. TMDL load). This TMDL load includes a load allocation from known nonpoint sources and a ten percent margin of safety. It should be noted that the TMDL loads, load allocations, and the MOS are estimated based on available data and reasonable assumptions and are to be used as a guide for implementation. The actual reduction needed to meet the applicable water quality standards may be higher or lower depending on the results of future monitoring

Table 9. TMDL Summary for Wintering River.

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 the Wintering River (ND-09010003-003-S_00) as Represented by Site 384107.

	Flow Regime		
	High Flow	**Medium Flow**	**Low Flow**
Existing Load	No Reduction is Necessary	6,539	457
TMDL		2,936	230
WLA		0	0
LA		2,642	207
MOS		294	23

8.0 ALLOCATION

There are no known point sources that could potentially impact the watershed. Therefore, the entire fecal coliform bacteria load for this TMDL is allocated to nonpoint sources in the watershed. Three flow regimes (high flows, medium flows, low flows) were identified for the TMDL. TMDLs were not required for the high flow regime because all samples collected at flows in these regimes were at or below the water quality standard of 200 CFU/100 mL

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, it 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 is put forth as a recommendation for what needs to be accomplished for Wintering River, 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 fecal coliform bacteria loading to the Wintering River. The following describe in detail those BMPs that will reduce fecal coliform bacteria levels in the Wintering River.

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 (Table 11).

Waste management system - 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 containing 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.

Table 11. Bacterial Water Quality Response to Four Grazing Strategies (Tiedemann et al., 1989).

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

8.2 Other Recommendations

Vegetative Filter Strip – Vegetated filter strips are used to reduce the amount of sediment, particulate organics, dissolved contaminants, nutrients, and in the case of this TMDL, fecal coliform bacteria to streams. The effectiveness of filter strips and other BMPs in removing fecal coliform bacteria is quite successful. Results from a study by Pennsylvania State University (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 12). The ability of the filter strip to remove contaminants is dependent on field slope, filter strip slope, erosion rate, amount and particulate size distribution of sediment delivered to the filter strip, density and height of vegetation, and runoff volume associated with erosion producing events (NRCS, 2001).

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

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

4. A leaching system that allows the effluent to enter the soil

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

Failure of septic systems can occur for several reasons, although the most common reason is improper maintenance (e.g. age and 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).

Table 12. Relative Gross Effectiveness 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.**

9.0 PUBLIC PARTICIPATION

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

- South McHenry County Soil Conservation District;
- South McLean County Soil Conservation District;
- McHenry County Water Resource Board;
- McLean County Water Resource Board;
- US EPA - Region VIII; and

- USDA-NRCS (State Office).

In addition to the mailed copies, the TMDL for Wintering River 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:

- Mouse River Journal; and
- McLean County Independent.

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

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 ensure that the implementation of BMPs will reduce fecal coliform bacteria levels to the necessary levels, water quality monitoring will be conducted in accordance with an approved Quality Assurance Project Plan (QAPP).

Specifically, monitoring will be conducted for all variables that are currently causing impairments to the beneficial uses of the waterbody. These include, but are not limited to fecal coliform bacteria. Once a watershed restoration plan (e.g. Section 319 Non point Source Project Implementation Plan [PIP]) is implemented, monitoring will be conducted in the watershed beginning two years after implementation and extending five years after the implementation project is complete.

11.0 TMDL IMPLEMENTATION STRATEGY

Implementation of TMDLs is dependent upon the availability of Section 319 NPS funds or other watershed restoration programs (e.g. USDA Environmental Quality Incentive Program), as well as securing a local project sponsor and required matching funds. Provided these three requirements are in place, a project implementation plan (PIP) is developed in accordance with the TMDL and submitted to the ND Nonpoint Source Pollution Task Force and US EPA for approval. The implementation of the BMPs contained in the NPS PIP is voluntary. Therefore, success of any TMDL implementation project is ultimately dependant on the ability of the local project sponsor to find cooperating producers.

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

Also, as part of any 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, it is the policy of the NDDoH that all permitted CAFOs (greater than or equal to 1000 animal units) be inspected annually. Permitted AFOs (<1000 animal units) in the Wintering River watershed are inspected on an as needed basis.

