Fecal Coliform Bacteria TMDL for the Turtle River in Grand Forks and Nelson Counties, North Dakota

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1.0 INTRODUCTION AND DESCRIPTION OF THE WATERSHED

The Turtle River watershed is a 457,907 acre watershed located in Nelson and Grand Forks Counties in northeastern North Dakota (Table 1 and Figure 1). For the purposes of this TMDL, the impaired segments are located in Grand Forks County and comprise approximately 232,234 acres. The Turtle River impaired segments lie within the Level III Northern Glaciated Plains (46) and Lake Agassiz Plain (48) Ecoregions.

Table 1. General Characteristics of the Turtle River Watershed.

Legal Name	Turtle River
Stream Classification	Class II
Major Drainage Basin	Red River
8-Digit Hydrologic Unit	09020307
Counties	Grand Forks and Nelson Counties
Level III Ecoregions	Northern Glaciated Plains (46) and Lake Agassiz Plain (48)
Watershed Area (acres)	457,907

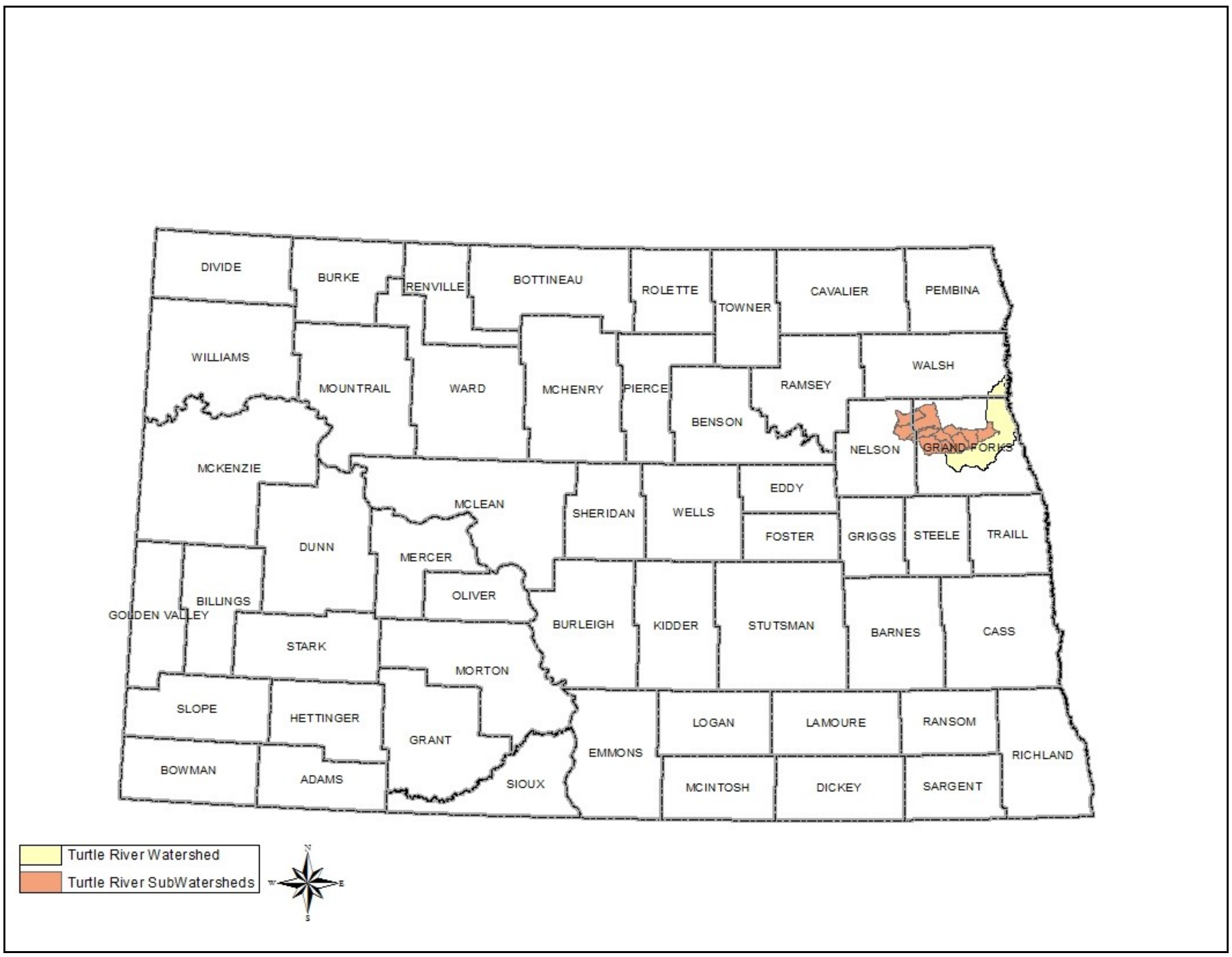


Figure 1. Turtle River Watershed in North Dakota.

1.1 Clean Water Act Section 303(d) Listing Information

Based on the 2012 Section 303(d) List of Impaired Waters Needing TMDLs (NDDoH, 2012), the North Dakota Department of Health has identified a 25.27 mile segment (ND-09020307-019-S_00) of the Turtle River from its confluence with tributary northeast of Turtle River State Park, downstream to its confluence with Kelly Creek as fully supporting but threatened for recreational uses, a 13.9 mile segment (ND-09020307-021-S_00) of the Turtle River from its confluence with South Branch Turtle River downstream to its confluence with a tributary northeast of Turtle River State Park as fully supporting but threatened for recreational uses, a 18.42 mile segment (ND-09020307-24-S_00) of the South Branch Turtle River downstream to Larimore Dam as fully supporting but threatened for recreational uses, and a 15.26 mile segment (ND-09020307-031-S_00) of the North Branch Turtle River from its confluence with Whiskey Creek, downstream to its confluence with South Branch Turtle River as fully supporting but threatened for recreational uses. The impairments are due to fecal coliform bacteria (Tables 2-5 and Figure 2).

