Fecal Coliform Bacteria TMDL for Souris River in Renville and Burke Counties, North Dakota

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1.0 INTRODUCTION AND DESCRIPTION OF THE WATERSHED

The Souris, or Mouse, River originates in the Yellow Grass Marshes north of Weyburn, Saskatchewan, Canada, and flows southeast, crossing the northern boundary of North Dakota west of Sherwood, North Dakota. It then forms a loop and flows back north, entering Manitoba, Canada near Westhope, North Dakota. The river eventually flows into the Assiniboine River near Brandon, Manitoba (Figure1). A map of the entire Souris River watershed can be found in Appendix C. Flow in the upper Souris River is regulated by three reservoirs in Canada (Boundary Reservoir, 48,990 acre-ft; Rafferty Reservoir, 356,400 acre-ft; and Alameda Reservoir, 85,560 acre-ft). Total reservoir capacity is about 490,000 acre-ft. Some diversions for irrigation and municipal supply exist on the river.

The Total Maximum Daily Load (TMDL) listed segment (ND-09010001-001-S_00) of this river is located in Renville County and the northeast portion of Burke County. It consists of 43.4 miles of the Souris River from the border with Saskatchewan, Canada to Lake Darling in North Dakota (Figure 2). Its watershed has an area of approximately 109,103 acres inside the United States (Figure 3). Data for the Canadian portion of this watershed is unavailable. Table 1 summarizes some of the geographical, hydrological and physical characteristics of this TMDL listed segment of the Souris River.

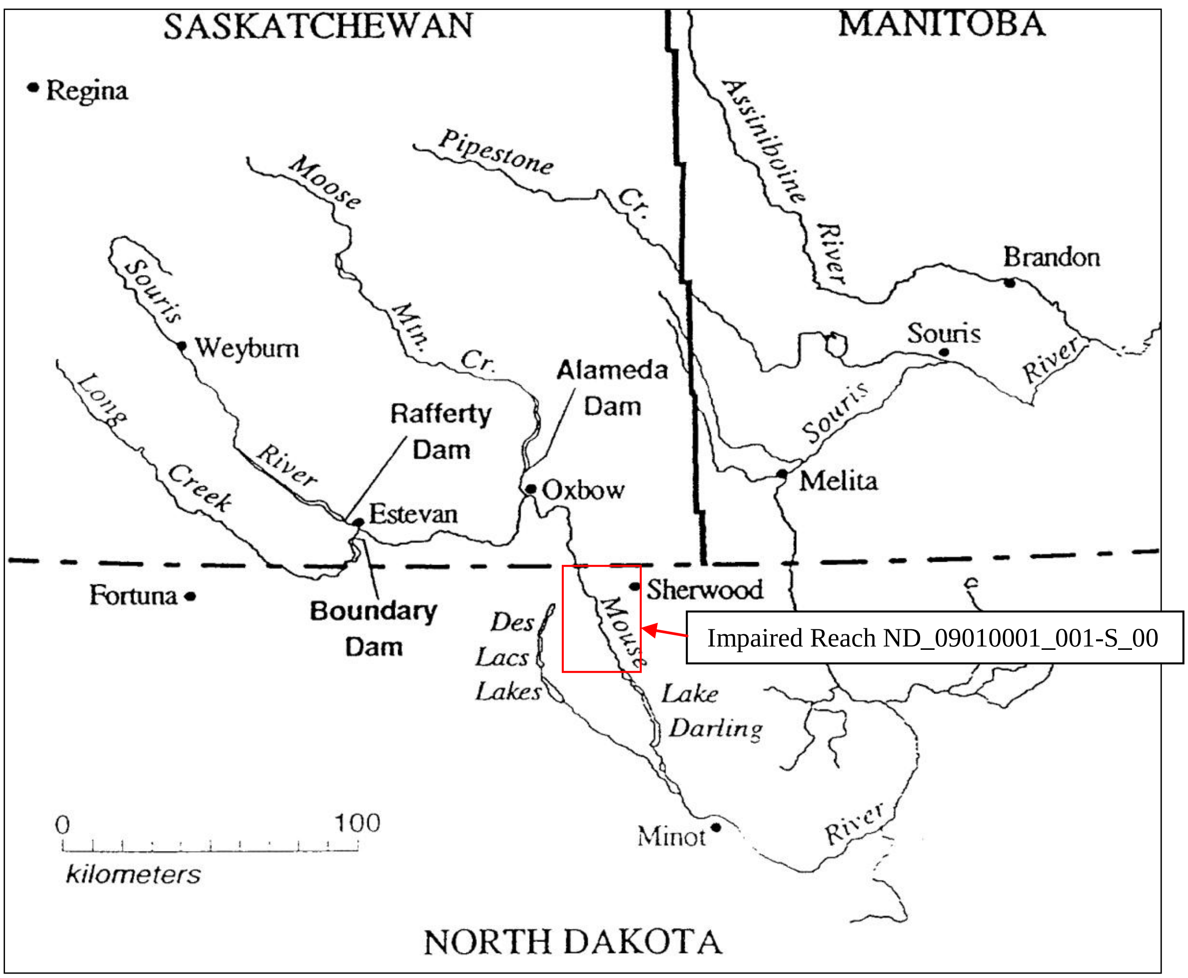


Figure 1. Souris River and TMDL Impaired Reach

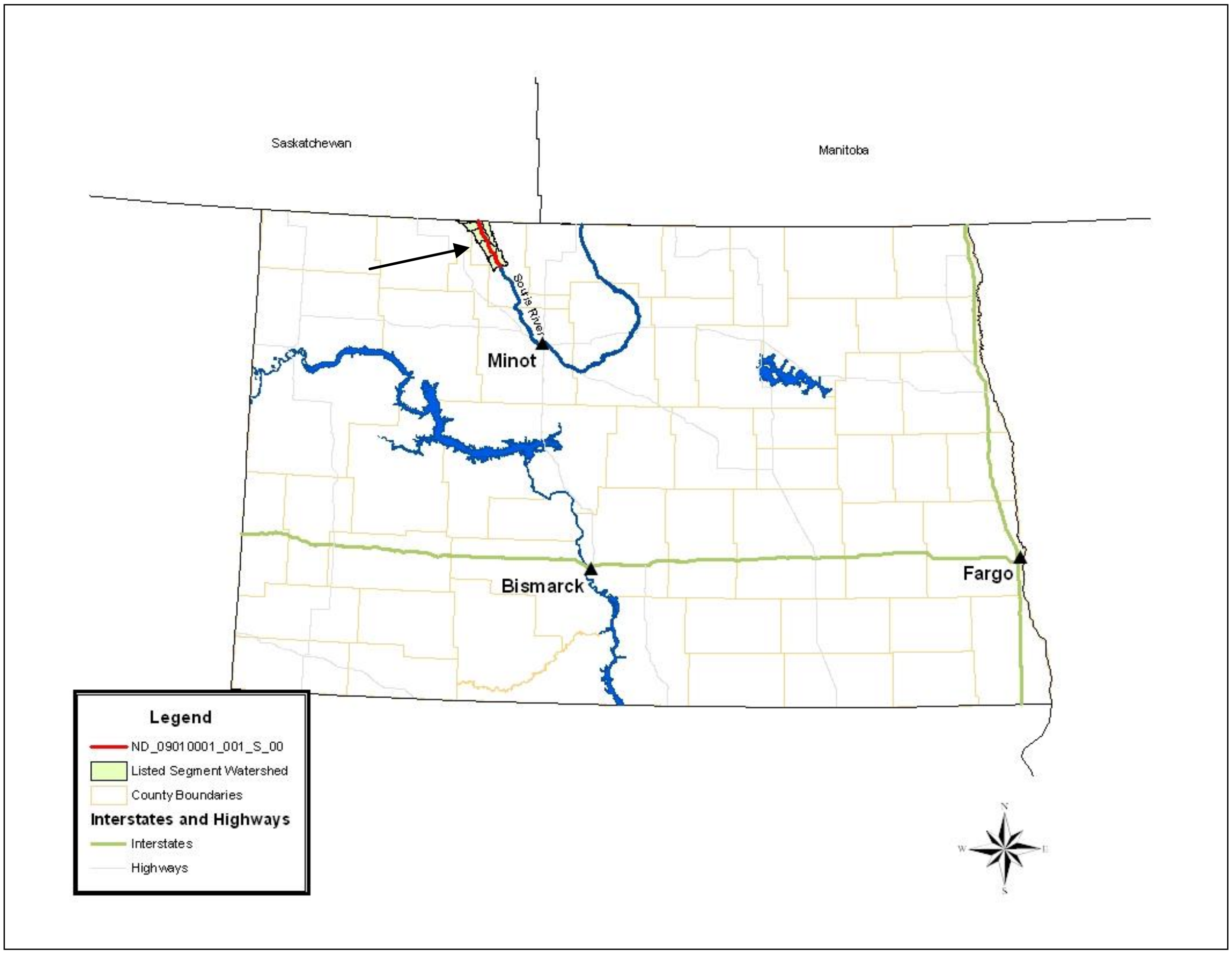


Figure 2. Location of Souris River in North Dakota

Table 1. General Characteristics of the Souris River and Its Watershed

Legal Name	Souris (Mouse) River[1]
Stream Classification	Class IA
Major Drainage Basin	Souris (Mouse) River[1]
8 Digit HUC	09010001
County	Renville and Burke Counties, ND
Eco-region	Level III: Northern Glaciated Plains - 46 Level IV: Northern Black Prairie – 46g
Watershed Area	109,103.72 acres
River Miles	43.4 miles

[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 too many state and federal agencies within North Dakota

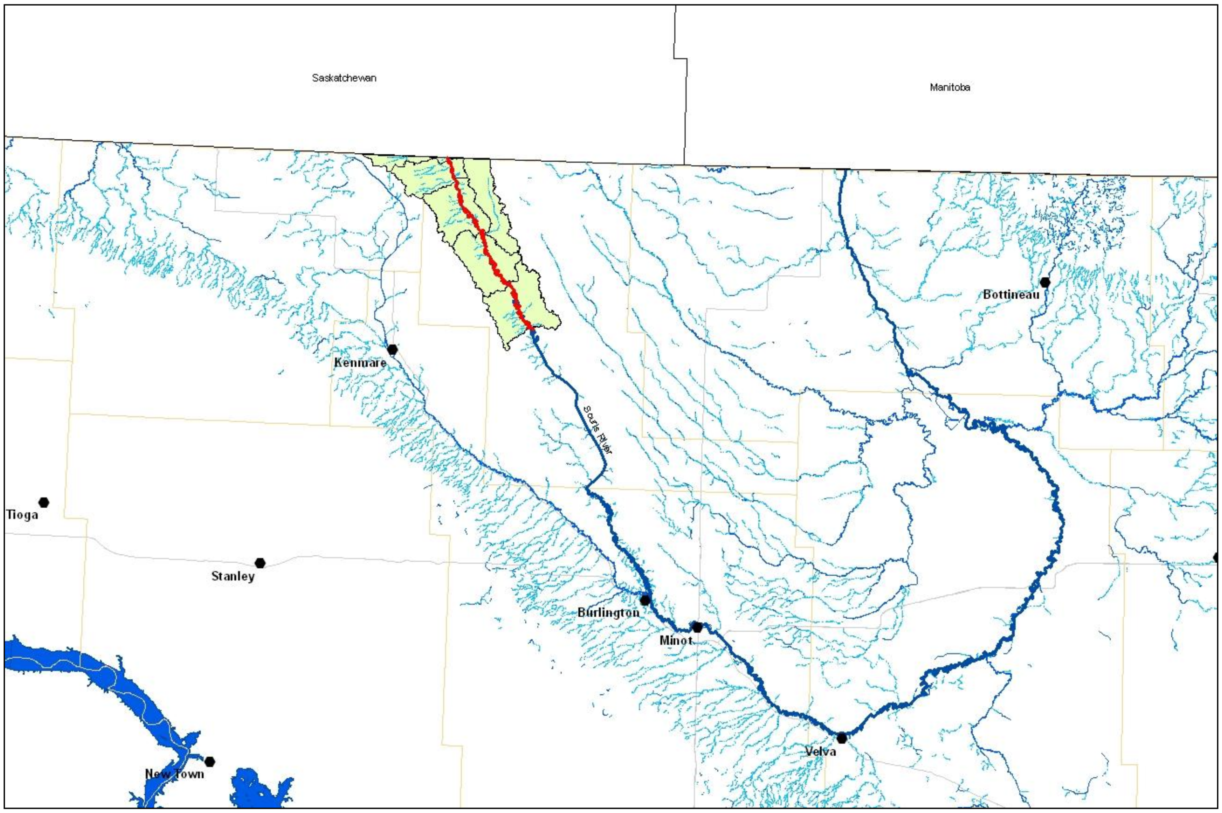


Figure 3. Location of the TMDL Listed Segment of the Souris River and Its Watershed

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 segment ND-09010001-001-S_00 of the Souris River as fully supporting but threatened for recreational beneficial uses due fecal coliform bacteria. It is also listed as fully supporting but threatened for aquatic life beneficial uses due to sedimentation and low dissolved oxygen. These impairments will be addressed in separate TMDL reports.

Table 2. 2010 Section 303(d) TMDL Listing Information for Souris River, Assessment Unit ID ND-09010001-001-S_00 (NDDoH, 2010)

Assessment Unit ID	ND-09010001-001-S_00
Waterbody Description	Souris River from the Saskatechewan, Canada border downstream to Lake Darling. Located in Renville County and a portion of NE Burke County.
Size	43.4 miles
Impaired Designated Use	Recreation
Use Support	Fully Supporting but Threatened
Impairment	Fecal Coliform Bacteria
TMDL Priority	High

1.2 Topography

This watershed is characterized as glaciated and generally flat, with occasional "washboard" undulations. High concentrations of temporary and seasonal wetlands are present and the drainage pattern is simple. Surficial material consists of glacial till over Cretaceous Pierre Shale. The soils present belong to the Order Mollisols and are typically Barnes, Svea, Hamerly, Cresbard, Buse, and Parnell. Though the till soil is very fertile, agricultural success is subject to annual climatic fluctuations (USEPA, et al. 1998). Elevation in the watershed ranges from 1,500 to 1,970 msl (USGS, 2006).

1.3 Land Use/Land Cover in the Watershed

This segment of the Souris River watershed lies within the Northern Black Prairie level IV ecoregion (46g) (Figure 4) which belongs to the Northern Glaciated Plains level III ecoregion.

Within the Northern Glaciated Plains level III ecoregion, the subhumid conditions foster a grassland transition between the tall and short grass prairie. High concentrations of temporary and seasonal wetlands are found throughout the region. Additionally, the Northern Black Prairie level IV ecoregion represents a broad phenological transition zone marking the introduction of boreal influence in climate from the north. Aspen and birch appear in wooded areas, willows grow on wetland perimeters, and rough fescue becomes evident in grassland associations. This ecoregion has the shortest growing season and lowest January temperatures of any level IV ecoregion in the Dakotas.