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Appendix A
Fecal Coliform Bacteria Data for Site 384107 Collected During 2006 and 2007

Site	Date	Time	Result
384107	4/4/2006	6:13:00 PM	<10
384107	4/10/2006	3:30:00 PM	<10
384107	4/17/2006	1:40:00 PM	<10
384107	4/19/2006	4:15:00 PM	60
384107	4/24/2006	10:30:00 AM	20
384107	4/26/2006	1:15:00 PM	10
384107	5/1/2006	1:45:00 PM	10
384107	5/3/2006	10:15:00 AM	20
384107	5/8/2006	10:15:00 AM	20
384107	5/15/2006	10:15:00 AM	100
384107	5/17/2006	3:15:00 PM	220
384107	5/23/2006	12:15:00 PM	540
384107	5/29/2006	5:45:00 PM	130
384107	6/5/2006	3:45:00 PM	570
384107	6/12/2006	1:45:00 PM	190
384107	6/14/2006	1:45:00 PM	140
384107	6/28/2006	1:45:00 PM	810
384107	7/12/2006	1:45:00 PM	530
384107	7/16/2006	6:45:00 PM	550
384107	7/18/2006	4:45:00 PM	340
384107	5/10/2007	1:36:00 PM	10
384107	5/16/2007	1:56:00 PM	90
384107	5/23/2007	1:34:00 PM	60
384107	5/30/2007	9:20:00 AM	180
384107	6/6/2007	10:18:00 AM	50
384107	6/11/2007	2:13:00 PM	520
384107	6/25/2007	1:52:00 PM	140
384107	6/27/2007	2:37:00 PM	130
384107	7/11/2007	5:15:00 PM	160
384107	7/17/2007	7:30:00 PM	280
384107	7/18/2007	5:00:00 PM	420
384107	7/25/2007	5:00:00 PM	290
384107	7/29/2007	9:00:00 PM	370
384107	7/30/2007	8:00:00 AM	250
384107	8/8/2007	9:30:00 AM	220

Appendix B
Riparian Health Assessment Protocol

The following is an excerpt from the Riparian Health Assessment for Streams and Small Rivers. The full document can be found at http://www.cowsandfish.org/pdfs/StreamsFieldWkbk2005.pdf (5.14MB):

Riparian Health Assessment for Streams and Small Rivers

FOREWORD

This workbook describing riparian health assessment has been written for those people who can most effectively influence riparian areas with their management - landowners, livestock producers, farmers, agency staff and others who use and value these green zones. Riparian health assessment blends many fields of science and undergoes periodic additions and modifications. In addition, the language describing the method of assessing riparian health undergoes continual evision, to clarify, expand and increase understanding. This printing of the Field Workbook incorporates the feedback from dozens of training workshops involving hundreds of participants. Riparian health assessment forms part of a larger package of awareness about riparian areas, leading to choices on managing these vital landscapes. When used as part of the Cows and Fish program, it provides a starting point for future plans and management decisions.

Why Develop Riparian Health Assessment?
Some History and Uses

Riparian areas are the focus of attention because of their agricultural benefits, the biodiversity values they represent and for concerns about water quality. Some riparian areas have declined in their ability to perform the ecological functions that relate directly to these benefits and values. Often, the health of these valuable landscapes has changed over time, even though that decline isn't readily apparent. We need to understand the current status of riparian areas so that we can improve or maintain their health. The first step is to determine the condition or health of the site. Once we know the health of a site, we have a mechanism to link management actions to improving or maintaining ecological function.

In response to many concerns in the United States, the University of Montana, through its Riparian and Wetland Research Program, devised a system to survey and measure the overall health or condition of a riparian site. Many scientific disciplines participated to determine what the key ecological functions of riparian areas were and how these could be measured with a relatively quick and easy assessment technique. This method was initially used to evaluate riparian health on approximately 8,000 km of rivers and streams in Montana, Idaho, Wyoming, North Dakota and South Dakota. The testing and refinement of the method was expanded to include Alberta, British Columbia and Saskatchewan. With this experience, the method has evolved into the present riparian health assessment. It has been adapted to include riparian situations that will be encountered in Alberta and may be useful for other jurisdictions.

RIPARIAN HEALTH ASSESSMENT QUESTIONS (1-11)

1. How much of the riparian area is covered by vegetation?

Vegetation cover of the floodplain and streambanks

Vegetation reduces the erosive forces of raindrop impacts and the velocity of water moving over the floodplain or along the streambanks. Vegetation cover also:

- traps sediment and stabilizes banks;
- absorbs and recycles nutrients;
- reduces the rate of evaporation; and
- provides shelter and forage values.