Table 2. Turtle River Section 303(d) Listing Information for Assessment Unit ID ND-09020307-019-S_00 (NDDoH, 2012).

Assessment Unit ID	ND-09020307-019-S_00
Waterbody Description	Turtle River from its confluence with a tributary northeast of Turtle River State Park, downstream to its confluence with Kelly Creek.
Size	25.27 miles
Designated Use	Recreation
Use Support	Fully Supporting, but Threatened
Impairment	Fecal Coliform Bacteria
TMDL Priority	Low

Table 3. Turtle River Section 303(d) Listing Information for Assessment Unit ID ND-09020307-021-S_00 (NDDoH, 2012).

Assessment Unit ID	ND-09020307-021-S_00
Waterbody Description	Turtle River from its confluence with South Branch Turtle River downstream to its confluence with a tributary northeast of Turtle River State Park.
Size	13.9 miles
Designated Use	Recreation
Use Support	Fully Supporting, but Threatened
Impairment	Fecal Coliform Bacteria
TMDL Priority	Low

Table 4. Turtle River Section 303(d) Listing Information for Assessment Unit ID ND-09020307-024-S_00 (NDDoH, 2012).

Assessment Unit ID	ND-09020307-024-S_00
Waterbody Description	South Branch Turtle River downstream to Larimore Dam.
Size	18.42 miles
Designated Use	Recreation
Use Support	Fully Supporting, but Threatened
Impairment	Fecal Coliform Bacteria
TMDL Priority	Low

Table 5. Turtle River Section 303(d) Listing Information for Assessment Unit ID ND-09020307-031-S_00 (NDDoH, 2012).

Assessment Unit ID	ND-09020307-031-S_00
Waterbody Description	North Branch Turtle River from its confluence with Whiskey Creek, downstream to its confluence with South Branch Turtle River.
Size	15.26 miles
Designated Use	Recreation
Use Support	Fully Supporting, but Threatened
Impairment	Fecal Coliform Bacteria
TMDL Priority	Low

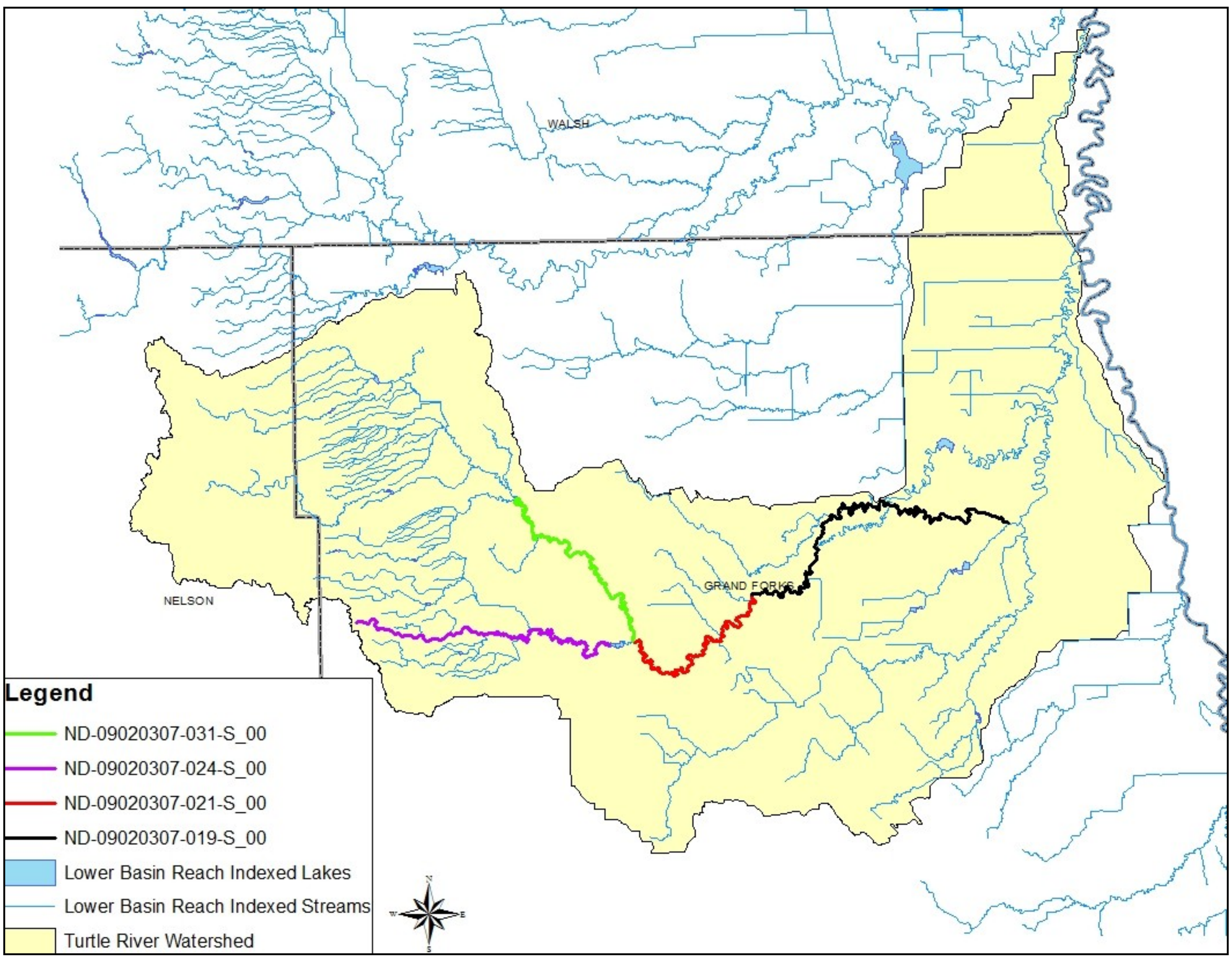


Figure 2. Turtle River TMDL Listed Segments.