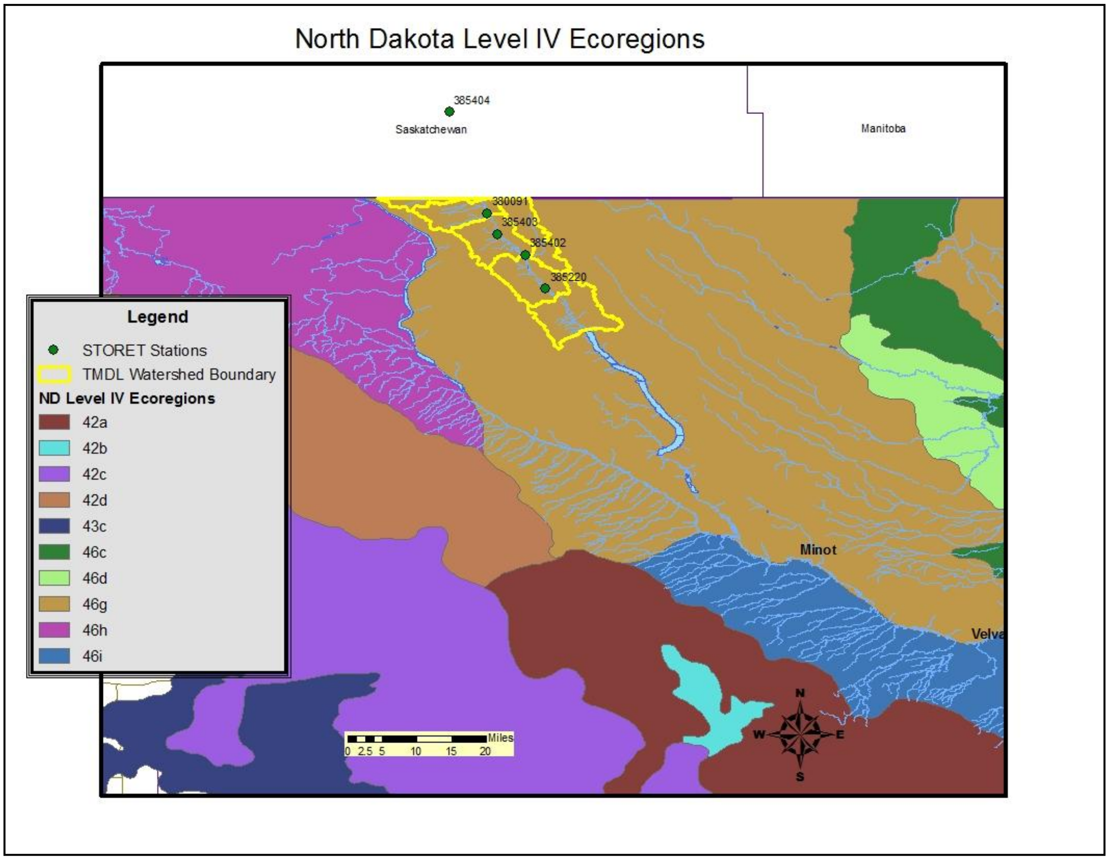


Figure 4. Level IV Ecoregions for the Souris River TMDL Watershed

Land use data from the North Dakota Agricultural Statistics Service (NASS, 2006) indicates that the North Dakota portion of the watershed is primarily agricultural (70.47 percent), consisting of crop production and livestock grazing. Forty-nine percent of the agricultural land is actively cultivated, tilled mainly for durum, spring wheat, and other small grains, but including a variety of crops. Twenty-one percent is in pasture/range/haylands. Water and woods make up over eighteen percent of the watershed (Tables 3 and 4, Figure 5). There are two permitted animal feeding operations (AFOs) which allow zero discharge and no confined animal feeding operations (CAFOs) within the contributing US drainage. The number of non-permitted animal feeding operations within the watershed is unknown, but is believed to be significant.

Table 3. Major Land Use Categories in the Section 303(d) Listed Souris River Watershed (based on 2006 NASS data)

Major Category	Acres	Percent of Watershed
Agriculture/Cultivated	53,923.6	49.43
Pasture/Range/Hay	22,955.2	21.04
Barren/Fallow	1,257.9	1.15
Urban/Roads	10,778.6	9.88
Water	18,298.8	16.77
Woods	1,889.6	1.73

Table 4. Land Use Types in the Section 303 (d) Listed Souris River (based on 2006 NASS data)

Land Use Type	Acres	Percent of Watershed
Winter Wheat	635.07	0.58
Durum/SpringWheat	35,576.44	32.61
Rye/Oats/Other Small Grains	6,744.44	6.18
Beans/Peas/Lentils	2,456.67	2.26
Sunflowers	1,400.70	1.28
Corn	860.14	0.79
Oil Seeds	6,250.12	5.73
Barren/Fallow	1,257.91	1.15
Alfalfa	409.33	0.37
Pasture/Grass/CRP	22,545.85	20.67
Water	18,298.86	16.77
Woods	1,889.59	1.73
Urban/Roads	10,778.60	9.88
TOTAL	109,103.72	100

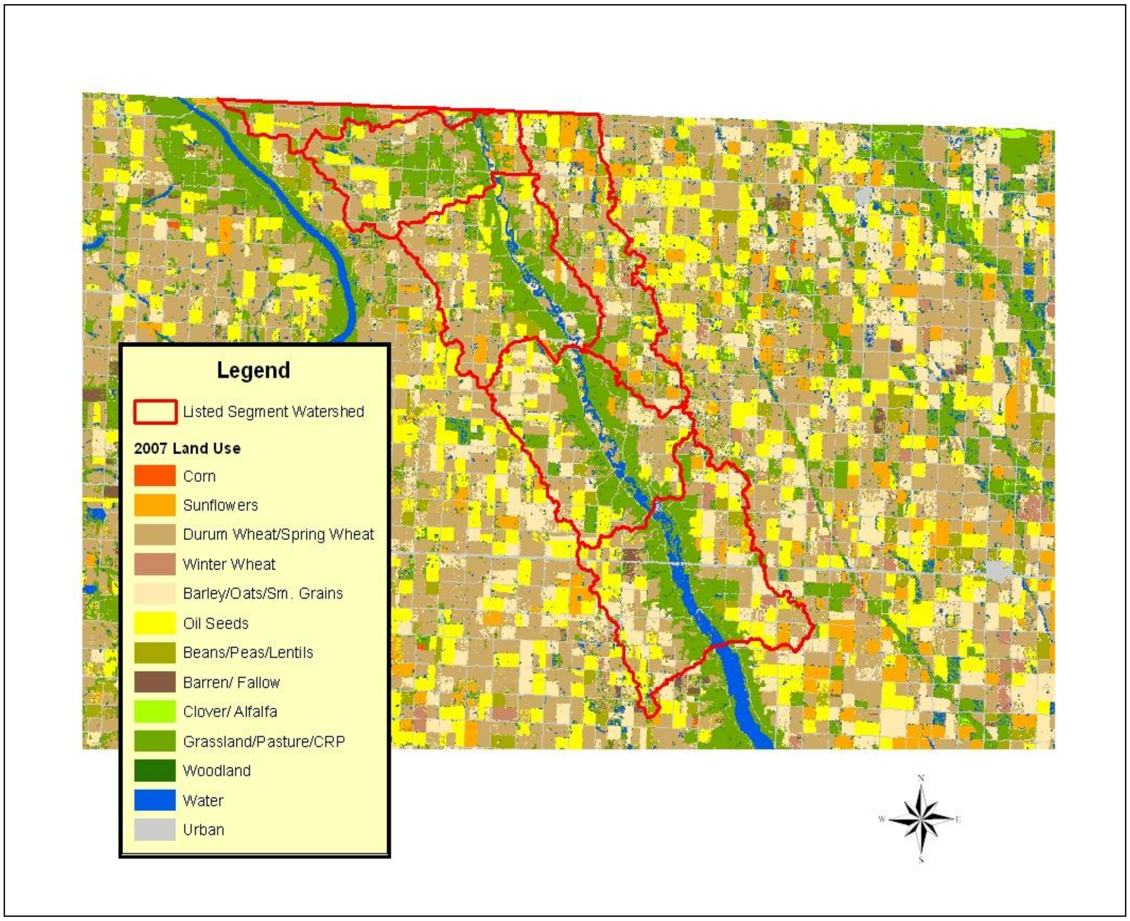


Figure 5. Land Use Map for the Souris River Watershed (NASS, 2006)

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 flow over the state. Movement of these air masses and their associated fronts cause near continuous wind and often result 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. 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). Historical average precipitation data for the climate station at Mohall, ND, which is within the watershed, were obtained from the High Plains Regional Climate Center (HPRCC) and can be seen in Figure 6.

Average annual air temperatures recorded at the Mohall North Dakota Agricultural Weather Network (NDAWN) station, located within the Souris River watershed, were 42° F in 2006 and 40° F in 2007, with an average annual wind speed of 9 mph. Annual precipitation ranged from 7.89 inches in 2006 to 11.07 inches in 2007 (NDAWN, 2009). Monthly precipitation totals for 2006 and 2007 are provided in Figure 7..

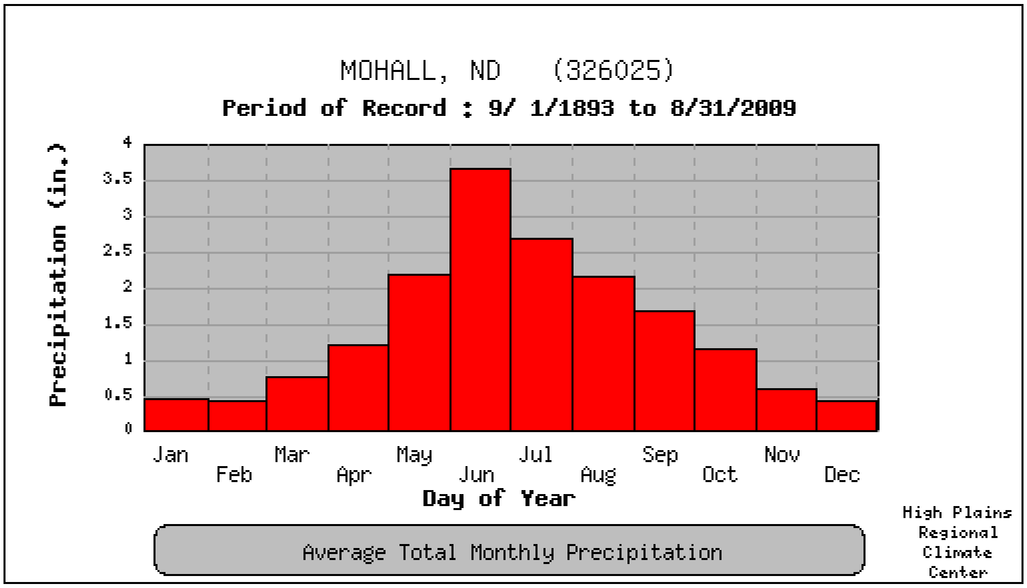


Figure 6. Average Total Monthly Precipitation Data for HPRCC Mohall Station 326025, 1893 – 2009

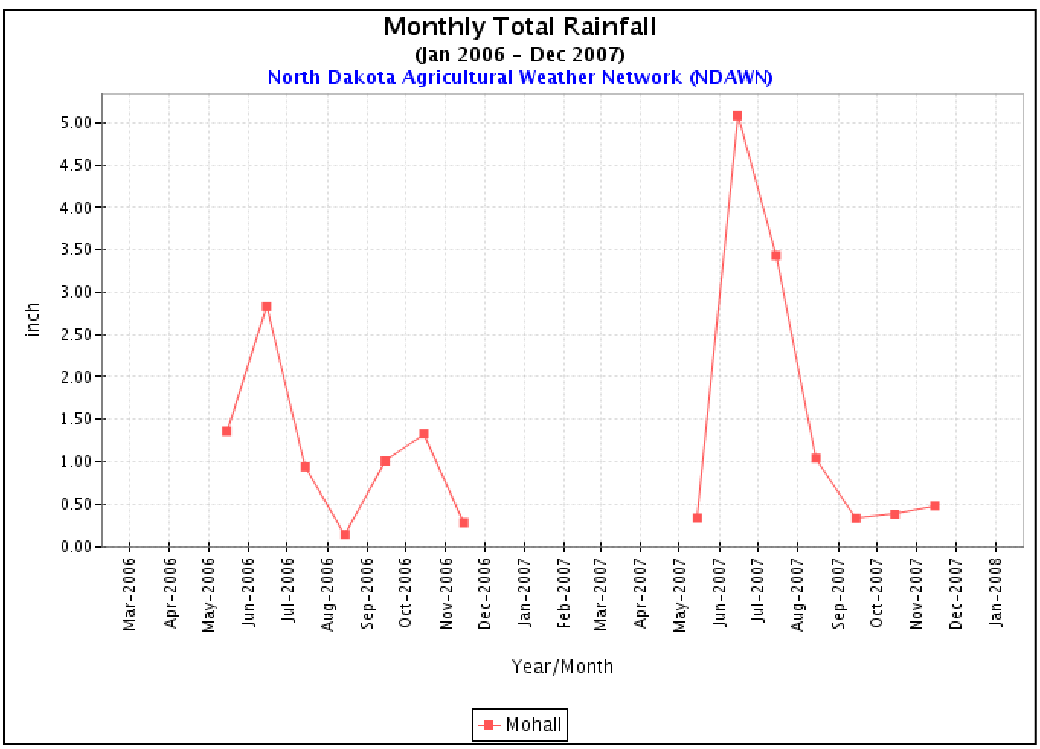


Figure 7. Rainfall Amounts at the Mohall North Dakota Agricultural Weather Network (NDAWN) Station, 2006-2007

1.5 Available Data

Five sites (four in North Dakota and one upstream in Saskatchewan, Canada) were sampled for fecal coliform bacteria along the Souris River from October, 2006 through September, 2007 (Figure 8). Additionally, there are fecal coliform bacteria data for one site (380091) at the upstream end of the reach, collected in 1997. While the state of North Dakota has an E. coli bacteria standard (see Section 2.0), no E. coli data are available for the TMDL reach or for the Souris River in Canada.

Near the US/Canada border there is a U.S.Geological Survey (USGS) stream gauging station (05114000), located approximately 14 miles west of Sherwood, North Dakota. To construct the load duration curve for this TMDL data from site 380091, the monitoring site closest to the USGS gauging site, were used for three reasons. First, this site has the most data available. Second, based on the data (Appendix B,) this site is the most impaired. And third, there is a great deal of local concern for this area of the Souris River.