Vegetation cover is visually estimated using the canopy cover method. Use the illustrations to help you estimate canopy cover on the reach.

- Sediment deposited on the reach is considered "bare ground" for this question.

Scoring:

6 = More than 95% of the reach soil surface is covered by plant growth (less than 5% bare soil).
4 = 85% to 95% of the reach soil surface is covered by plant growth (5-15% bare soil).
2 = 75% to 85% of the reach soil surface is covered by plant growth (15-25% bare soil).
0 = Less than 75% of the reach soil surface is covered by plant growth (greater than 25% bare soil).

Scoring Tip: Soil not covered by plants, litter, moss, downed wood, or rocks larger than 6 cm (2.5 in) is considered bare ground. Count standing rooted, dead or living plants as vegetative cover.

5. Is Woody Vegetation Being Used?

Utilization of preferred trees and shrubs

Because woody species have such an important role to play in riparian health, measurements of the level of use helps us understand whether they will persist in the reach. Livestock will often browse woody plants, especially in late summer and fall. Wildlife, including beaver, make use of woody plants year-round. Woody plants can sustain low levels of use but heavier browsing can:

- deplete root reserves;
- inhibit establishment and regeneration;
- lead to replacement by less desirable woody species;
- cause the loss of preferred woody species; and
- lead to invasion by disturbance or weed species.

Not all woody species are palatable or used by animals. Some species do not contribute significantly to riparian condition and stability although some utilization may occur. Other species may persist under high use but are not good indicators to evaluate the effect of utilization. These species are excluded from this evaluation of utilization. See the table on the next page for a list of these species. To establish the amount of utilization:

• first, randomly pick 2 to 3 plants of each of the preferred woody species found on the reach;
• for each plant, select a branch that would be available or accessible to browsing animals;
• count the total number of leaders (twigs) on the branch;
• now count only the older leaders (2nd year growth and older) that have been clipped off by browsing;
• determine the percentage of utilization by comparing the number of leaders browsed with the total number of leaders available on the branch; and
• do not count current year's use since an estimate in mid-season does not accurately reflect actual use, because browsing can continue year-round.

Riparian Health Assessment – Field Sheet

Landowner/Lessee: ______________________ Date:________Reach No.:___________
Stream/River:____
Site Description:____

						Scores or N/A Actual	Possible
1. Vegetative Cover of Floodplain and Streambanks							
	6	**4**	**2**	**0**		____	____
2. Invasive Plant Species							
	3	**2**	**1**	**0**	**(cover)**	____	____
	3	**2**	**1**	**0**	**(density)**	____	____
3. Disturbance-Increaser Undesirable Herbaceous Species							
	3	**2**	**1**	**0**		____	____
4. Preferred Tree and Shrub Establishment and Regeneration							
	6	**4**	**2**	**0**		____	____
5. Utilization of Preferred Trees and Shrubs							
	3	**2**	**1**	**0**		____	____
6. Standing Decadent and Dead Woody Material							
	3	**2**	**1**	**0**		____	____
7. Streambank Root Mass Protection							
	6	**4**	**2**	**0**		____	____
8. Human-Caused Bare Ground							
	6	**4**	**2**	**0**		____	____
9. Streambank Structurally Altered by Human Activity							
	6	**4**	**2**	**0**		____	____
10. Pugging, Hummocking and/or Rutting							
	3	**2**	**1**	**0**		____	____
11. Stream Channel Incisement (vertical stability)							
	9	**6**	**3**	**0**		____	____
					TOTAL	____	____

Appendix C
Rapid Geomorphic Assessment

Rapid Geomorphic Assessments: RGA’s

To evaluate channel-stability conditions and stage of channel evolution of a particular reach, a Rapid Geomorphic Assessment (RGA) will be carried out using the Channel-Stability Ranking Scheme. RGAs utilize diagnostic criteria of channel form to infer dominant channel processes and the magnitude of channel instabilities through a series of nine questions. Granted, evaluations of this sort do not include an evaluation of watershed or upland conditions; however, stream channels act as conduits for energy, flow and materials as they move through the watershed and will reflect a balance or imbalance in the delivery of sediment. RGA’s provide a rapid characterization of stability conditions.