1.2 Ecoregions

The watersheds for the Section 303(d) listed segments highlighted in this TMDL lie within the Level IV Drift Plains (46i), Glacial Lake Agassiz Basin (48a), Sand Deltas and Beach Ridges (48b), and Saline Area (48c) level IV ecoregions (Figure 3). The Drift Plains (46i) ecoregion was formed by the retreating Wisconsinan glacier that left a thick mantle of glacial till. The landscape consists of temporary and seasonal wetlands. Due to the productive soil of this ecoregion almost all of the area is under cultivation. Glacial Lake Agassiz Basin (48a) is comprised of thick beds of glacial drift overlain by silt and clay lacustrine deposits from glacial Lake Agassiz. The topography of this ecoregion is extremely flat, with sparse lakes and pothole wetlands. Tallgrass prairie was the dominant habitat prior to European settlement and has now been replaced with intensive agriculture. Agricultural production in the southern region consists of corn, soybeans, wheat, and sugar beets. The Sand Deltas and Beach Ridges (48b) ecoregion disrupts the flat topography of the Red River Valley. The beach ridges are parallel lines of sand and gravel that were formed by wave action of the contracting shoreline levels of Lake Agassiz. The deltas consist of lenses of fine to coarse sand and are blown into dunes. The Saline Area (48c) is characterized by salty artesian groundwater flowing to the surface through glacial till and lacustrine sediments from underlying beds of Cretaceous sandstone. Areas of heavily saline soils are primarily grazed, while moderate salinity soils are planted into sunflowers, sugarbeets, and potatoes (USGS, 2006).

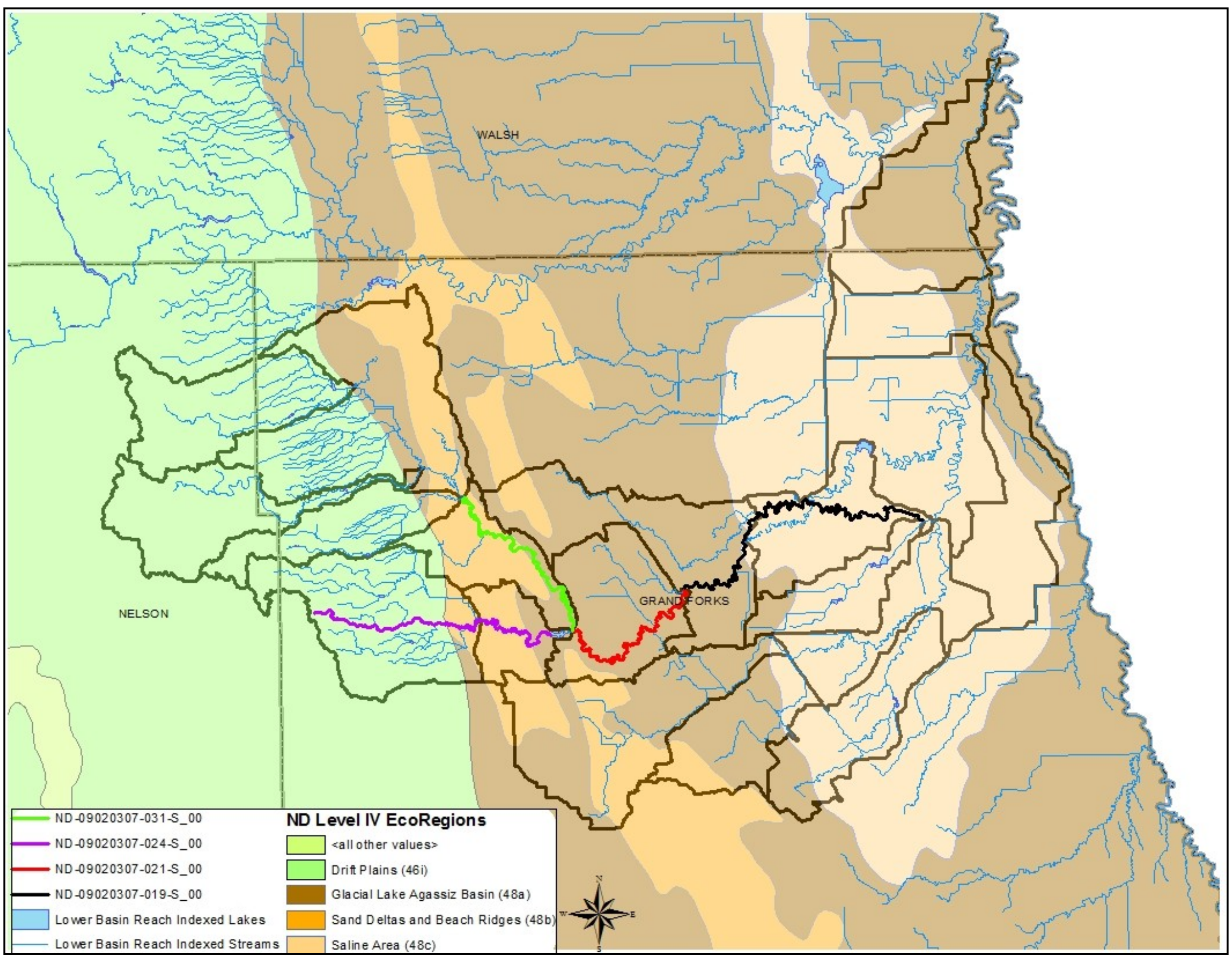


Figure 3. Level IV Ecoregions in the Turtle River and TMDL Listed Segments.