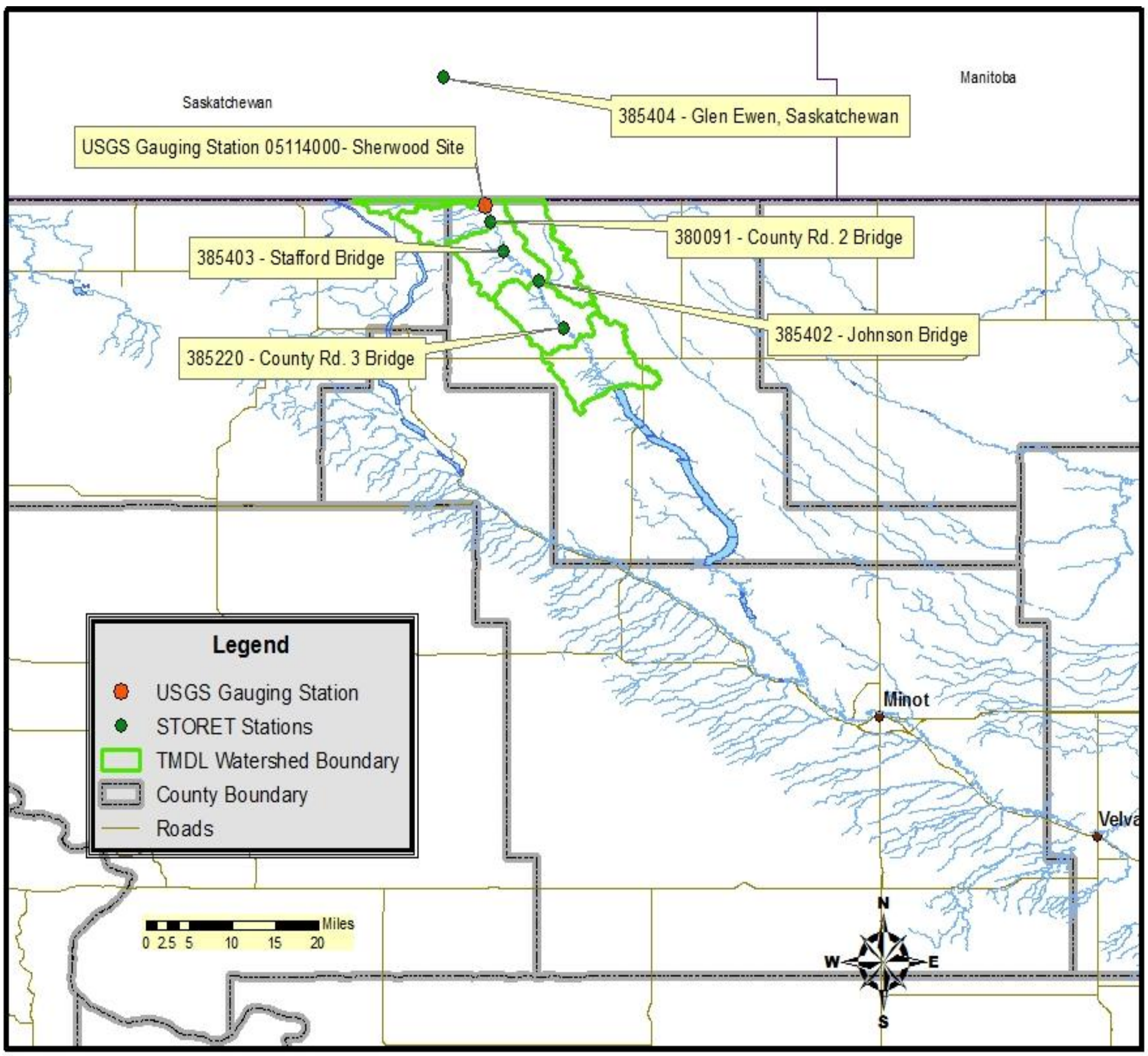
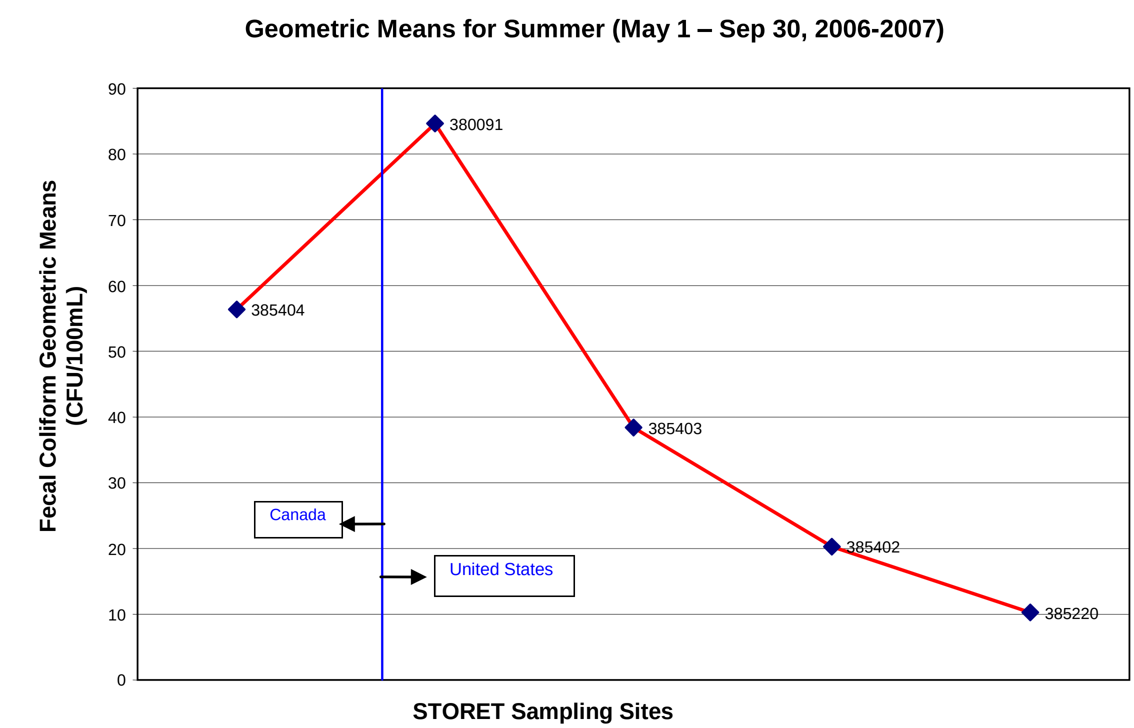


Figure 8. Sampling Site Locations for the TMDL Listed Segment of the Souris River

1.5.1 Fecal Coliform Bacteria Data

Fecal coliform bacteria samples were collected at all five sites from September 2006, through September 2007 (Figure 8 and Appendix B). A limited amount of 1997 data were also available for site 380091. Geometric means for the entire summer season, using all data from May 1 to Sept 30, 2006 – 2007 inclusive, were calculated for each site (Figure 9). These results clearly show a trend of increasing fecal coliform concentrations from the site located near Glen Ewen, Saskatchewan downstream to the site below the North Dakota – Saskatchewan border (380091). Then the fecal coliform bacteria concentrations show a decreasing trend along the Souris River downstream to Lake Darling.



	385404	380091	385403	385402	385220
N	13	25	13	13	26

Figure 9. Upstream to Downstream Trend in Summer Geomentric Means for Fecal Coliform Bacteria Concentrations for Five Sites on the Souris River

Using data collected in 1997, 2006, and 2007 and pooled monthly across years, the monthly geometric means and percent of samples exceeding the 400 CFU/100mL water quality standard were calculated for site 380091 (Table 5). Based on these data, and the State's water quality standards (NDDoH, 2006) and beneficial use assessment methodology (NDDoH, 2010), recreational use was fully supported in the months of May and June. For the month of July, both the geometric mean and the percentage of exceedances were above the State water quality standards and resulted in having the recreational use assessed as not supporting. During the months of August and September, the geometric mean was below State water quality standards, but the percentage of exceedances was above, which results in a recreational use assessment of fully supporting, but threatened.

Table 5. Summary of Fecal Coliform Bacteria Data for Site 380091, Souris River (Recreation Season of May – Sept, 1997, 2006, 2007).

Month	N	Geometric Mean* Concentration (CFU/100mL)	Percentage of Samples Exceeding 400 CFU/100mL	Recreational Use Assessment
May	6	44.36	0%	Fully Supporting
June	8	62.18	0%	Fully Supporting
July	6	204.61	16.7%	Not Supporting
August	5	80.69	20.0%	Fully Supporting. But Threatened
September	7	74.95	14%	Fully Supporting. But Threatened

*** The value of half the detection limit (5 CFU/100mL) is used for all Non-Detect values.**

Insufficient data exists for the remaining four sites to calculate monthly geometric means for all months of the summer recreation season (May 1 – September 30). A basic summary of the data for these sites along with the data for site 380091 (Table 6) was used in the determination of recreational use attainment for the entire reach. It is interesting to note that for site 385220, the downstream-most site of the segment, the 200 CFU/100mL geometric mean standard was not exceeded and fecal coliform bacteria concentrations only exceeded 400 CFU/100mL once in 26 samples taken during the recreation season (once in 40 of the year round samples) (Appendix B). Also, of the 26 samples collected during the recreation season at this site, 15 samples (58%) had fecal coliform bacteria concentrations below detection limits, compared to 1 of 32 samples (3%) at the border site (380091).

Based on these data, this segment of the Souris River is listed as fully supporting, but threatened for recreation beneficial use. Fecal coliform bacteria data for all five sites and the entire range of dates are available in Appendix B.

Table 6. Summary of Fecal Coliform Bacteria Data (CFU/100mL) for Sites Sampled, Souris River (Recreation Season of May – Sept, 2006- 2007, as well as 1997 for site 380091)

	STORET Sites				
	385404	380091	385403	385402	385220
SUMMER (May - Sept)					
Min	5	5	5	5	5
Max	530	1800	110	690	530
Average	126.54	173.28	55.38	78.85	32.88
Geometric Mean	56.37	79.17	38.38	20.30	10.29
N	13	32	13	13	26
% of Samples Below Detection Limits	8%	3%	15%	23%	58%
MAY					
Min	5	5	5	5	5
Max	150	210	90	30	40
Average	61.25	80.83	41.25	16.25	15
Geometric Mean	NA	44.36	NA	NA	NA
N	4	6	4	4	4
JUNE					
Min	80	10	5	5	5
Max	530	230	110	690	30
Average	257.50	88.75	48.75	191.25	12.50
Geometric Mean	NA	62.18	NA	NA	9.53
N	4	8	4	4	6
JULY					
Min	10	70	40	10	5
Max	10	1800	80	160	60
Average	10.00	426.67	60.00	85.00	22.00
Geometric Mean	NA	204.61	NA	NA	13.51
N	2	6	2	2	5
AUGUST					
Min	40	10	30	5	5
Max	40	470	30	5	530
Average	40.00	152	30.00	5.00	136.25
Geometric Mean	NA	80.69	NA	NA	NA
N	1	5	1	1	4
SEPTEMBER					
Min	20	20	100	10	5
Max	290	510	110	10	30
Average	155.00	147.14	105.00	10.00	9.29
Geometric Mean	NA	74.95	NA	NA	7.13
N	2	7	2	2	7

*** The value of one-half the detection limit (5 CFU/100mL) is used for all Non-Detect values.**

1.5.2 Hydraulic Discharge

Flow in the upper reach of the Souris River is regulated by three reservoirs in Canada: the Boundary, Rafferty, and Alameda Reservoirs (Figure 10). Constructed by the Rafferty-Alameda Project (1988-1995), these reservoirs provide water to users in the area, as well as flood protection for residents downstream, including those in North Dakota. Water releases are governed in accordance with the Boundary Waters Treaty and determined by the International Souris River Board of Control (ISRB), under the International Joint Commission.

Specifically, "the Province of Saskatchewan shall have the right to divert, store, and use waters which originate in the Saskatchewan portion of the Souris River basin, provided that such diversion, storage, and use shall not diminish the annual flow of the river at the Sherwood Crossing more than fifty percent of that which would have occurred in the state of nature, as calculated by the Board. For the benefit of riparian users of water between the Sherwood Crossing and the upstream end of Lake Darling, the Province of Saskatchewan shall so far as practicable regulate its diversions, storage, and sues in such as manner that the flow in the Souris River channel at the Sherwood Crossing shall not be less than 0.113 cubic meters per second (4 cubic feet per second) when that much flow would have occurred under conditions of water use development prevailing in the Saskatchewan portion of the Souris River basin prior to construction of the Boundary Dam, Rafferty Dam, and Alameda Dam" (ISRB, 1992). The ISRB has established numeric fecal coliform bacteria objectives for water crossing the boundary (see Section 2.3).

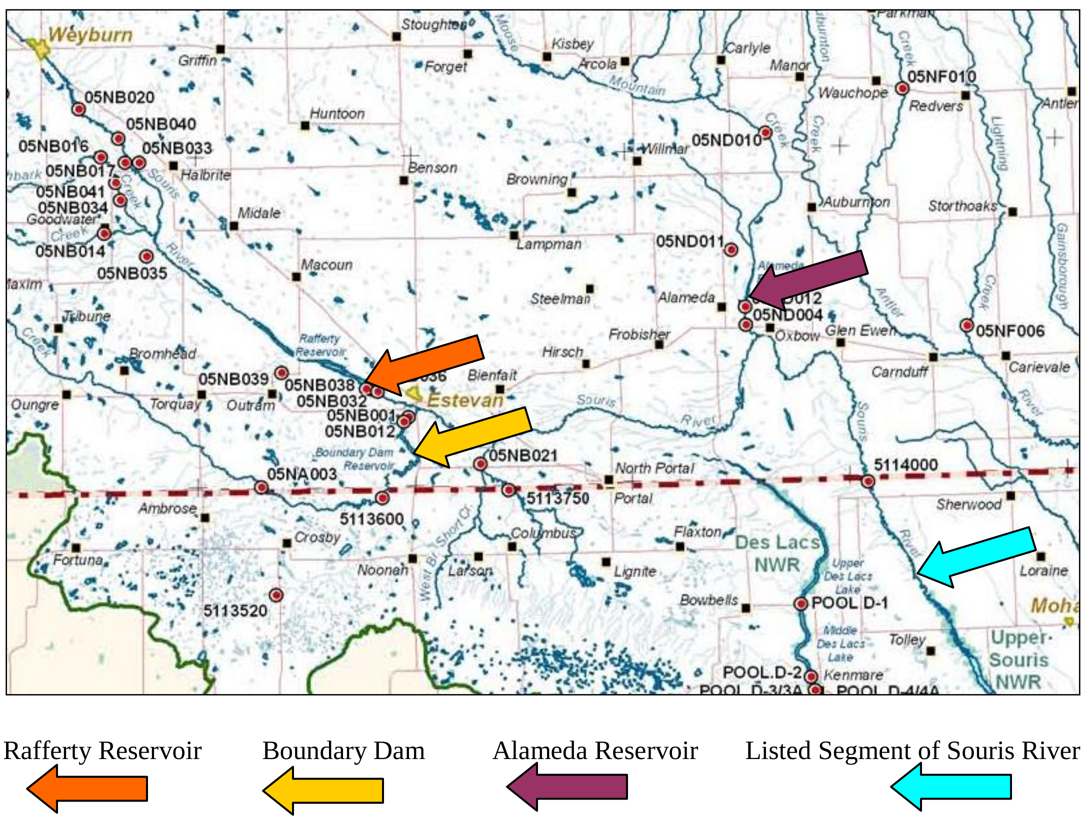


Figure 10. Location of Canadian Reservoirs Controlling Souris River Flow

The discharge record from USGS site 05114000 was chosen to represent the entire reach. For the TMDL listed reach's immediate watershed in North Dakota, there are no major tributaries or streams flowing to the Souris River. As such, it has been determined that flow is similar (i.e. not gaining or losing) all along the 43.4-mile TMDL listed reach. Because of the effect the upstream reservoirs have on flow, only the flow record from 1991, the date the first reservoir, Rafferty, was completed, to present were used in the construction of the flow and load duration curves. For comparison, flows prior to reservoir construction (1931 to 1991) and after reservoir construction (1991 to 2010) are illustrated in Figure 11. Discharge for the sampling period is show in Figure 12.