The RGA procedure consists of four steps to be completed on site:

1. Determine the ‘reach’. The ‘reach’ is described as the length of channel covering 6-20 channel widths, thus is scale dependent and covers at least two pool-riffle sequences.
2. Take photographs looking upstream, downstream and across the reach; for quality assurance and quality control purposes. Photographs are used with RGA forms to review the field evaluation
3. Make observations of channel conditions and diagnostic criteria listed on the channel-stability ranking scheme.
4. Sample bed material.

Channel-Stability Index

A field form containing nine criteria (Figure J.1) will be used to record observations of field conditions during RGAs. Each criterion was ranked from zero to four and all values summed to provide an index of relative channel stability. The higher the number the greater the instability: sites with values greater than 20 exhibit considerable instability; stable sites generally rank 10 or less. Intermediate values denote reaches of moderate instability. However, rankings are not weighted, thus a site ranked 20 is not twice as unstable as a site ranked 10. The process of filling out the form enables the final decision of ‘Stage of Channel Evolution’.

CHANNEL-STABILITY RANKING SCHEME

River__________________________ Site Identifier_____________________________________

Date _____________ Time_______ Crew _______________ Samples Taken__________________________

Pictures (circle) U/S D/S X-section Slope__________ Pattern: Meandering / Straight / Braided

1. Primary bed material

	Bedrock	Boulder/Cobble		Gravel	Sand	Silt Clay	
	0	1		2	3	4	_____

2. Bed/bank protection

	Yes	No	(with)	1 bank protected	2 banks		
	0	1		2	3		_____

3. Degree of incision (Relative elevation of "normal" low water; floodplain/terrace @ 100%)

	0-10%	11-25%	26-50%	51-75%	76-100%		
	4	3	2	1	0		_____

4. Degree of constriction (Relative decrease in top-bank width from up to downstream)

	0-10%	11-25%	26-50%	51-75%	76-100%		
	0	1	2	3	4		_____

5. Stream bank erosion (Each bank)

	None	Fluvial	Mass wasting (failures)				
Left	0	1	2				_____
Right	0	1	2				_____

6. Stream bank instability (Percent of each bank failing)

	0-10%	11-25%	26-50%	51-75%	76-100%		
Left	0	0.5	1	1.5	2		_____
Right	0	0.5	1	1.5	2		_____

7. Established riparian woody-vegetative cover (Each bank)

	0-10%	11-25%	26-50%	51-75%	76-100%		
Left	2	1.5	1	0.5	0		_____
Right	2	1.5	1	0.5	0		_____

8. Occurrence of bank accretion (Percent of each bank with fluvial deposition)

	0-10%	11-25%	26-50%	51-75%	76-100%		
Left	2	1.5	1	0.5	0		_____
Right	2	1.5	1	0.5	0		_____

9. Stage of channel evolution

	I	II	III	IV	V	VI	
	0	1	2	4	3	1.5	_____

Figure L.1 - Channel stability ranking scheme used to conduct rapid geomorphic assessments (RGA's). The channel stability index is the sum of the values obtained for the nine criteria.

1. Primary bed material

Bedrock	The parent material that underlies all other material. In some cases this becomes exposed at the surface. Bedrock can be recognized by appearing as large slabs of rock, parts of which may be covered by other surficial material.
Boulder/Cobble	All rocks greater than 64 mm median diameter.
Gravel	All particles with a median diameter between 64.0 – 2.00 mm
Sand	All Particles with a median diameter between 2.00 – 0.63 mm
Silt Clay	All fine particles with a median diameter of less than 0.63 mm

2. Bed/bank protection

Yes	Mark if the channel bed is artificially protected, such as with rip rap or concrete.
No	Mark if the channel bed is not artificially protected and is composed of natural material.
1 bank protected	Mark if one bank is artificially protected, such as with rip rap or concrete.
2 banks	Mark if two banks are artificially protected.

3. Degree of incision (Relative elevation Of "normal" low water; floodplain/terrace @ 100%)

Calculated by measuring water depth at deepest point across channel, divided by bank height from bank top to bank base (where slope breaks to become channel bed). This ratio is given as a percentage and the appropriate category marked.

4. Degree of constriction (Relative decrease in top-bank width from up to downstream)

Often only found where obstructions or artificial protection are present within the channel. Taking the reach length into consideration, channel width at the upstream and downstream parts of the reach are measured and the relative difference calculated.