1.3 Land Use

The dominant land use in the Turtle River watershed is row crop agriculture. According to the 2007 National Agricultural Statistical Service (NASS, 2007) land survey data, approximately 57 percent of the land is cropland, 18 percent in grassland, and 13 percent is wetlands, the remaining 12 percent is either developed space, woods, or barren. The majority of the crops grown consist of soybeans, corn, spring wheat, sunflowers, and dry beans (Figure 4).

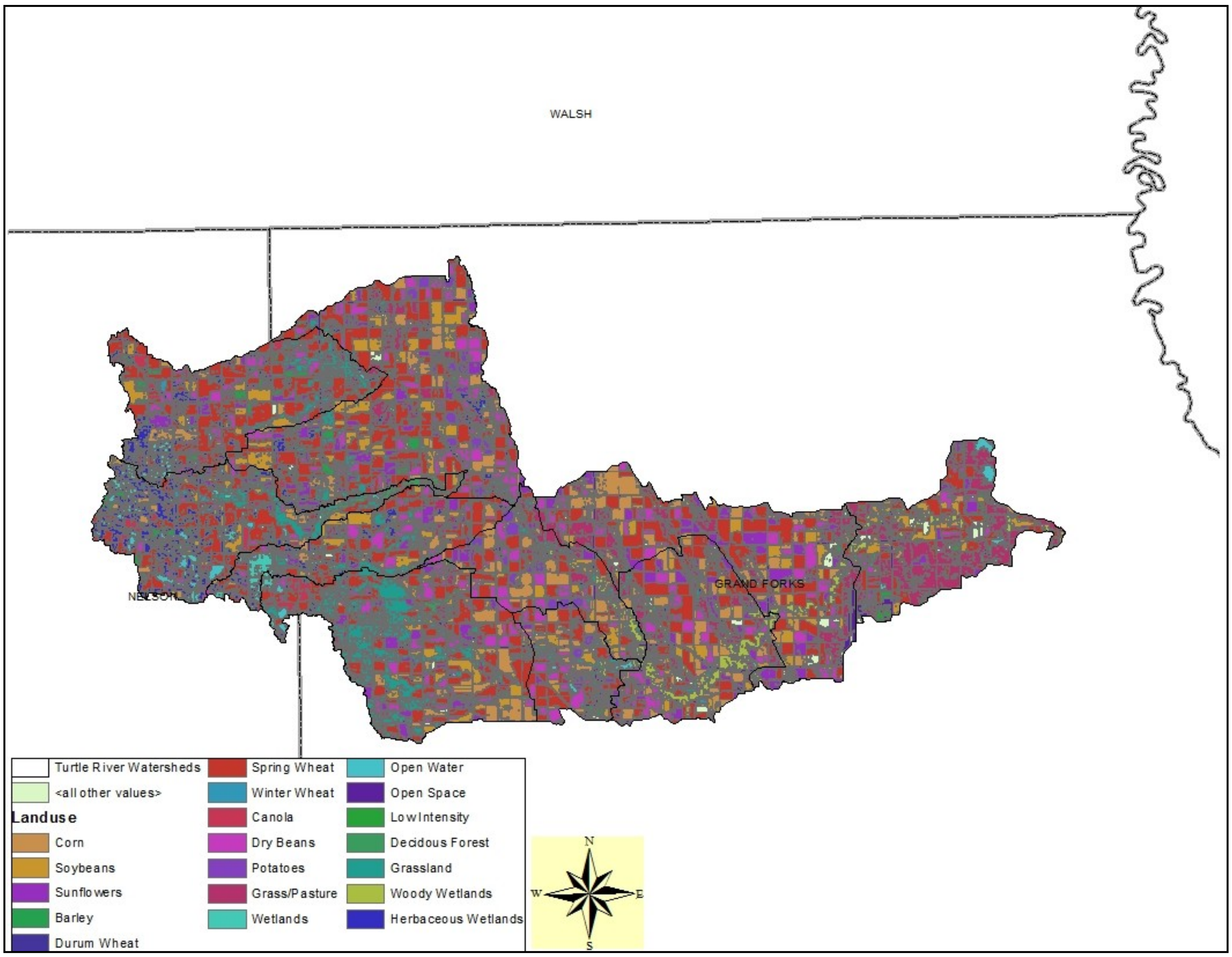


Figure 4. Land Use in the Turtle River Watersheds (NASS, 2007).

1.4 Climate and Precipitation

Figures 5 and 6 show the monthly precipitation and average temperature for the Michigan, ND (Grand Forks County) North Dakota Agriculture Weather Network (NDAWN) station from 2003-2007. Grand Forks County has a subhumid climate characterized by warm summers with frequent hot days and occasional cool days. Average temperatures range from 7º F in winter to 70º F in summer. Precipitation occurs primarily during the warm period and is normally heavy in later spring and early summer. Total annual precipitation is about 20 inches.