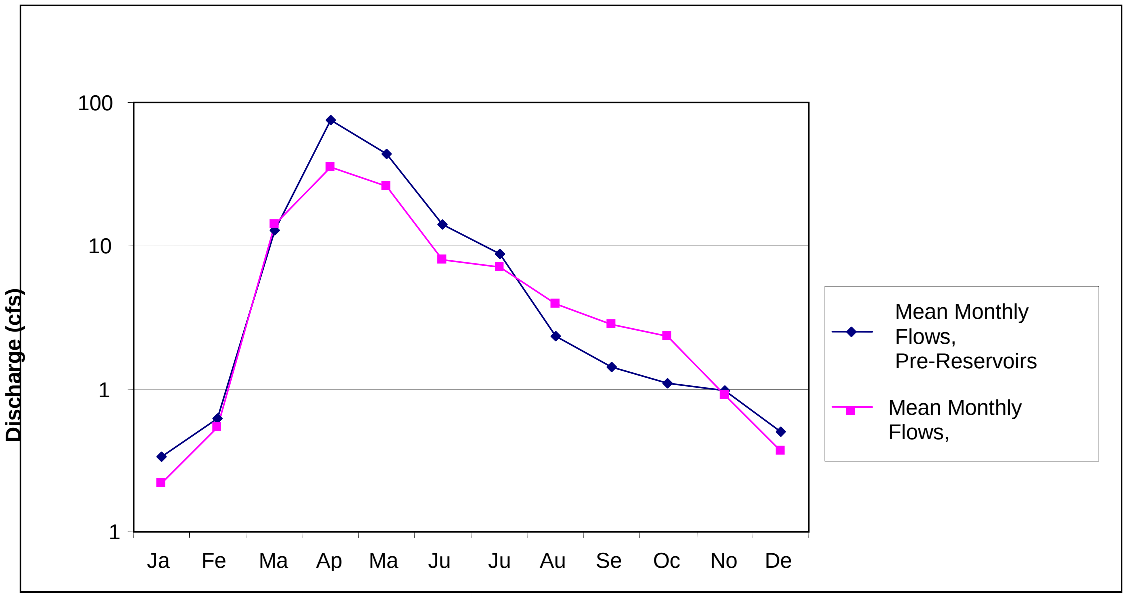


Figure 11. Mean Monthly Flows at USGS Site 05114000, Pre- and Post- Canadian Reservoir Construction

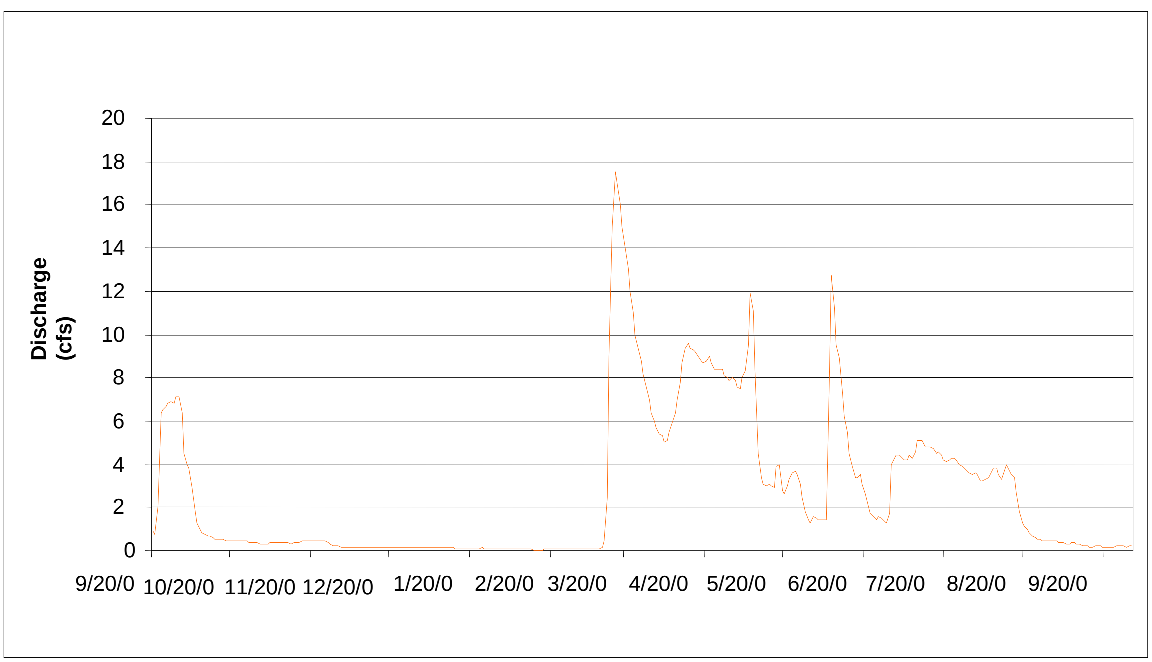


Figure 12. Discharge for USGS Site 05114000, Sampling Season 2006-2007

1.5.3 Other Data

On May 27 and 28, 2007 an NDSU field team canoed along the Souris River from Glen Ewen, Saskatchewan, Canada to County Road 3 in North Dakota, excluding a few miles near the border on the Canadian side, covering a total distance of 52 river miles. The purposes of the trip included identifying point sources and potential nonpoint sources; assessing river characteristics, water depth and bank slopes; taking sediment samples; and surveying river cross sections at predetermined locations. The NDSU field team surveyed 13 cross sections, recorded ten log-jammed sections which were restricting flow, and identified 64 locations where the river was used as part of livestock operations (Figure 13). The majority of livestock crossings and water sites were found in Saskatchewan, Canada where water is shallow. At several locations, livestock were found on river banks or in the river. As water depth increased in the lower portion of the reach, fewer cattle operations along the river were found. No point sources were identified. Based on this field trip, livestock usage of the river was identified as a primary source for fecal contamination of the river reach.

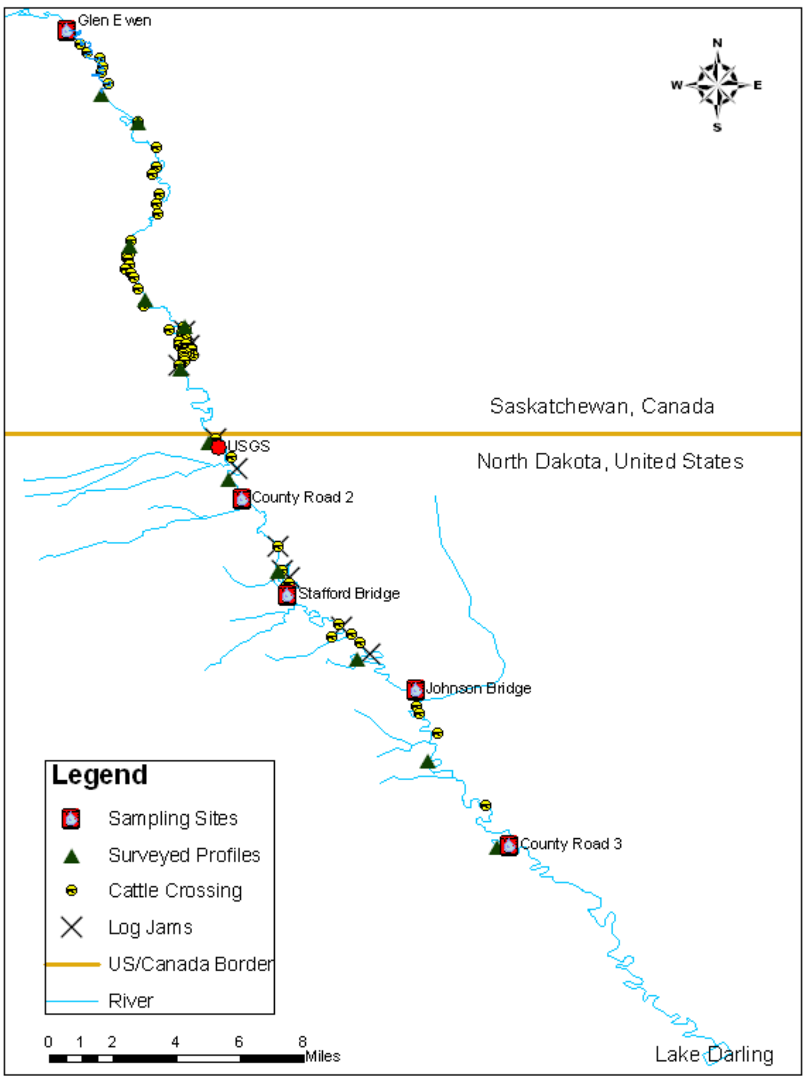


Figure 13. Visual Assessment of Livestock Along the Souris River, Conducted by NDSU Personnel, May 27 and 28, 2007

Macroinvertebrate data were also collected during this assessment for use in a separate project of developing Indices of Biological Integrity (IBIs) for all regions of the State.

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

The Souris River is a Class IA stream. The NDDoH definition of a Class IA Stream is shown below (NDDoH, 2006)

Class IA - The quality of waters in this class shall be suitable for the propagation or protection, or both, of resident fish species and other aquatic

> biota and for swimming, boating, and other water recreation. The quality of the waters shall be suitable for irrigation, stock watering, and wildlife without injurious effects. After treatment consisting of coagulation, settling filtration, and chlorination, or equivalent treatment processes, the water quality shall meet the bacteriological, physical, and chemical requirements of the Department for municipal or domestic use. Treatment for municipal use may also require softening to meet the drinking water requirements.

Numeric criteria have been developed for Class IA streams for both fecal coliform bacteria and E. coli (Table 7). Both bacteria standards applies only during the recreation season of May 1 to September 30.

Table 7. North Dakota Fecal Coliform and E. coli Bacteria Standards for Class IA Streams

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

[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.**

2.3 Water Quality Objectives Set by the International Souris River Board

The International Souris River Board has set water quality objectives for the Souris River as it crosses the boundary from Canada to the United States, which is the upper portion of this TMDL reach. As documented in their most recent Annual Report to the International Joint Commission, the fecal coliform bacteria objective is 200 CFU/100mL (ISRB, 2007). With this objective, even one sample with a fecal coliform bacteria concentration above 200CFUs/100mL is considered an exceedance.

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 Souris 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

Souris River and its tributaries have a recreation designated use that is fully supported, but threatened because of fecal coliform bacteria counts exceeding the North Dakota water quality standard. The North Dakota water quality standard for fecal coliform bacteria is a 30-day geometric mean of 200 CFU/100 mL during the recreation season which is from May 1 to September 30. In addition, no more than ten percent of the samples collected may exceed 400 CFU/100 mL. The International Souris River Board has also set a water quality objective of a monthly mean for fecal coliform bacteria of 200 CFU/100 mL, which is identical to Saskatchewan Environment's 2006 Surface Water Quality Objectives for Saskatchewan. Therefore, the TMDL target for this report is the fecal coliform bacteria standard expressed as the 30-day geometric mean 200 CFU/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.

Currently, the state of North Dakota has both a fecal coliform bacteria standard and an E. coli bacteria standard. During the current triennial water quality standards review period, the Department will be eliminating the fecal coliform bacteria standard and will only have the E. coli standard for bacteria. This standards change is recommended by the US EPA as E. coli is believe to be a better indicator of recreational use risk (i.e., incidence of gastrointestinal disease). During this transition period to an E. coli only bacteria standard, the fecal coliform bacteria target for this TMDL and the resulting load allocation is believe to be protective of the E. coli standard as well. This conclusion is based on the assumption that the ratio of E. coli to fecal coliform in the environment is equal to or less that the ratio of the E. coli bacteria standard to the fecal coliform bacteria standard, which is 63% (126:200). If the ratio of E. coli to fecal coliform in the environment is greater than 63%, then it is unlikely that the current TMDL will result in attainment of the E. coli standard. The department will assess attainment of the E. coli standard through additional monitoring consistent with the state's water quality standards and beneficial use assessment methodology.

4.0 SIGNIFICANT SOURCES

4.1 Point Sources

Within the U. S. portion of Souris 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. It should also be noted that the upstream city of Estevan, Saskatchewan, Canada has implemented advanced wastewater treatment systems.

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

The data collected during the water quality assessment indicate that the primary nonpoint sources for fecal coliform bacteria (an indicator of fecal pathogens) in the Souris River watershed are as follows:

- Runoff of manure from cropland and pasture if there is knowledge of manure being applied;

- Runoff of manure from animal feeding areas;
- Direct deposit of manure into Souris River by livestock; and
- Background levels associated with wildlife

The data collected during the watershed assessment indicate that the primary contributors of fecal coliform bacteria for the watershed are unpermitted animal feeding areas located in close proximity to Souris River and livestock grazing and watering directly in and adjacent to Souris River, with a majority of these occurring in Canada, where the water is shallow.

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

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

4.3 Canada

As illustrated by Figure 9, the majority of the fecal coliform loading seems to be occurring along the portion of the Souris River immediately upstream of the US border. Also, the visual assessment completed by NDSU field staff notes a greater occurrence of livestock in and along the river on the Canadian side of the border. This suggests a significant contribution to the load observed on the US side of the border.

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 reductions necessary to achieve the water quality standards target for fecal coliform bacteria of 200 CFU/100 mL with a margin of safety.

5.1 Mean Daily Stream Flow

In north-central North Dakota, rain events are variable, generally occurring during the months of April through August. Rain events can be sporadic and heavy or light, occurring over a short duration 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 (wet and moist conditions as depicted in Figure 15 below) 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.

The mean daily flow record for the period of January 1991 through November 2009 used in the development of the flow duration curves and load duration curves for sites 380091 and 385220 was obtained from the USGS gauging site 05114000 located west of Sherwood, ND, at the upper end of the reach. As noted before, flow has been determined to be the same for the entire reach. Mean monthly discharge data, as well as data for the flow duration curve may be found in Appendix A.