5. Stream bank erosion (Each bank)

The dominant form of bank erosion is marked separately for each bank, left and right, facing in a downstream direction.

If the reach is a meandering reach, the banks are viewed in terms of ‘Inside, Outside’ as opposed to ‘Left, Right’ (appropriate for questions 5-8). Inside bank, being the inner bank of the meander, if the stream bends to the left as you face downstream, this would be the left bank. Outside bank, being the outer bank, on your right as you face downstream in a stream meandering left.

None	No erosion
Fluvial	Fluvial processes, such as undercutting of the bank toe, cause erosion.
Mass Wasting	Mass movement of large amounts of material from the bank is the method of bank erosion. Often characterized by high, steep banks

with shear bank faces. Debris at the bank toe appears to have fallen from higher up in the bank face. Includes, rotational slip failures and block failures.

6. Stream bank instability (Percent of each bank failing)
If the bank exhibits mass wasting, mark percentage of bank with failures over the length of the reach. If more than 50% failures are marked, the dominant process is mass wasting (see question 5).

7. Established riparian woody-vegetative cover (Each bank)
Riparian woody-vegetative cover is the more permanent vegetation that grows on the stream banks, distinguished by its woody stem, this includes trees and bushes but does not include grasses. Grasses grow and die annually with the summer and thus do not provide any form of bank protection during winter months whilst permanent vegetation does.

8. Occurrence of bank accretion (Percent of each bank with fluvial deposition)
The percentage of the reach length with fluvial deposition of material (often sand, also includes fines and gravels) is marked.

9. Stage of channel evolution
Stage of channel evolution are given by Simon and Hupp, 1986 (see diagram below). All of the above questions help lead to an answer to this question. Refer bank to previously answered questions for guidance. See Table 2 for guidelines of what features are often found with each stage of channel evolution.

Total Score Total up the responses to the 9 questions.

Stages of Channel Evolution

The channel evolution framework set out by Simon and Hupp (1986) is used to assess the stability of a channel reach (Figure L.2; Table L.1). With stages of channel evolution tied to discrete channel processes and not strictly to specific channel shapes, they have been successfully used to describe systematic channel-adjustment processes over time and space in diverse environments, subject to various disturbances such as stream response to: channelization in the Southeast US Coastal Plain (Simon, 1994); volcanic eruptions in the Cascade Mountains (Simon, 1999); and dams in Tuscany, Italy (Rinaldi and Simon, 1998). Because the stages of channel evolution represent shifts in dominant channel processes, they are systematically related to suspended-sediment and bed-material discharge (Simon, 1989a; Kuhnle and Simon, 2000), fish-community structure, rates of channel widening (Simon and Hupp, 1992), and the density and distribution of woody-riparian vegetation (Hupp, 1992).