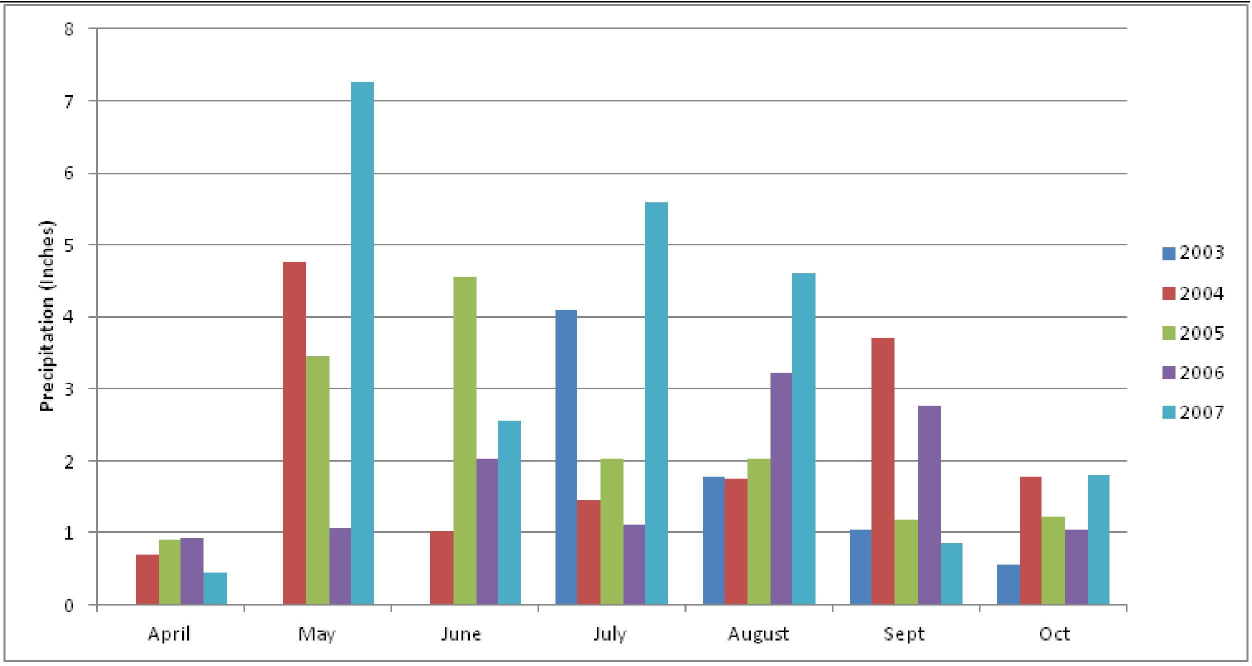


Figure 5. Monthly Total Precipitation at Michigan, North Dakota from 2003-2007. North Dakota Agricultural Weather Network (NDAWN).

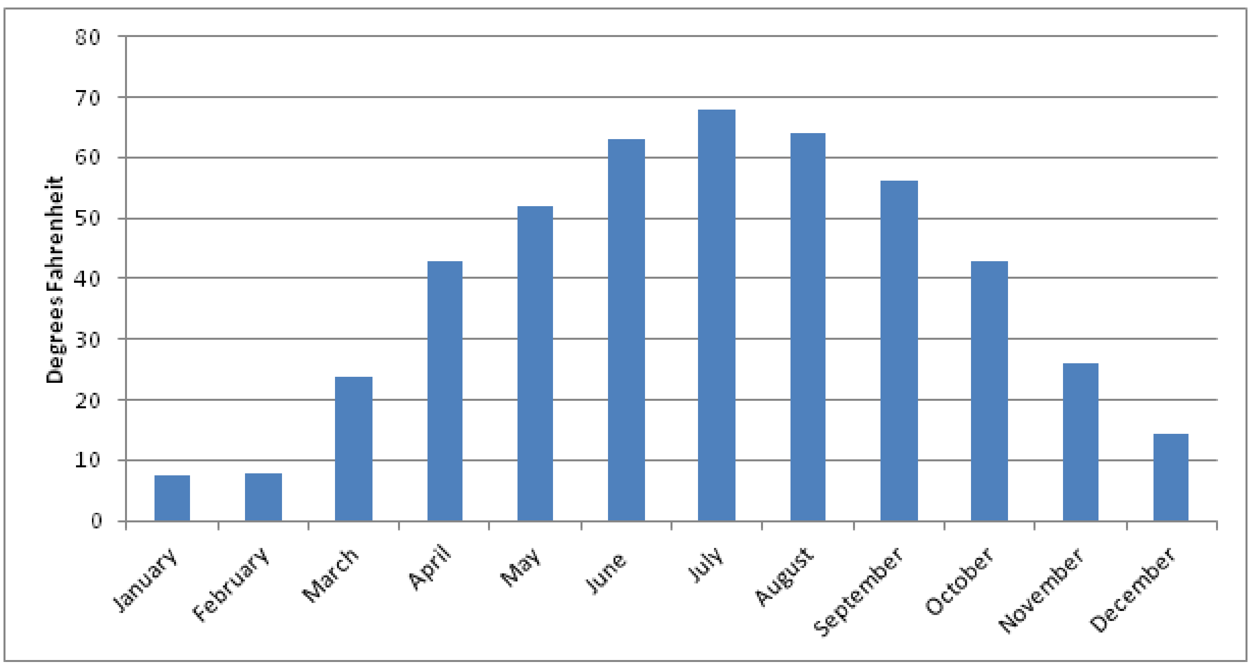


Figure 6. Monthly Average Air Temperature at Michigan, North Dakota from 2003-2007. North Dakota Agricultural Weather Network (NDAWN).