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 14). 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 14, a flow duration interval of 25 percent associated with a stream flow of 56 cfs, implies that 25 percent of all observed mean daily discharge values equal or exceed 56 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 regimes, provide additional insight about conditions and patterns associated with the impairment (USEPA, 2007). As depicted in Figure 14, the flow duration curve was divided into four flow regimes. For purposes of this TMDL, high flows are flows which are exceeded less than 17 percent of the time or flows greater than 100.0 cfs. Wet flows are flows between 6.7 cfs and 100.0 cfs in the stream. Moist flows are flows between 1.2 cfs and 6.7 cfs. Low flows are equal to no flow up to 1.2 cfs in the stream.

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 14). A secondary factor in determining the flow intervals used in the analysis is the number of fecal coliform bacteria observations available for each flow interval.

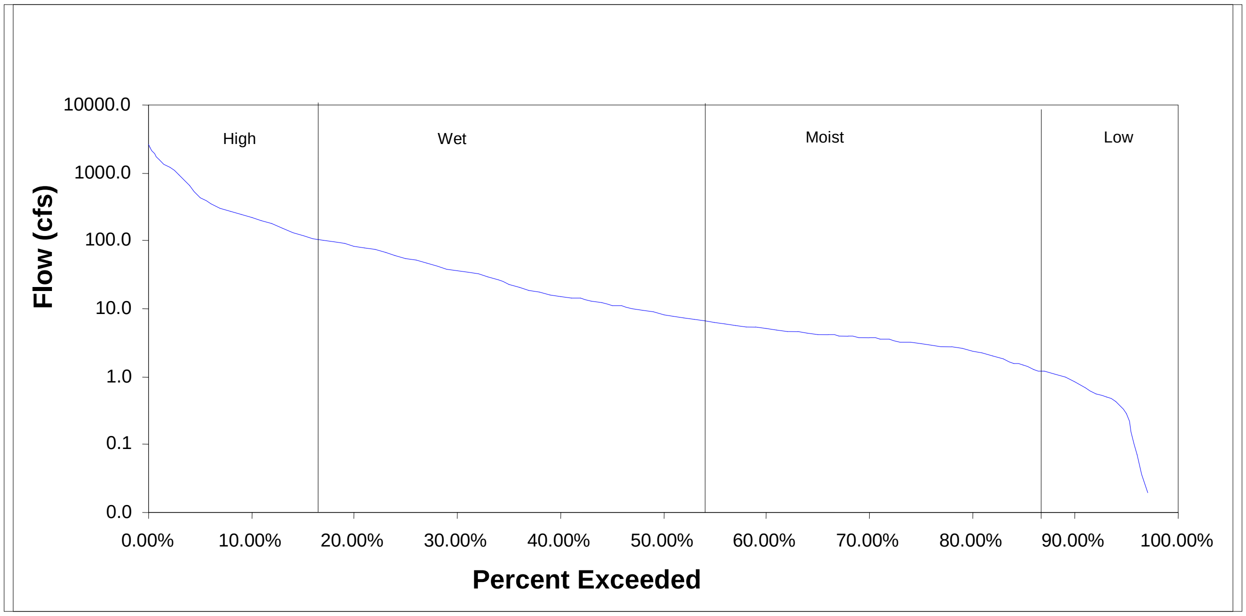


Figure 14. Flow Duration Curve for Souris River USGS Gauging Site 05114000, Based on Data Collected from 1991 - 2009

5.3 Load Duration Curve Analysis

An important factor in determining nonpoint source 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 this impaired reach of the Souris 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 and 5.2.

Observed in-stream fecal coliform bacteria concentrations from monitoring sites 380091 and 385220 (Appendix B) were converted to pollutant loads by multiplying fecal coliform bacteria concentrations by the mean daily flow and a conversion factor. These loads are plotted against the percent exceeded of the flow on the day of sample collection (Figures 15 and 16). 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 regime (i.e., high, wet, moist, 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 curves for sites 380091 and 385220 are provided in Figures 15 and 16. The flow regimes without regression lines are those intervals where there were no fecal coliform bacteria concentrations above the TMDL target, so a regression relationship could not be calculated.

The regression lines for wet and moist flow regimes for site 380091 were then used with the midpoint of the percent exceeded flow for each interval to calculate the existing total fecal coliform bacteria load for that flow interval. For example, in Figure 16 the regression relationship between observed fecal coliform bacteria loading and percent exceeded flow for the wet flow interval (17-43 percent) is:

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

Where the midpoint of the flow interval from 17-43 percent is 30 percent, the existing fecal coliform bacteria load is:

Fecal coliform bacteria load (10^7 CFUs/day) = antilog (4.18 + (-1.82*0.30))
= 35,913.02 x 10^7 CFUs/day

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 30 percent exceeded flow derived from the 200 CFU/100 mL TMDL target curve is 1,7617.67x 10^7 CFUs/day.

As shown in Figure 16, only one sample of fecal coliform bacteria had concentrations above the 200 CFU/100mL line, so the average is well below the standard at site 385220, which is located at the lower end of this TMDL impaired reach. Also, since concentrations of fecal coliform bacteria declined steadily from site 380091 downstream to site 385220, it can be assumed that the entire load can be allocated to sources upstream from site 380091 (i.e., sources in Canada).

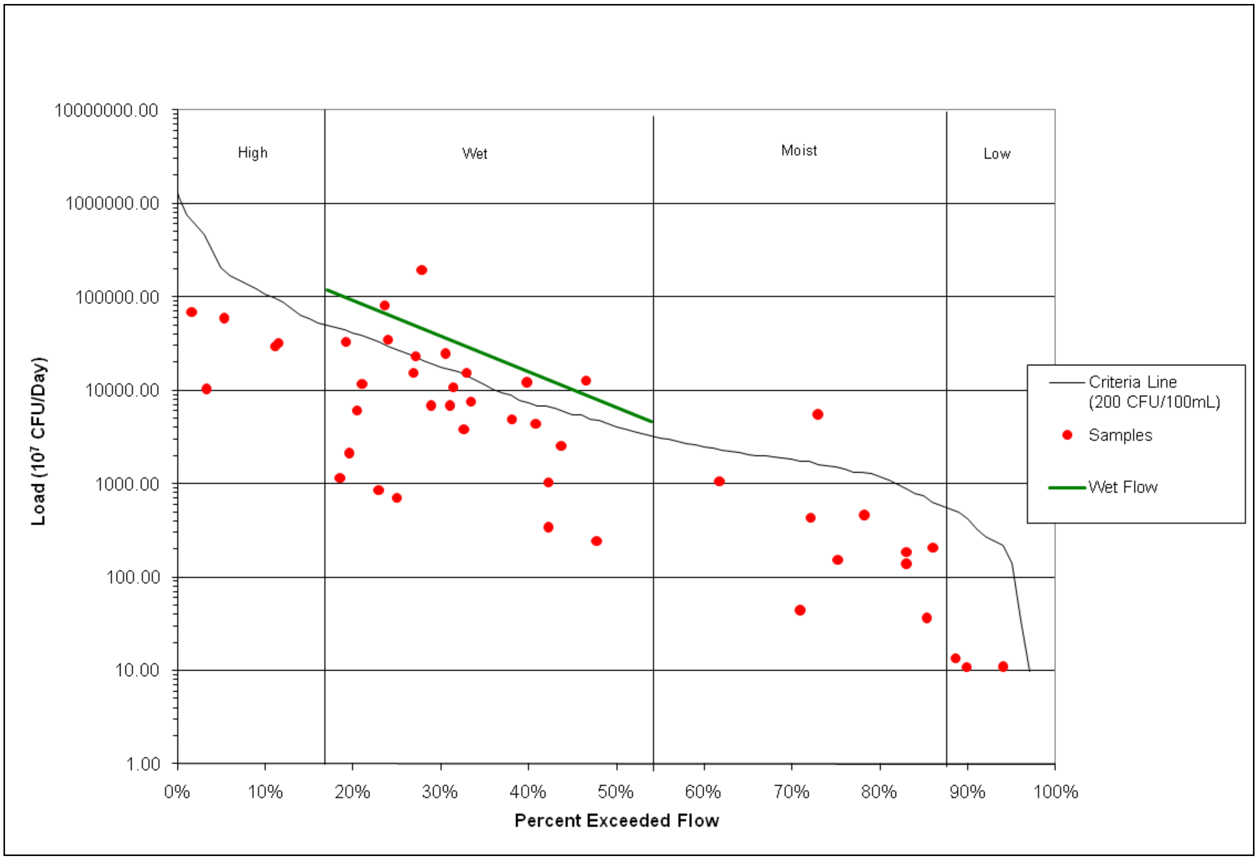


Figure 15. Load Duration Curve for Souris River Site 380091

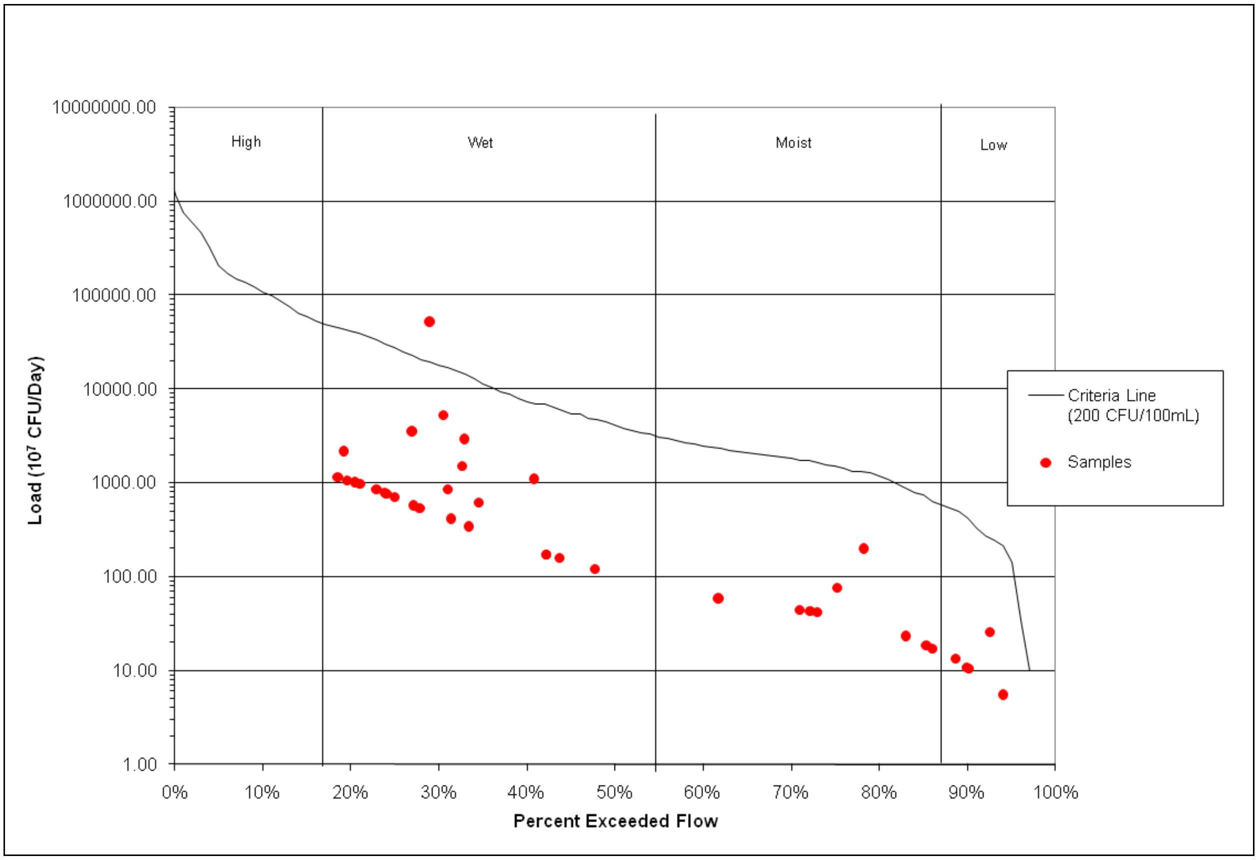


Figure 16. Load Duration Curve for Souris River Site 385220

5.4 Loading Sources

The load reductions needed for the Souris River fecal coliform bacteria TMDL can generally be allotted to nonpoint sources. Based on the data available, the general focus of BMPs and load reductions for the listed segment should be on unpermitted animal feeding areas, range/pastureland, and riparian areas that are greatly disturbed. Higher priority should be given to the animal feeding areas rated higher or located in close proximity to Souris River.

Significant sources of fecal coliform bacteria loading were defined as nonpoint source pollution originating from livestock, mainly directly above the US/Canadian border as indicated by the geometric trends (Figure 9) and the visual survey (Figure 13). 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). A TMDL was developed for one flow regime at site 380091 (i.e., wet), as samples indicated this is where the exceedances of the water quality standard occurred. (Figure 15).

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 (wet and moist flow regimes) 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.

Since there are no point sources in the watershed (Section 4.1), loading sources exceeding the target curve in the moist and dry flow regimes, between 1.0 cfs and 100 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 Souris 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	Flows		
	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 Souris River TMDL addresses seasonality because the flow duration curve was developed using 18 years of USGS gauge 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

Table 9 provides an outline of the critical elements of the Souris River fecal coliform bacteria TMDL. The TMDL for site 380091 is presented in Table 10. This table provides an estimate of the existing daily loads 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. As shown in Figure 16, no TMDLs are needed for site 385220, as based on available data, water quality standards are not exceeded there.

While there were no exceedences of the 200 CFU/100 mL fecal coliform standard for the high flow, moist and low flow regimes for the TMDL listed segment, a TMDL load has been provided for each of these flow regimes as a guide to future watershed management. Based on available data, it can be assumed that this segment of the Souris River is currently meeting the water quality standard for those three flow regimes

Table 9. TMDL Summary for the Souris 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

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 10. Fecal Coliform Bacteria TMDL (10^7 CFU/day) for Souris River ND-09010001-001-S_00, as represented by STORET 380091

	Loads Expressed as Average 10^7 CFU/day			
	High Flow	**Wet Flow**	**Moist Flow**	**Low Flow**
Existing Load		23,635.17		
TMDL	127,728[1]	10,766.35	1,762[1]	269[1]
WLA	No Load Reduction Necessary	0	No Load Reduction Necessary	No Load Reduction Necessary
LA		9,689.72		
MOS		1076.63		

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

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. 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). For the TMDL target to be met, the majority of conservation measures will need to be implemented upstream of the Sherwood site (380091), and mostly in Canada.

In 2005, the Saskatchewan Watershed Authority completed a State of the Watershed report for the Lower Souris River (that portion of the Canadian watershed just above the border). Of the three conditions used to rank watersheds throughout Saskatchewan, Canada, (healthy, stressed, and impacted) based on ecosystem services, ecosystem function, and the watershed’s resistance and resilience to change, the Lower Souris River watershed is categorized as stressed (Davies 2010). There are 22 stressor indicators that contribute to that watershed condition. A summary of some of the data from the Saskatchewan report relevant to this TMDL are provided in Table 11. An advisory board was established to determine ways to implement best management practices to improve water quality. The International Souris River Board also has set water quality objectives for the Souris River crossing the border, so the issue is important to both countries.