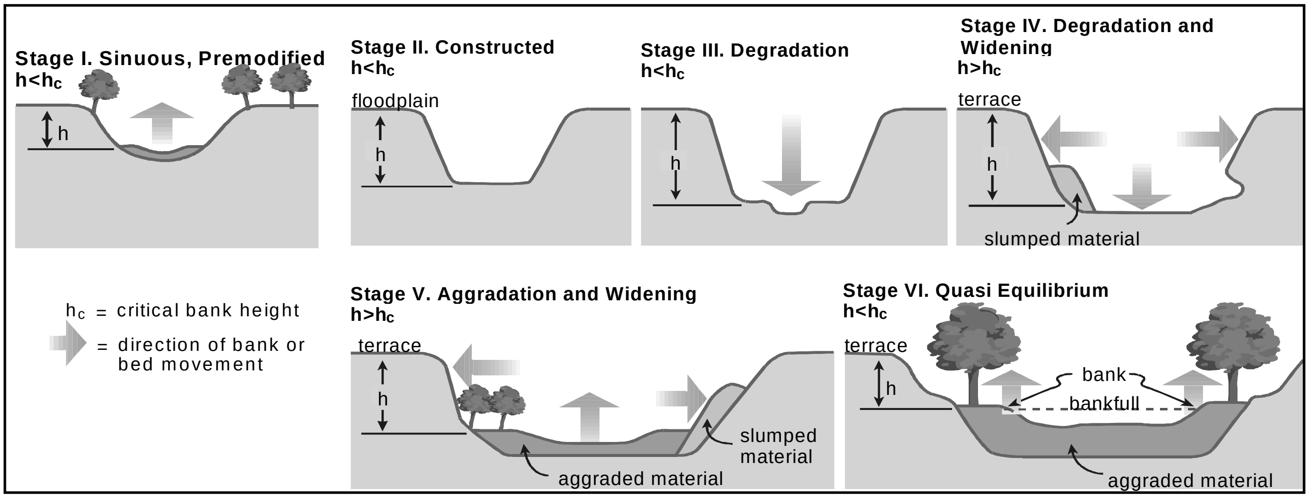


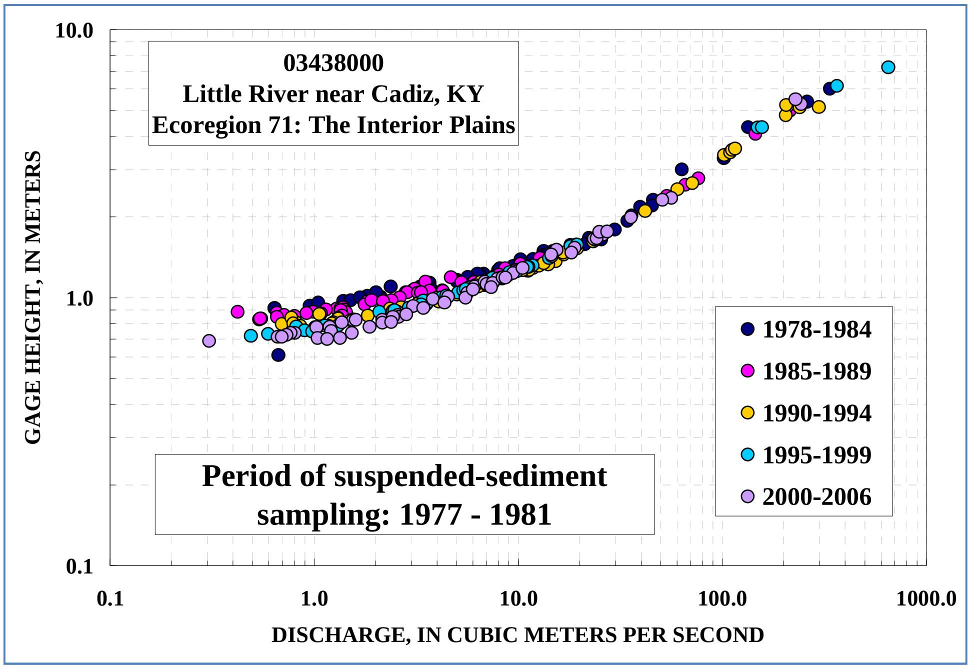
Figure L.2 - Six stages of channel evolution from Simon and Hupp (1986) and Simon (1989b) identifying Stages I and VI as "reference" conditions for given Ecoregions

Table L.3 – Summary of conditions to be expected at each stage of channel evolution.

Stage	Descriptive Summary
I	*Pre-modified* – Stable bank conditions, no mass wasting, small, low angle bank slopes. Established woody vegetation, convex upper bank, and concave lower bank.
II	*Constructed* – Artificial reshaping of existing banks. Vegetation often removed, banks steepened, heightened and made linear.
III	*Degradation* – Lowering of channel bed and consequent increase of bank heights. Incision without widening. Bank toe material removed causing an increase in bank angle.
IV	*Threshold* – Degradation and basal erosion. Incision and active channel widening. Mass wasting from banks and excessive undercutting. Leaning and fallen vegetation. Vertical face may be present.
V	*Aggradation* – Deposition of material on bed, often sand. Widening of channel through bank retreat; no incision. Concave bank profile. Filed material re-worked and deposited. May see floodplain terraces. Channel follows a meandering course.
VI	*Restabilization* – Reduction in bank heights, aggradation of the channel bed. Deposition on the upper bank therefore visibly buried vegetation. Convex shape. May see floodplain terraces.