1.5 Available Data

1.5.1 Fecal Coliform Bacteria Data

Fecal coliform bacteria samples were collected at one location within each TMDL listed reach (Figure 7). Monitoring site 385368, is located on the South Branch of the Turtle River (ND-09020307-24-S_00) one mile north of Larimore, ND. Monitoring site 385369 is located on the North Branch of the Turtle River (ND-09020307-31-S_00) one mile east and 3.5 miles north of Larimore, ND. Monitoring site 385370 is located on the Turtle River (ND-09020307-21-S_00) one mile west and one mile north of Arvilla, ND. Monitoring site 385371 is located on the Turtle River (ND-09020307-19-S_00) one mile north of Mekinok, ND. Sites 385368, 385369, 385370, and 385371were monitored weekly or when flow conditions were present during the recreation season (May-September) of 2006 and 2007. Each monitoring station was sampled by personnel with the Grand Forks County Soil Conservation District. While the state of North Dakota has an E. coli bacteria standard (see Section 2.0), no E. coli data are available for the TMDL reaches, so fecal coliform bacteria will be used as the parameter to determine recreational use attainment.

Tables 6-9 provide a summary of fecal coliform geometric mean concentrations, the percentage of samples exceeding 400 CFU/100mL for each month and the recreational use assessment by month. The geometric mean fecal coliform bacteria concentration and the percent of samples over 400 CFU/100ml was calculated for each month (May-September) using those samples collected during each month in 2006 and 2007.

Table 6. Summary of Fecal Coliform Bacteria Data for Site 385368 Data Collected in 2006 and 2007.

Month	N	Geometric Mean Concentration (CFU/100mL)	Percentage of Samples Exceeding 400 CFU/100mL	Recreational Use Assessment
May	18	57	0%	Fully Supporting
June	10	143	10%	Fully Supporting
July	10	337	30%	Not Supporting
August	8	208	13%	Not Supporting
September	7	67	0%	Fully Supporting

Table 7. Summary of Fecal Coliform Bacteria Data for Site 385369 Data Collected in 2006 and 2007.

Month	N	Geometric Mean Concentration (CFU/100mL)	Percentage of Samples Exceeding 400 CFU/100mL	Recreational Use Assessment
May	18	23	0%	Fully Supporting
June	10	303	50%	Not Supporting
July	10	150	10%	Fully Supporting
August	8	231	13%	Not Supporting
September	7	255	14%	Not Supporting

Table 8. Summary of Fecal Coliform Bacteria Data for Site 385370 Data Collected in 2006 and 2007.

Month	N	Geometric Mean Concentration (CFU/100mL)	Percentage of Samples Exceeding 400 CFU/100mL	Recreational Use Assessment
May	18	36	6%	Fully Supporting
June	10	91	20%	Fully Supporting but Threatened
July	10	229	30%	Not Supporting
August	8	111	0%	Fully Supporting
September	7	84	0%	Fully Supporting

Table 9. Summary of Fecal Coliform Bacteria Data for Site 385371 Data Collected in 2006 and 2007.

Month	N	Geometric Mean Concentration (CFU/100mL)	Percentage of Samples Exceeding 400 CFU/100mL	Recreational Use Assessment
May	18	32	0%	Fully Supporting
June	10	104	10%	Fully Supporting
July	10	150	10%	Fully Supporting
August	8	280	13%	Not Supporting
September	7	134	14%	Fully Supporting but Threatened

An analysis of the 2006 and 2007 fecal coliform bacteria data collected at site 385368, showed that for the months of May, June, and September, recreational use was fully supporting (Table 6). For the months of July and August, results for both the geometric mean concentration and the percentage of samples exceeding the previous fecal coliform bacteria water quality standard should recreational use was not supporting (Table 6).

Monthly results for site 385369 showed that during the months of June, August, and September recreation use was not supporting, while May and July were assessed as fully supporting recreational beneficial uses (Table 7).

The recreation use assessment for site 385370 concluded that during the months of May August and September recreation use was fully supporting, while July was assessed as not supporting (Table 8) and June was fully supporting, but threatened.

The recreation use assessment for site 385371 concluded that the months of May, June, and July were fully supporting, September was fully supporting, but threatened, and August was assessed as not supporting (Table 9).

1.5.2 Hydraulic Discharge

The daily discharge record for site 385369, corresponding to waterbody segment ND-09020307-031-S_00, and site 385368, corresponding to waterbody segment ND-09020307-024-S_00 were constructed by applying stage data collected at each site during 2006 and 2007 to the stage/discharge rating curve developed for each site.

The daily stream discharge record for water quality monitoring site 385370, corresponding to waterbody segment ND-09020307-021-S_00, was obtained from the United States Geological Survey (USGS) gauging station 05082625 located on Turtle River near Arvilla, ND (Figure 7). USGS station 05082625 has operated continuously since 1992 and is collocated with the North Dakota Department of Health (NDDoH) monitoring location 385370.

A discharge record was constructed for site 385371, corresponding to waterbody segment ND-09020307-019-S_00, using the Drainage Area Ratio Method (Ries et al., 2000) and the historical discharge measurements collected by the USGS at gauging station 05082625 from 1992-2007.