Table 11. A Sample of Stressors that Contribute to Watershed Health for Saskatchewan, Canada's Lower Souris River (upstream of CAN/US border)

Category	Condition	Score (Average for Watershed)	Year	Comment
Riparian Health	Healthy	80-100% (of 100%)	1999-2003	
Riparian Health	Stressed	60-70% (of 100%)	2004-2008	
Riparian Buffer	Stressed	25-74.99% (of 100%)	2001	Permanent cover adjacent to waterway
Livestock Density	High Density	10-14 Animal Unit Equivalents/100ha	2001, 2006	17% increase in number of livestock animal unit equivalents from 2001 to 2006
Livestock Manure Production	High Intensity	1629 – 2533 kg/hectare	2001, 2006	17% increase in amount of manure from 2001 to 2006
Livestock Operations Within 300m of Waterway	Moderate Intensity	Between 214 and 426 operations	2001	
Livestock Operations Within 300m of Waterway	Low Intensity	Between 1 and 213 operations	2006	Due to the 2001 data it is believed that this number is towards the higher end of the range.

To achieve the TMDL targets identified in the report, it will require the wide spread international 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 Souris 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 Souris River. The following describe in detail those BMPs that will reduce fecal coliform bacteria levels in the Souris 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. The following specific BMPs are known to reduce NPS pollution from livestock.

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

Water well and tank development - Fencing animals from stream access requires an alternative water source, installing water wells and tanks satisfies this need. 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.

Prescribed grazing – 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. (1988), 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 12).

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

Grazing Strategy		Geometric Mean CFU
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

Vegetated Filter Strip – Vegetated filter strips are used to reduce the amount of sediment, particulate organics, dissolved contaminants, nutrients, and in the case of this TMDL, fecal coliform bacteria to streams. The effectiveness of filter strips and other BMPs in removing fecal coliform bacteria is quite successful. Results from a study by Pennsylvania State University (1992a) as presented by USEPA (1993), suggest that vegetative filter strips are capable of removing up to 55 percent of fecal coliform bacteria loading to rivers and streams (Table 13). 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 13. Relative Gross Effectiveness of Confined Livestock Control Measures (Pennsylvania State University, 1992a)

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 Souris River and request for comment wasl mailed to participating agencies, partners, and to those requesting a copy. Those included in the hard copy mailing were:

- Burke and Renville County Soil Conservation Districts
- Burke and Renville County Water Resource Boards
- International Souris River Board of Control
- Saskatchewan Watershed Authority
- US Fish and Wildlife Service, Upper Souris National Wildlife Refuge
- US EPA - Region VIII
- USDA-NRCS State Offices

In addition to mailing copies of this TMDL for Souris River to interested parties, the TMDL wasl be 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:

- The Bismarck Tribune
- Minot Daily News
- Renville County Farmer
- Burke County Tribune

Comments were received from the Saskatchewan Water Authority and the Natural Resources Conservation Service (Appendix E) and the US EPA Region 8, which were provided as part of their normal public notice review (Appendix F). The NDDoH's response to these comments are provided in Appendix G.

10.0 MONITORING

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

To ensure that the implementation of BMPs will reduce fecal coliform, as well as E. coli bacteria levels necessary to meet water quality standards, 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 and E. coli 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.

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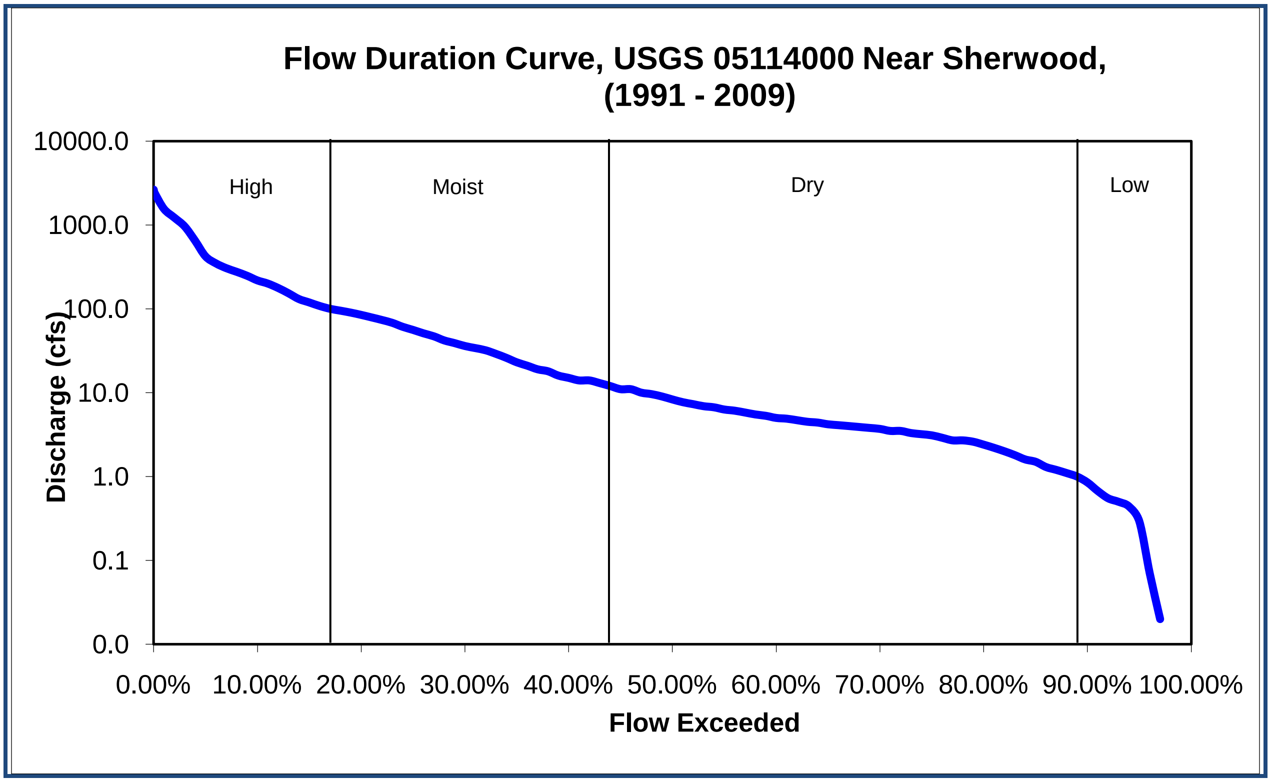
Appendix A
Mean Monthly Discharge Data And Flow Duration Curve
for Souris River at the USGS Site 05114000

Souris River Mean Monthly Discharge Data				USGS Site 05114000				
	1991	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**
Jan	0.000	4.6	0.000	3.79	1.08	2.48	3.80	2.90
Feb	0.000	3.29	0.000	2.79	1.28	1.73	3.72	4.16
Mar	1.08	185.8	22.9	327.7	429	341.3	228.8	8.02
Apr	72.8	72.2	41.9	231.7	262.2	988.6	1133.0	115.2
May	64.9	33.8	8.2	179.0	117.9	802.5	974.7	18.8
Jun	4.8	11.2	2.11	116.3	145.9	102.6	253.7	36.4
Jul	101.2	3.04	26.6	9.53	77.3	32.9	167.1	14.6
Aug	39.	0.365	111.8	2.35	16.1	33.8	11.1	4.06
Sep	8.06	0.029	62.1	1.33	4.99	23.5	9.16	2.64
Oct	54.4	0.016	120.5	0.775	6.67	6.19	5.46	4.52
Nov	22.7	0.044	17.2	0.947	6.13	5.17	4.51	5.31
Dec	10.8	0.017	4.91	1.34	3.65	3.89	3.95	5.85
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Jan	2.57	4.98	4.19	5.13	3.75	0.620	2.66	3.24
Feb	3.66	5.25	78.8	5.04	1.22	0.491	2.63	3.00
Mar	207.3	17.2	858.2	4.89	169.6	4.83	121.1	3.93
Apr	1834.0	13.0	1424.0	36.5	139.7	78.9	409.3	75.8
May	1232.0	14.1	1159.0	54.3	114.1	25.2	78.8	22.2
Jun	290.4	23.1	221.4	16.4	35.9	166.3	195.3	14.3
Jul	376.7	83.6	147.3	30.5	6.53	136.5	204.2	5.95
Aug	324.1	18.5	105.0	17.7	6.51	14.2	101.6	2.6
Sep	173.2	5.30	97.4	18.6	9.88	16.8	102.0	22.2
Oct	19.1	6.69	71.4	6.49	44.3	14.4	62.9	12.0
Nov	14.2	51.8	12.1	6.61	4.02	9.36	17.3	3.67
Dec	7.76	5.45	7.48	5.21	1.08	5.52	4.65	1.43
	2007	**2008**	**2009**					
Jan	1.17	1.10	0.462					
Feb	0.517	0.153	0.496					
Mar	66.6	81.8	0.507					
Apr	77.8	109.3	332.7					
May	46.8	5.34	670.6					
Jun	39.8	16.0	52.7					
Jul	43.5	4.41	44.2					
Aug	22.4	0.875	32.2					
Sep	2.40	0.485	61.5					
Oct	2.88	2.14						
Nov	2.47	4.33						
Dec	1.25	1.66						

Data for Flow Duration Curve

Storet		380091 (USGS 05114000)				
Site Description		Souris River W of Sherwood, ND				
Percent Exceeded	**Q**	**Percent Exceeded**	**Q**	**Percent Exceeded**	**Q**	
0.01%	2631.0	32.00%	32.0	65.00%	4.2	
0.10%	2403.9	33.00%	29.0	66.00%	4.1	
1.00%	1550.0	34.00%	26.0	67.00%	4.0	
2.00%	1219.6	35.00%	23.0	68.00%	3.9	
3.00%	956.7	36.00%	21.0	69.00%	3.8	
4.00%	646.6	37.00%	19.0	70.00%	3.7	
5.00%	421.8	38.00%	18.0	71.00%	3.5	
6.00%	347.9	39.00%	16.0	72.00%	3.5	
7.00%	305.0	40.00%	15.0	73.00%	3.3	
8.00%	275.8	41.00%	14.0	74.00%	3.2	
9.00%	247.8	42.00%	14.0	75.00%	3.1	
10.00%	218.0	43.00%	13.0	76.00%	2.9	
11.00%	200.0	44.00%	12.0	77.00%	2.7	
12.00%	177.0	45.00%	11.0	78.00%	2.7	
13.00%	153.0	46.00%	11.0	79.00%	2.6	
14.00%	130.7	47.00%	10.0	80.00%	2.4	
15.00%	119.0	48.00%	9.6	81.00%	2.2	
16.00%	108.0	49.00%	9.0	82.00%	2.0	
17.00%	100.0	50.00%	8.3	83.00%	1.8	
18.00%	95.0	51.00%	7.7	84.00%	1.6	
19.00%	90.0	52.00%	7.3	85.00%	1.5	
20.00%	84.6	53.00%	6.9	86.00%	1.3	
21.00%	79.0	54.00%	6.7	87.00%	1.2	
22.00%	73.6	55.00%	6.3	88.00%	1.1	
23.00%	68.0	56.00%	6.1	89.00%	1.0	
24.00%	61.0	57.00%	5.8	90.00%	0.9	
25.00%	56.0	58.00%	5.5	91.00%	0.7	
26.00%	51.0	59.00%	5.3	92.00%	0.6	
27.00%	47.0	60.00%	5.0	93.00%	0.5	
28.00%	42.0	61.00%	4.9	94.00%	0.4	
29.00%	39.0	62.00%	4.7	95.00%	0.3	
30.00%	36.0	63.00%	4.5	96.00%	0.1	
31.00%	34.0	64.00%	4.4	97.00%	0.0	



Flow Duration Curve, USGS 05114000 Near Sherwood,
(1991 - 2009)
High
Moist
Dry
Low
10000.0
1000.0
100.0
10.0
1.0
0.1
0.0
Discharge (cfs)
0.00%
10.00%
20.00%
30.00%
40.00%
50.00%
60.00%
70.00%
80.00%
90.00%
100.00%
Flow Exceeded