An advantage of a process-based channel-evolution scheme is that Stages I and VI represent true "reference" conditions. In some cases, such as in the Midwestern United States where land clearing activities near the turn of the 20th Century caused massive changes in rainfall-runoff relations and land use, channels are unlikely to recover to Stage I, pre-modified conditions. Stage VI, a re-stabilized condition, is a much more likely target under present regional land use and altered hydrologic regimes (Simon and Rinaldi, 2000) and can be used as a "reference" condition. Stage VI streams can be characterized as a 'channel-within-a-channel', where the previous floodplain surface is less frequently inundated and can be described as a terrace. This morphology is typical of recovering and re-stabilized stream systems following incision. In pristine areas, where disturbances have not occurred or where they are far less severe, Stage I conditions can be appropriate as a reference.

Unfortunately it is not uncommon that suspended-sediment sampling was carried out over twenty years ago. It may also be the case that the stage of channel evolution relevant to a given site now, was not relevant at the time of suspended-sediment sampling. As we cannot readily create a rating equation to fit the current stability of a given site, plotting certain stream morphology characteristics against a range of discharges over time can help us to establish the stability of the channel at the time of suspended-sediment sampling



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 the Wintering River in McHenry and McLean Counties, North Dakota**
Submitted by:	**Mike Ell, North Dakota Department of Health**
Date Received:	**August 20, 2009**
Review Date:	**September 22, 2009**
Reviewer:	**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 Wintering River fecal coliform TMDL was submitted to EPA for review during the public notice period via an email from Mike Ell, NDDoH on August 20, 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 Wintering River its tributaries are a stream system located in McHenry and McLean Counties, in north central North Dakota. The Wintering River is part of the larger Souris (Mouse[1]) River basin in the Lower Souris sub-basin (HUC 0901003). The Wintering River and tributary segments flow approximately 207.8 miles, with a total drainage area of 555,520 acres. There is one 303(d) listed segment of the Wintering River covered by this TMDL document: 1) Wintering River, including all tributaries, located in SW McHenry and NE McLean Counties (ND-10160004-035-S_00). The segment is listed as high priority for TMDL development.

The designated use for the listed segment of the Wintering River and its tributaries is based on the Class III stream classification in the ND water quality standards (NDCC 33-15-02.1-09). The segment was

[1] Recent local legislation passed that determined that the river shall be called the Mouse River on all identifiable signs. It is still known as the Souris River in Canada and to many State and Federal agencies.

included on the ND 2008 303(d) list for fecal coliform bacteria which is impairing primary contact recreation uses.

COMMENTS: None.

1.3 Water Quality Standards

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

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

Minimum Submission Requirements:

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

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

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

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

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

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

SUMMARY: The Wintering River segment addressed by this TMDL is impaired based on fecal coliform concentrations for primary contact recreational uses. Wintering River and its tributaries are Class III streams 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 7 shown below. Discussion of additional applicable water quality standards for Wintering River can be found on pages 11 and 12 of the TMDL.

Table 7. 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 target for this TMDL is based on the numeric water quality standards for fecal coliform bacteria based on the primary contact recreational beneficial use for Wintering River and its tributaries. The target for the Wintering River segment included in the TMDL document is the fecal coliform standard expressed as the 30-day geometric mean of 200 CFU/100 mL during the recreation season from May 1 to September 30. 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, Tables 4 and 5, include the landuse breakdown in the watershed. Approximately 43 percent of the landuse in the watershed was cropland under active cultivation, 41 percent was pasture/rangeland and the remainder was water, roads or low density development.

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

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

There are no municipal wastewater treatment plant discharges in the watershed. Towns that are located in the watershed (e.g., Balfour, Drake, and Karlsruhe) all utilize septic systems for their domestic waste. There are two permitted animal feeding operations (AFOs) in the watershed. However, these permits require no discharge so they are not considered significant point sources in the TMDL document.

COMMENTS: The report states that data were collected at several locations in the watershed and the report also states that the water quality assessment was used to determine 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. 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., the two permitted 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.

4. TMDL Technical Analysis

TMDL determinations should be supported by a robust data set and an appropriate level of technical analysis**.** This applies to **all** of the components of a TMDL document. It is vitally important that the technical basis for **all** conclusions be articulated in a manner that is easily understandable and readily apparent to the reader.

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

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

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

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

Where:

TMDL = Total Pollutant Loading Capacity of the waterbody

LAs = Pollutant Load Allocations

WLAs = Pollutant Wasteload Allocations

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

Minimum Submission Requirements:

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

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

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

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

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

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

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

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

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

SUMMARY: The technical analysis should describe the cause and effect relationship between the identified pollutant sources, the numeric targets, and achievement of water quality standards. It should also include a description of the analytical processes used, results from water quality modeling, assumptions and other pertinent information. The technical analysis for the Wintering River 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 segment.