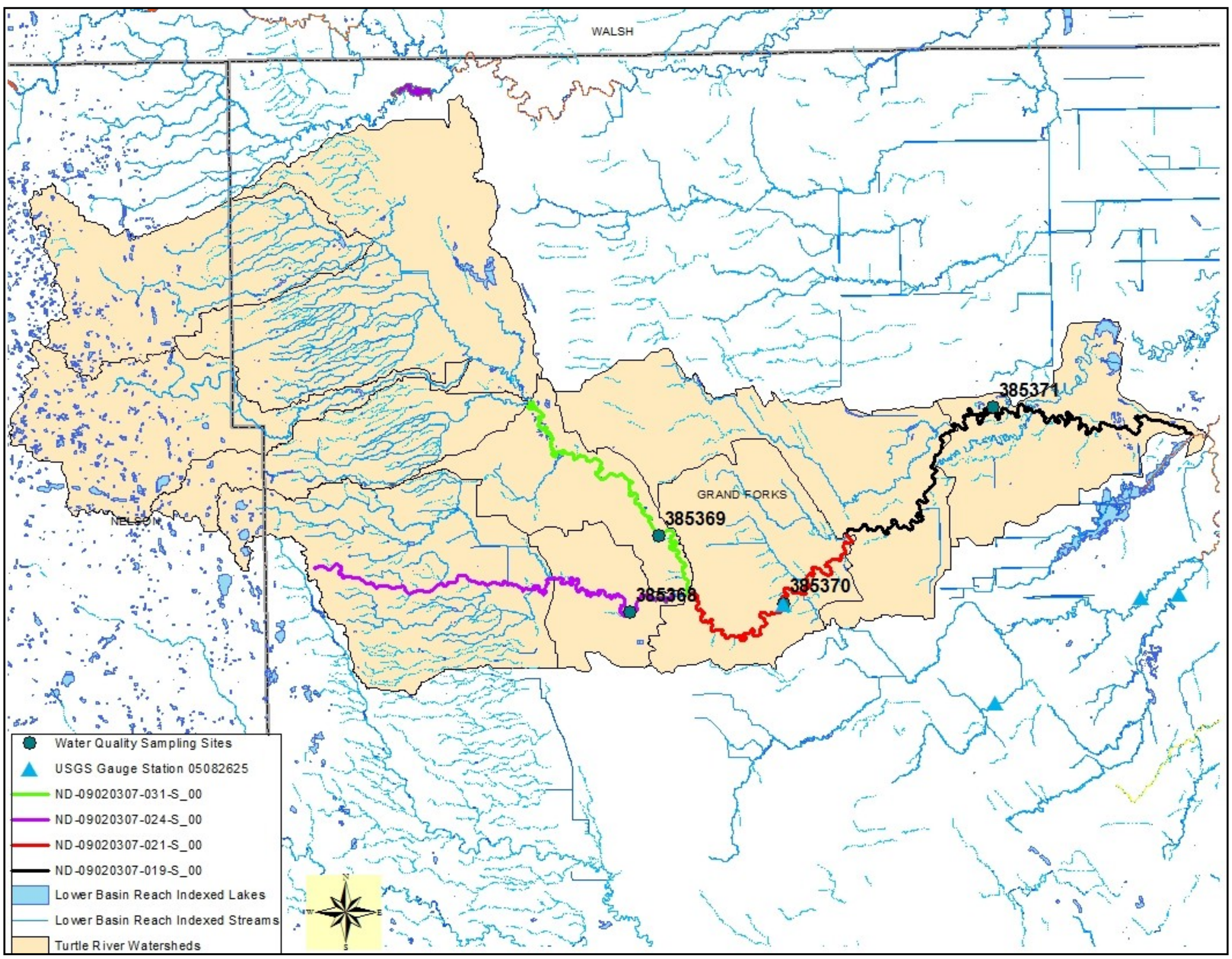


Figure 7. Fecal Coliform Bacteria Sample Sites and USGS Gauge Station (05082625) on the Turtle River.

2.0 WATER QUALITY STANDARDS

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

2.1 Narrative Water Quality Standards

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

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

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

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

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

2.2 Numeric Water Quality Standards

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

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

Effective January 2011, the Department revised the State water quality standards. In these latest revisions the Department eliminated the fecal coliform bacteria standard, retaining only the E. coli bacteria standard for the protection of recreational uses. This standards change was recommended by the US EPA as E. coli is believed to be a better indicator of recreational use risk (i.e., incidence of gastrointestinal disease). It is anticipated that the reductions necessary to achieve the fecal coliform bacteria water quality target will also meet the E. coli bacteria water quality standards. If future E. coli bacteria monitoring data shows that an E. coli bacteria impairment exists in any of the impaired segments, a separate reduction analysis will be conducted and this TMDL document will be revised or a separate TMDL will be developed.

Table 10 provides a summary of the current numeric E. coli criteria which applies to Class II streams as well as the former fecal coliform bacteria standard. The E. coli bacteria standard applies only during the recreation season from May 1 to September 30.

Table 10. North Dakota Bacteria Water Quality Standards for Class II Streams.

Parameter	Standard	
	Geometric Mean[1]	Maximum[2]
E. coli Bacteria	126 CFU/100 mL	409 CFU/100 mL
Fecal Coliform Bacteria[3]	200 CFU/100 mL	400 CFU/100 mL

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

3.0 TMDL TARGETS

A TMDL target is the value that is measured to judge the success of the TMDL implementation effort. TMDL targets must be based on state water quality standards, but can also include site specific values when no numeric criteria are specified in a state's water quality standards. The following primary TMDL targets for the South Branch Turtle River, North Branch Turtle River and the two Turtle River segments are based on the State water quality standards for E. coli bacteria. Since the E. coli bacteria water quality standard of 126 CFUs/100 mL is now the current applicable water quality standard for bacteria, it is the primary TMDL target for the four impaired TMDL segments. Even though it is no longer considered a numeric criterion in the water quality standards for North Dakota, the secondary TMDL target for these TMDL segments remains the fecal coliform bacteria standard of 200 CFUs/100 mL. In addition, no more than ten percent of the samples may exceed 409 CFUs/100 mL for E. coli bacteria or 400 CFUs/100 mL for fecal coliform bacteia. While the 126 CFUs/100 mL and 200 CFUs/100 mL E. coli and fecal coliform bacteria criterion are intended to be expressed as a 30-day geometric mean, for purposes of these TMDLs, both are expressed as the daily average concentration based on individual grab samples. Expressing both the fecal coliform TMDLs and the E. coli TMDLs in this way will ensure the TMDLs will result in the target being met during all flow regimes, that both components of the criterion will be met, and that recreational uses will be restored.