Appendix B
Fecal Coliform Bacteria Data

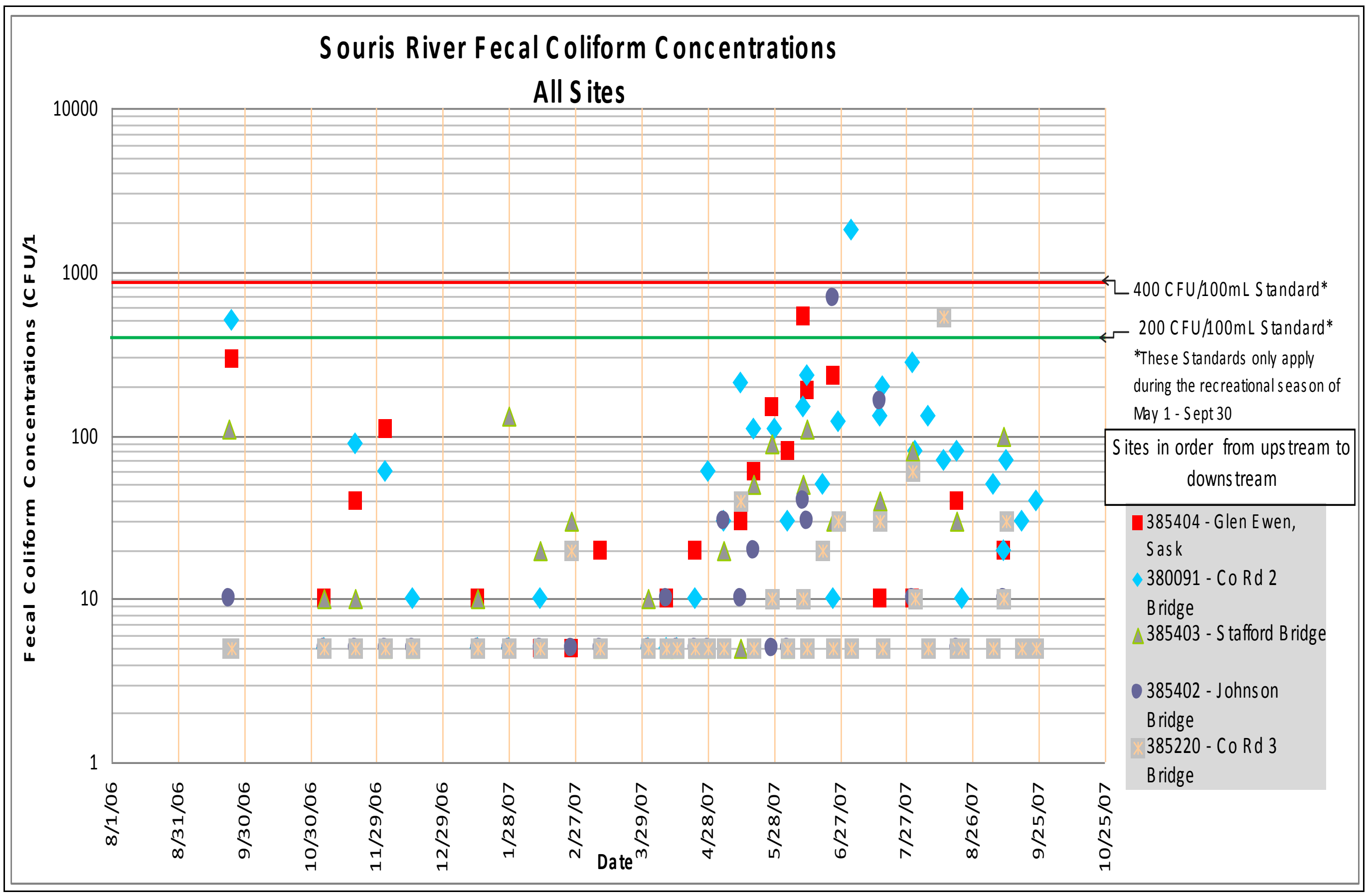
Concentrations C Site 380091				
Date	C	Q	PercentRank	Load(CFUx10^7/Day)
5/6/1997	20	1400	1.6%	68513
5/20/1997	5	847	3.3%	10363
6/2/1997	60	401	5.3%	58872
6/16/1997	60	200	11.1%	29363
7/15/1997	70	188	11.5%	32201
8/12/1997	470	11	46.5%	12650
9/9/1997	310	16	39.8%	12137
9/24/2006	510	65	23.6%	81115
11/5/2006	5	3.6	70.9%	44
11/19/2006	90	4.8	61.7%	1057
12/3/2006	60	1.4	86.0%	206
12/15/2006	10	1.5	85.3%	37
1/14/2007	5	1.1	88.6%	13
1/28/2007	5	0.88	89.9%	11
2/11/2007	10	0.45	94.0%	11
4/1/2007	5	57	25.0%	697
4/9/2007	5	70	22.9%	856
4/14/2007	5	94	18.5%	1150
4/22/2007	10	87	19.6%	2129
4/28/2007	60	80	21.0%	11745
5/5/2007	30	83	20.4%	6093
5/13/2007	210	30	32.9%	15415
5/19/2007	110	28	33.4%	7536
5/28/2007	110	18	38.1%	4845
6/3/2007	30	14	42.2%	1028
6/10/2007	150	89	19.2%	32666
6/12/2007	230	62	24.0%	34893
6/19/2007	50	31	32.6%	3793
6/24/2007	10	14	42.2%	343
6/26/2007	120	15	40.8%	4404
7/2/2007	1800	44	27.8%	193794
7/15/2007	130	48	26.9%	15269
7/16/2007	200	47	27.1%	23001
7/30/2007	280	36	30.5%	24665
7/31/2007	80	35	31.0%	6851
8/6/2007	130	34	31.4%	10815
8/13/2007	70	40	28.9%	6851
8/19/2007	80	13	43.7%	2545
8/21/2007	10	9.9	47.7%	242
9/4/2007	50	3.5	72.1%	428
9/9/2007	20	3.1	75.2%	152
9/10/2007	70	2.7	78.2%	462
9/17/2007	30	1.9	83.0%	139
9/24/2007	40	1.9	83.0%	186
10/21/2007	660	3.4	72.9%	5491

Concentrations C for Site 385220				
Date	**C**	**Q**	**PercentRank**	**Load(CFUx10^7/Day)**
9/23/2006	5	64	23.8%	783
11/5/2006	5	3.6	70.9%	44
11/19/2006	5	4.8	61.7%	59
12/3/2006	5	1.4	86.0%	17
12/15/2006	5	1.5	85.3%	18
1/14/2007	5	1.1	88.6%	13
1/28/2007	5	0.88	89.9%	11
2/11/2007	5	0.45	94.0%	6
2/25/2007	20	0.52	92.5%	25
3/10/2007	5	0.85	90.1%	10
4/1/2007	5	57	25.0%	697
4/9/2007	5	70	22.9%	856
4/14/2007	5	94	18.5%	1150
4/22/2007	5	87	19.6%	1064
4/28/2007	5	80	21.0%	979
5/5/2007	5	83	20.4%	1015
5/13/2007	40	30	32.9%	2936
5/19/2007	5	28	33.4%	343
5/27/2007	10	25	34.5%	612
6/3/2007	5	14	42.2%	171
6/10/2007	10	89	19.2%	2178
6/12/2007	5	62	24.0%	759
6/19/2007	20	31	32.6%	1517
6/24/2007	5	14	42.2%	171
6/26/2007	30	15	40.8%	1101
7/2/2007	5	44	27.8%	538
7/15/2007	30	48	26.9%	3524
7/16/2007	5	47	27.1%	575
7/30/2007	60	36	30.5%	5285
7/31/2007	10	35	31.0%	856
8/6/2007	5	34	31.4%	416
8/13/2007	530	40	28.9%	51874
8/19/2007	5	13	43.7%	159
8/21/2007	5	9.9	47.7%	121
9/4/2007	5	3.5	72.1%	43
9/9/2007	10	3.1	75.2%	76
9/10/2007	30	2.7	78.2%	198
9/17/2007	5	1.9	83.0%	23
9/24/2007	5	1.9	83.0%	23
10/21/2007	5	3.4	72.9%	42

Fecal Coliform Bacteria Concentrations for Sites on the Souris River

Fecal Coliform Bacteria CFU/100mL					
Date	385404	380091	385403	385402	385220
5/6/1997		20			
5/20/1997		5			
6/2/1997		60			
6/16/1997		60			
7/15/1997		70			
8/12/1997		470			
9/9/1997		310			
23-Sep-06			110	10	5
24-Sep-06	290	510			5
05-Nov-06	10	5	10	5	5
19-Nov-06	40	90	10	5	5
03-Dec-06	110	60	5	5	5
15-Dec-06	5	10	5	5	5
14-Jan-07	10	5	10	5	5
28-Jan-07	5	5	130	5	5
11-Feb-07	5	10	20	5	5
25-Feb-07	5		30	5	20
10-Mar-07	20		5	5	5
01-Apr-07	5	5	10	5	5
09-Apr-07	10	5	5	10	5
14-Apr-07	5	5	5	5	5
22-Apr-07	20	10	5	5	5
28-Apr-07	5	60	5	5	5
05-May-07	5	30	20	30	5
13-May-07	30	210	5	10	40
19-May-07	60	110	50	20	5
27-May-07	150		90	5	10
28-May-07		110			
03-Jun-07	80	30	5	5	5
10-Jun-07	530	150	50	40	10
12-Jun-07	190	230	110	30	5
19-Jun-07		50			20
24-Jun-07	230	10	30	690	5
26-Jun-07		120			30
02-Jul-07		1800			5
15-Jul-07	10	130	40	160	30
16-Jul-07		200			5
30-Jul-07	10	280	80	10	60
31-Jul-07		80			10
06-Aug-07		130			5
13-Aug-07		70			530
19-Aug-07	40	80	30	5	5

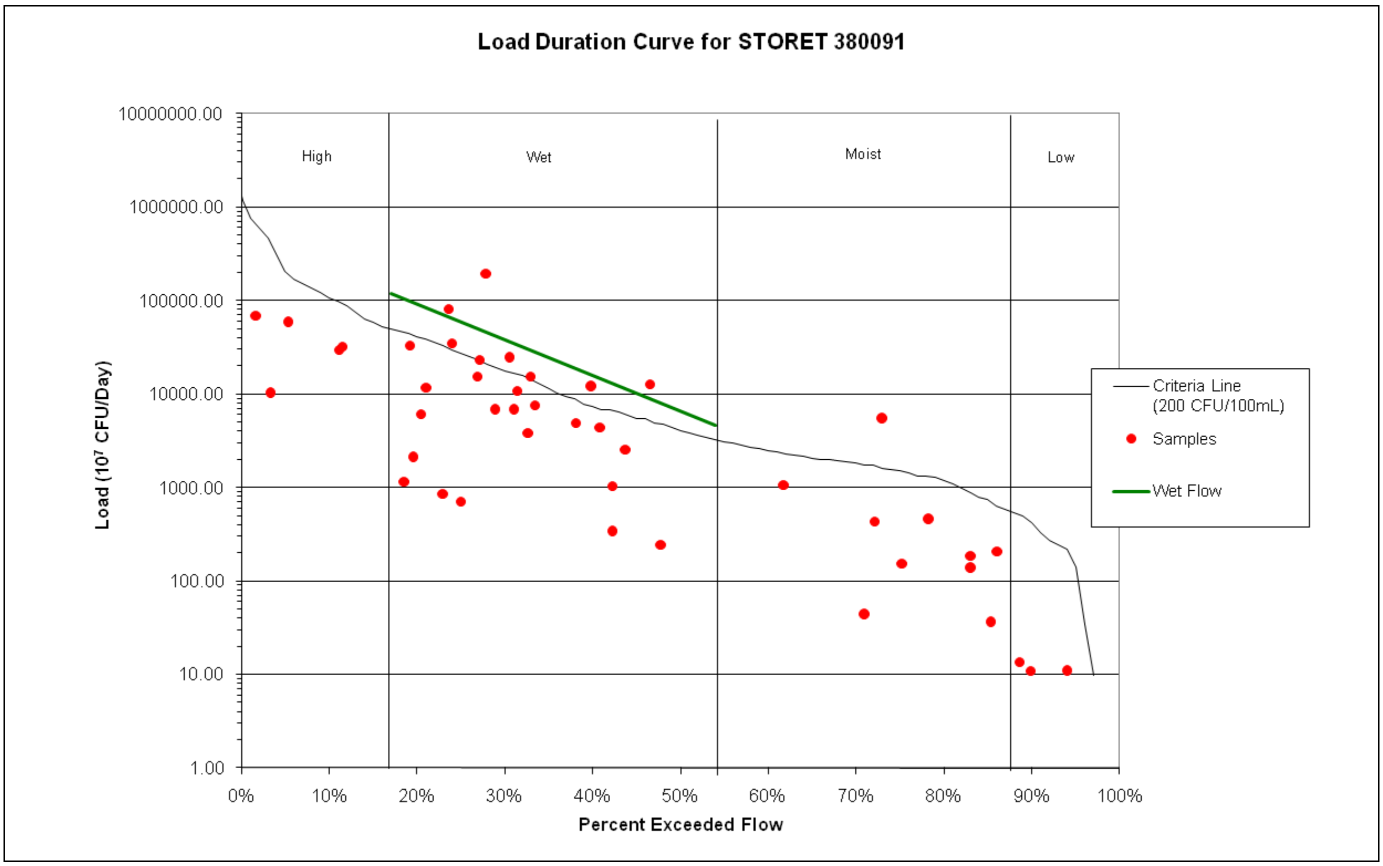
Fecal Coliform Bacteria CFU/100mL (cont.)					
Date	385404	380091	385403	385402	385220
21-Aug-07		10			5
04-Sep-07		50			5
09-Sep-07	20	20	100	10	10
10-Sep-07		70			30
17-Sep-07		30			5
24-Sep-07		40			5



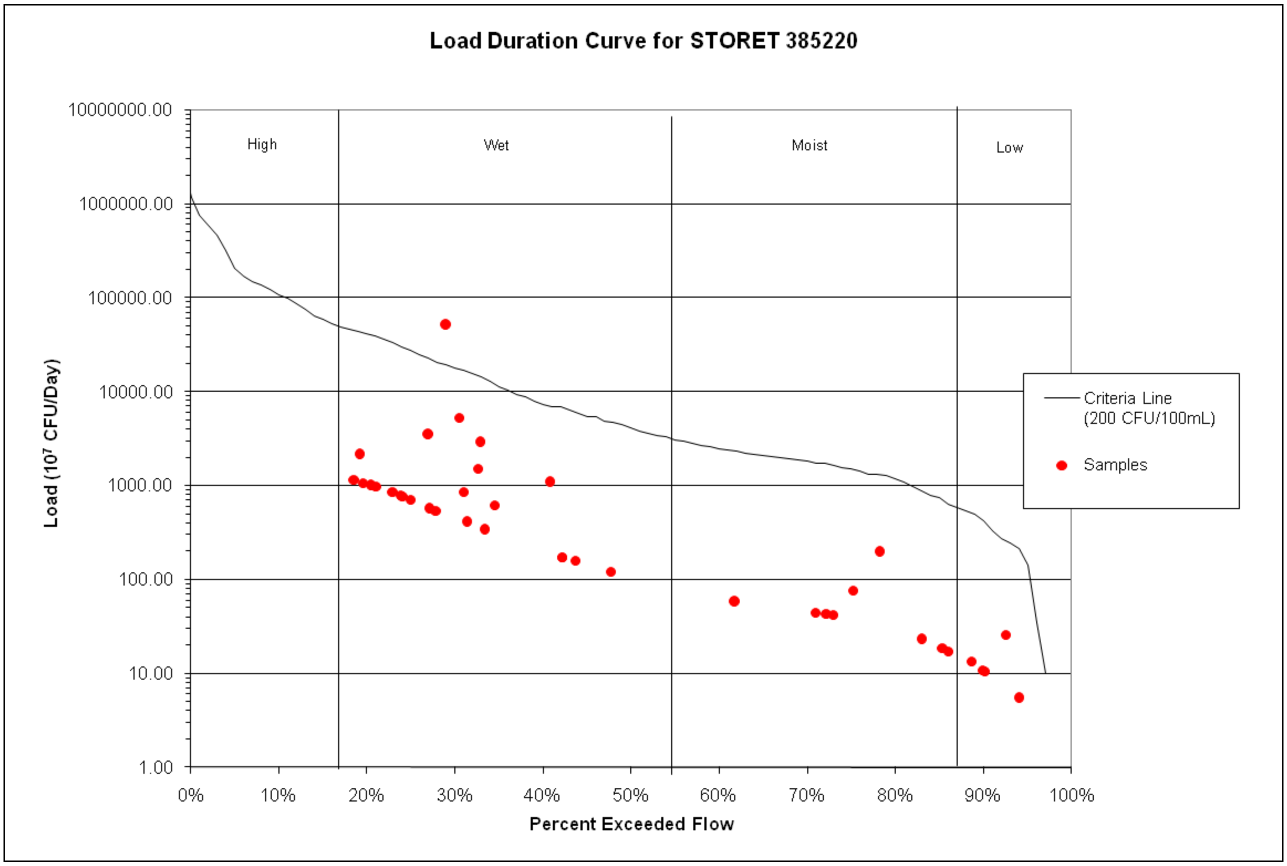
Appendix C
Load Duration Curves, Estimated Loads, and TMDL Targets From Load Duration Curve Spreadsheet

Souris River Site 380091 – County Rd 2 Bridge, West of Sherwood

	Load (10^7 CFU/Day)				Load (10^7 CFU/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
Wet	35.5%	23,635.17	10,766.35	135.05			
					Only one flow regime so no comparison between regimes		
			Total	135.05			



Due to no water quality standards exceedences, there is no load reduction results table for STORET 385220, County Rd. 3 Bridge site.