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 Wintering River monitoring site 384107. The LDC was derived using the 200 CFU/100 mL TMDL target (i.e., state water quality standard), the daily flow record obtained for the site, and the observed fecal coliform data collected from the water quality monitoring station (see Figure 8 of the TMDL document) from 2006 and 2007.

Mean daily flows for the period January 1996 through December 2007 were obtained from the USGS gauge site (05120500). This mean daily flow record was used in flow duration curve development, and in the development of the load duration curve for the impaired segment of the Wintering River.

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.

The LDCs represent a flow-variable TMDL targets across the flow regimes shown in the TMDL document. For the Wintering River segment covered by the TMDL document, the LDC is a dynamic expression of the allowable load for any given daily flow. Loading capacities were derived from this approach the watershed at each flow regime. Tables 10 shows the loading capacity loads (or TMDL loads) for the listed segment of the Wintering River and its tributaries.

COMMENTS: It is not clear why 3 flow zones were used in the LDCs for these TMDLs. Page 14 of the document explains ***how*** the flow regimes were defined for each site, but no explanation is given for ***why*** 3 zones were used. A brief explanation of why 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 14 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 Wintering River TMDL data description and summary are included tables throughout the document and in the data tables in Appendix A and B. The recent water quality monitoring was conducted over the period from 2006 to 2007. The data set also includes the 11 years of flow record on the Wintering River from the USGS gauging site (05120500). The flow data was used to develop a load duration curve for the Wintering River.

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 municipal wastewater treatment facilities with permitted fecal coliform discharges in the watershed. There are two permitted animal feeding operations in the watershed. The 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, Tables 4 and 5, include the landuse breakdown in the watershed. Approximately 43 percent of the landuse in the watershed was cropland under active cultivation, 41 percent was pasture/rangeland and the remainder was water, roads or low density development. The point sources are considered negligible sources of fecal coliform loading. Therefore, 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 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)			

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 Wintering River TMDL includes an explicit MOS for the listed segment derived by calculating 10 percent of the loading capacity. The explicit MOS for the listed segment of the Wintering River watershed are included in Table 10.

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: The Wintering River watershed will be monitored according to an approved quality assurance project plan. Once a watershed restoration plan is developed and implemented (e.g., a Section 319 Project Implementation Plan), monitoring will be conducted on the Wintering River according to a future Quality Assurance Project Plan.

COMMENTS: None.

7. Restoration Strategy

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

Minimum Submission Requirements:

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

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

SUMMARY: The TMDL Allocation section of the TMDL document includes a list of BMPs that are recommended to meet the TMDL loads. NDDoH typically works with local conservation districts or other cooperators to develop and implement Watershed Restoration Projects after the TMDL has been developed and approved. Detailed project implementation plans are developed as part of this process if Section 319 money is used.

There are no significant permitted point sources in the watershed so it’s not necessary to fully document reasonable assurance demonstrating that the nonpoint source loadings are practicable.

COMMENTS: None.

8. Daily Loading Expression

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

TMDL analysis. The level of effort spent to develop the daily load indicator should be based on the overall utility it can provide as an indicator for the total load reductions needed.

Minimum Submission Requirements:

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

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

SUMMARY: The Wintering River fecal coliform TMDL document includes daily loads expressed as colonies per day for the listed segment of 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 US EPA Region 8

EPA Region 8 Comment: The report states that data were collected at several locations in the watershed and the report also states that the water quality assessment was used to determine 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. 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., the two permitted 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.

NDDoH Response: Additional justification providing estimates of the number livestock in the two county region and the number of animal feeding areas located in the watershed was added to Section 4.2. The basis for this additional information were aerial animal feeding area survey data collected by the NDDoH and county livestock data data collected by the North Dakota Agricultural Statistics Service in 2008. In addition, supporting data taken from Section 1.53 on the results of the riparian assessments was added as addition supporting evidence for the conclusions drawn in Section 4.2.

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)."

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

EPA Region 8 Comment: It is not clear why 3 flow zones were used in the LDCs for these TMDLs. Page 14 of the document explains ***how*** the flow regimes were defined for each site, but no explanation is given for ***why*** 3 zones were used. A brief explanation of why 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 14 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.