Appendix D
Map of Entire Souris River Watershed

Map of the Souris River Drainage Basin
INTERNATIONAL JOINT COMMISSION • COMMISSION MIXTE INTERNATIONALE
1909
Miles
0 5 10 15 20
Kilometres
0 10 20 30 40
North
Legend
Souris River Basin
Indian / Native Reserve
Provincial Park
US Fish and Wildlife
Gauging Stations
City
Town, Village
Highway
River
Lake or Reservoir
Datum: NAD 1983
Projection: Lambert Conformal Conic
Latitude of Origin: 49'
Central Meridian: -104'
Standard Parallel 1: 49'
Standard Parallel 2: 77'
Date: September 2007
Contact: M.R. Gilchrist, 306-780-6411
Environment Canada
Saskatchewan
Manitoba
Canada
U.S.A.
Montana
North Dakota
SASKATCHEWAN
MANITOBA
MONTANA
NORTH DAKOTA
Regina
Weyburn
Estevan
Brandon
Minot
Bottineau
Rugby
Devils Lake
Williston
New Town
Parshall
Harvey
Fessenden
Garrison
Sidney
Culbertson
Moose Mountain Provincial Park
Turtle Mountain Provincial Park
Spruce Woods Provincial Park
Riding Mountain National Park
Des Lacs NWR
Upper Souris NWR
J. Clark Salyer NWR
Lostwood NWR
FORT PECK INDIAN RESERVATION
FORT BERTHOLD INDIAN RESERVATION
SPIRIT LAKE INDIAN RESERVATION
TURTLE MOUNTAIN INDIAN RESERVATION

Appendix E
Public Comment Letter Received from the Saskatchewan Water Authority and the Natural Resources Conservation Service

Saskatchewan

Saskatchewan Watershed Authority

Head Office

Victoria Place
111 Fairford Street East
Moose Jaw, Canada
S6H 7X9

(306) 694-3900
(306) 694-3944 Fax

www.swa.ca

July 28, 2010

(306) 694-7737

Mr. Michael J. Ell
North Dakota Department of Health
Division of Water Quality, Gold Seal Center
918 East Divide Avenue
4th floor
Bismarck ND 58501-1947

RECEIVED
AUG 06 2010
DIV. OF WATER QUALITY

Dear Mr. Ell,

Re: Souris River Fecal Coliform Bacteria TMDL Report

Thank you for the draft copy of the Souris River Fecal Coliform Bacteria TMDL report and the opportunity to comment on the report.

I understand Saskatchewan Watershed Authority's representative, Dr. Terry Hanley, has been having ongoing discussions with your office on the TMDL issue. Overall, Saskatchewan Watershed Authority is pleased with the report; however, Dr. Hanley has expressed concern that the data set used in developing it is not sufficient to come up with a specific loading level for fecal coliforms.

Thank you again for your letter and the opportunity to comment on the report.

Yours truly,

Bob Carles
Vice President
Stewardship

cc: Dr. Terry Hanley, Director, Science, Information & Monitoring (SWA)
Doug Johnson, Director, Basin Operations (SWA)

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
P.O. Box 1458
Bismarck, ND 58502-1458

July 6, 2010

Michael J. Ell
ND Department of Health
Division of Water Quality
Gold Seal Center
918 E. Divide Ave. 4th Floor
Bismarck, ND 58501-1947

Dear Mr. Ell:

Thank you for the opportunity to contribute the following comments on the DRAFT Souris River Fecal Coliform Bacteria TMDL Report:

1. Page 7, Paragraph 1. "Annual Precipitation" or "Actual Precipitation" values for the years 2006 and 2007 may be more appropriate than "Average Annual Precipitation" for a specific year.

2. Pages 18-23, 5.0 Technical Analysis subparts 5.1-5.4. NRCS would prefer wording indicating the TMDL goal would be "less than" 200CFU/100mL.

If you have any questions, please contact Curtis Bradbury, Resource Conservationist, at (701) 530-2092 or curtis.bradbury@nd.usda.gov.

Sincerely,

ACTING PAUL J. SWEENEY
State Conservationist

Helping People Help the Land

Appendix F
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 Souris River in Renville and Burke Counties, North Dakota**
Submitted by:	**Mike Ell, North Dakota Department of Health**
Date Received:	**June 23, 2010**
Review Date:	**July 19, 2010**
Reviewer:	**Vern Berry, EPA**
Rough Draft / Public Notice / Final?	**Public Notice**
Notes:	

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

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

Approval Notes to Administrator:

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

1. Problem Description
   - 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 Souris River fecal coliform TMDL was submitted to EPA for review via an email from Mike Ell, NDDoH on June 23, 2010. The email included the draft TMDL document and a request to review and comment on the TMDL document.

COMMENTS: None.

1.2 Identification of the Waterbody, Impairments, and Study Boundaries

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

Minimum Submission Requirements:

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

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

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

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

SUMMARY: The Souris River watershed is a 109,103 acre watershed located in Renville and Burke Counties, in north western North Dakota. The listed segment of the Souris River mainstem is from the N.D. / Saskatchewan border downstream to Lake Darling (43.4 miles; ND-09010001-001-S_00). It is part of the larger Souris River basin in the Upper Souris sub-basin (HUC 09010001). This segment is listed as impaired for sediment/siltation, dissolved oxygen and fecal coliform. The TMDL document included in this review only addresses the fecal coliform impairment. The other impairments will be addressed in separate documents.

The designated uses for this segment of the Souris River are based on the Class IA stream classification in the ND water quality standards (NDCC 33-15-02.1-09).

COMMENTS: None.

1.3 Water Quality Standards

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

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

Minimum Submission Requirements:

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

☒ The purpose of a TMDL analysis is to determine the assimilative capacity of the waterbody that corresponds to the existing water quality standards for that waterbody, and to allocate that assimilative capacity between the significant sources. Therefore, all TMDL documents must be written to meet the existing water quality standards 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 Souris River segment addressed by this TMDL document is impaired based on fecal coliform concentrations for primary contact recreational uses. The Souris River is Class IA stream that shall be suitable for the propagation and/or protection of resident fish species and other aquatic biota and for swimming, boating, and other water recreation. Class IA streams shall also be suitable for irrigation, stock watering and wildlife without injurious effects. Numeric criteria for fecal coliforms in Class IA streams have been established and are presented in the excerpted Table 7 shown below. Discussion of additional applicable water quality standards for Souris River can be found on pages 15 and 16 of the TMDL.

Table 7. North Dakota Fecal Coliform Bacteria Standards for Class IA 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.**

The International Souris River Board has set water quality objectives for the Souris River as it crosses the boundary from Canada to the United States, which is the upper portion of this TMDL reach. As documented in their most recent Annual Report to the International Joint Commission, the fecal coliform bacteria objective is 200 CFU/100mL (ISRB, 2007). With this objective, even one sample with a fecal coliform bacteria concentration above 200CFUs/100mL is considered an exceedance.

COMMENTS: None.

2. Water Quality Targets

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

Minimum Submission Requirements:

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

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

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

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

SUMMARY: The water quality targets for these TMDLs are based on the numeric water quality standards for fecal coliform bacteria based on the primary contact recreational beneficial use for Souris River. The target for the Souris 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) standard.

The International Souris River Board has set water quality objectives for the Souris River as it crosses the boundary from Canada to the United States. As documented in their most recent Annual Report to the International Joint Commission, the fecal coliform bacteria objective is 200 CFU/100mL (ISRB, 2007). With this objective, even one sample with a fecal coliform bacteria concentration above 200CFUs/100mL is considered an exceedance. This objective, effective at the border, creates a boundary condition of 200 CFU/100mL and is equivalent to the North Dakota target.

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 includes the landuse breakdown for the watershed based on the 2006 National Agricultural Statistics Service data. In 2006, approximately 49 percent of the landuse in the watershed was cropland under active cultivation, 21 percent was pasture/range/haylands, and the remaining 30 percent was idle/fallow, water or roads.

Within the U.S. portion of Souris 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. The upstream city of Estevan, Saskatchewan, Canada discharges from an advanced wastewater treatment system.

There are two permitted animal feeding operations in the watershed, however, they are zero discharge facilities and are not deemed a significant source for this report.

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

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

It appears that the fecal coliform load from Canada may be a significant portion of the total load based on: 1) visual assessments completed by NDSU field staff indicating a greater occurrence of livestock grazing in and along the river on the Canadian side of the border, and 2) data from several dates showing an increase of fecal coliform concentration from the Glen Ewen site in Canada to the County Road 2 bridge site in North Dakota.

COMMENTS: None.

4. TMDL Technical Analysis

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

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

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

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

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

Where:

TMDL = Total Pollutant Loading Capacity of the waterbody

LAs = Pollutant Load Allocations

WLAs = Pollutant Wasteload Allocations

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

Minimum Submission Requirements:

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

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

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

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

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

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

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

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

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

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

The TMDL loads and loading capacities were derived using the load duration curve (LDC) approach. To better correlate the relationship between the pollutant of concern and the hydrology of the Section 303(d) listed waterbody, a LDC was developed for monitoring site 380091. The LDC was derived using the 200 CFU/100 mL TMDL target (i.e., state water quality standard), the daily flow record recorded nearby, and the observed fecal coliform data collected from the site (see Figure 8 of the TMDL document) from 2006-2007.

Mean daily flows from 1991 through 2009 were used in the development of the flow duration curve and load duration curve for site 380091 (Souris River near County Road 2, ND). Flows were obtained from the discharge record at the United States Geological Survey (USGS) gauge station (05114000) which is located west of Sherwood, ND at the upper end of the impaired segment in ND. The load duration curve was constructed using data from site 380091, the monitoring site closest to the USGS gauging site, for three reasons: 1) this site had the most available data; 2) this site is the most impaired, based on the data; and 3) there is a great deal of local concern for this area of the Souris River.

The load duration curve plots the allowable fecal coliform load (using the 200 CFU/100 mL standard) across the four flow regimes. Single grab sample fecal coliform concentrations were converted to loads by multiplying by flow and a conversion factor to produce CFU/day values. Each value was plotted individually on the load duration 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 LDC represents flow-variable TMDL targets across the flow regimes shown in the TMDL document. For the Souris 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 for the entire listed segment at each flow regime. Table 10 shows the loading capacity load (i.e., TMDL load) for the listed segment of the Souris River.

COMMENTS: We recommend including the LC (or TMDL load) for all flow regimes in Table 10. It is not necessary to include the "existing load", the "WLA" or the "MOS" for those flow regimes that don't require and load reduction. The purpose for including LC at all flow zones is to document the allowable TMDL loads across all flows in the event that future sampling results show exceedances at other flow regimes.

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 Souris River TMDL data description and summary are included tables throughout the document and in the data tables in Appendix B. Recent water quality monitoring was conducted over the period from 2006-2007 and included 37 fecal coliform samples at station 380091. The data set also includes approximately 18 years of flow record on Souris River from the USGS gauging site (05114000). The flow data, along with the TMDL target, were used to develop the fecal coliform load duration curve for the Souris 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: Within the U.S. portion of Souris 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. The upstream city of Estevan, Saskatchewan, Canada discharges from an advanced wastewater treatment system.

There are two permitted animal feeding operations in the watershed, however, they are zero discharge facilities and are not deemed a significant source for this report. Therefore, the WLA for the fecal coliform 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 includes the landuse breakdown for the watershed based on the 2006 National Agricultural Statistics Service data. In 2006, approximately 49 percent of the landuse in the watershed was cropland under active cultivation, 21 percent was pasture/range/haylands, and the remaining 30 percent was idle/fallow, water or roads. There are no significant point sources of fecal coliform loading located in the watershed (i.e., the WLA = 0). 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	Flows		
	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 Souris River TMDL includes an explicit MOS for the listed segment derived by calculating 10 percent of the loading capacity. The explicit MOS for the Souris River segment is 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 TMDL is only applicable during that period.

COMMENTS: None.

5. Public Participation

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

Minimum Submission Requirements:

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

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

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

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

COMMENTS: None.

6. Monitoring Strategy

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

Minimum Submission Requirements:

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

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

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

SUMMARY: The Souris River segments 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 Souris 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 Allocation section (Section 8.0) 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 Souris River fecal coliform TMDL document includes daily loads expressed as colonies per day for the listed segment of the river. The daily TMDL loads are included in TMDL section (Section 7.0) of the document.

COMMENTS: None.

Appendix G
NDDoH's Response to Comments Received from the Saskatchewan Water Authority, the Natural Resources Conservation Service and the US EPA Region 8

Saskatchewan Water Authority Comment: Concern that the data set usedin developing the TMDL is not sufficient to come up with a specific loading level for fecal coliforms.

NDDoH Response: Ideally it is always more helpful if more and better data are available to develop TMDLs and this TMDL is no exception. The data set used to develop the TMDL for the Souris River is comparable to data sets used to for other TMDLs developed and approved in Region 8. The allowable TMDL loads were derived by using the load duration curve approach. This approach is an EPA accepted method to calculate the loads needed to meet NDDoH's water quality standards. Additional data would be useful to more closely pinpoint sources of nonpoint loading and to get a more precise understanding of the statistical boundaries of the fecal coliform impairment which could be helpful in implementation. However, implementation can proceed based on the existing loading source information and reduction estimates as long as data collection efforts continue until it compliance with WQS can be demonstrated. The fecal coliform bacteria objective of 200 cfu/100mL set by the International Souris River Board and the International Joint Commission matches the NDDoH's water quality standards and is an appropriate boundary condition that Canada should strive for when designing implementation measures. When that objective is met at the border, along with the controls proposed to reduce loading in ND, the TMDL loads will be achieved and ND's water quality will be restored.

NRCS Comment: Page 7, Paragraph 1. “Annual Precipitation” or “Actual Precipitation” values for the years 2006 and 2007 may be more appropriate than “Average Annual Precipitation” for a specific year.

NDDoH Response: Wording on page 7, paragraph 1, changed to “annual precipitation”.

NRCS Comment: Pages 18-23, 5.0 Technical Analyasis subparts 5.1-5.4. NRCS would prefer wording indicating the TMDL goal would be “less than” 200 CFU/100 mL.

NDDoH Response: While the NDDoH agrees that the goal of any watershed restoration project should result in the implementation BMPs that will result in water quality that is better than the water quality standard of 200 CFUs/100 mL, the water quality standard for fecal coliform bacteria and the resulting TMDL target is 200 CFUs/100 mL. Wording to reflect the water quality standard and resulting TMDL target will not be changed.

US EPA Region 8 Comment: We recommend including the LC (or TMDL load) for all flow regimes in Table 10. It is not necessary to include the “existing load”, the “WLA” or the “MOS” for those flow regimes that don’t require and load reduction. The purpose for including LC at all flow zones is to document the allowable TMDL loads across all flows in the event that future sampling results show exceedances at other flow regimes.

NDDoH Response: TMDL loads have been included in Table 10 for the high flow, moist and low flow conditions. These additional TMDL loads have been provided for each of these flow regimes as a guide to future watershed management.