As stated previously (see Section 1.5.1), there are currently no E. coli data available for the four listed TMDL reaches. The North Branch Turtle River (ND-09020307-31-S_00), South Branch Turtle River (ND-09020307-24-S_00) and two Turtle River main stem reaches (ND-09020307-21-S_00 and ND-09020307-19-S_00) were assessed as fully supporting, but threatened for recreational uses due to exceedences of the fecal coliform bacteria standard which was in effect at the time of the TMDL listing. For this reason, the fecal coliform standard will remain the secondary TMDL target, while the E.coli standard will be considered the primary TMDL target and TMDLs will be provided for the four TMDL segments which are the focus of this report.

While the fecal coliform bacteria target of 200 CFU/100 mL is greater than the E. coli target of 126 CFU/100 mL, it is still believed to be protective of the E. coli standard. This conclusion is based on the assumption that the ratio of E. coli to fecal coliform in the environment is equal to or less than 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 bacteria in the environment is greater than 63%, then it is unlikely that the current TMDL will result in attainment of the E. coli bacteria standard.

Since E. coli is now the current bacteria standard, a TMDL, including a load allocation and a margin of safety, will also be provided for E. coli bacteria. This TMDL is based on the E. coli standard of 126 CFU/100 mL. As is the case with the fecal coliform TMDL, while the E. coli standard is intended to be expressed as a 30-day geometric mean, for purposes of the four TMDLs it is expressed as the daily average concentration based on a single grab sample. It is assumed that by expressing both the fecal coliform TMDL and the E. coli TMDL in this way will ensure the TMDLs will result in the target being met during all flow regimes, that both components of the criterion will be met, and that recreational uses will be restored. The NDDoH will assess attainment of the E. coli bacteria standard through additional monitoring consistent with the state’s water quality standards and beneficial use assessment methodology.

4.0 SIGNIFICANT SOURCES

4.1 Point Source Pollution Sources

There are no known point sources that discharge directly to the TMDL listed segments of the Turtle River. There are two municipalities, one located in Larimore, ND near segment ND-09020307-024-S_00 and the Grand Forks Air Force Base located within the contributing watershed of segment ND-09020307-019-S_00. These facilities are permitted through the North Dakota Pollutant Discharge Elimination System (NDPDES) Program. The Larimore facility has no reported discharges filed with the NDPDES Program. While the Grand Forks Air Force Base (GFAFB) is partially located in the contributing watershed of TMDL listed segment ND-09020307-019-S_00. The GFAFB lagoons are permitted to discharge into the Kelly Slough which is not part of the TMDL listed segment covered in this TMDL.

There are four permitted animal feeding operations (AFOs) in the target watersheds of the Turtle River. The NDDoH has permitted one large (1,000 + animal units (AUs)), one medium (301-999 AUs), and two small (0-300 (AUs)) AFOs to operate. All four AFOs are zero discharge facilities and are not deemed a significant point source of fecal coliform or E. coli bacteria loadings to the Turtle River.

4.2 Nonpoint Source Pollution Sources

The TMDL listed segments which are the focus of this report are experiencing fecal coliform bacteria, and presumably E. coli bacteria, pollution from nonpoint sources in the watersheds. Septic system failure might contribute to the fecal coliform and E. coli bacteria in the water quality samples. Failures can occur for several reasons, although the most common reason is improper maintenance (e.g., age, inadequate pumping). Other reasons for failure include improper installation, location, and choice of system. Harmful household chemicals can also cause failure by killing the bacteria that digest the waste. While the number of systems that are not functioning properly is unknown, it is estimated that 28 percent of the systems in North Dakota are failing likely due to backup and surfacing (EPA, 2002).

These assessments are supported by the load duration curve analysis (Section 5.3) which shows the exceedences of the fecal coliform bacteria standard occurring during high, moist and dry conditions, and low flows.

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

Livestock production is not the dominant agricultural practice in the watershed but unpermitted animal feeding operations (AFOs) and "hobby farms" with fewer than 100 animals and livestock grazing and watering in proximity to the Turtle River and its tributaries do exist and may be a contributor.

The northeast section of North Dakota typically experiences long duration or intense precipitation during the early summer months. These storms can cause overland flooding and rising river levels. Due to the close proximity of these unpermitted AFOs and "hobby farms" and livestock grazing and watering to the river, it is likely that this contributes fecal coliform and E. coli bacteria to the Turtle River and its tributaries.

5.0 TECHNICAL ANALYSIS

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

The loading capacity or total maximum daily load (TMDL) is the amount of a pollutant (e.g. fecal coliform and E. coli bacteria) a waterbody can receive and still meet and maintain water quality standards and beneficial uses. The following technical analysis addresses the fecal coliform bacteria reductions necessary to achieve the secondary water quality standards target for fecal coliform bacteria of 200 CFU/100 mL with a margin of safety. It is expected that the estimated fecal coliform bacteria reductions will also meet the E. coli bacteria targets.

5.1 Mean Daily Stream Flow

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

Flows for TMDL segment ND-0902020307-019-S_00 were determined by utilizing the Drainage-Area Ratio Method developed by the USGS (Ries et. al, 2000). The Drainage-

Area Ratio Method assumes that the streamflow at the ungauged site is hydrologically similar (same per unit area) to the stream gauging station used as an index. This assumption is justified since the ungauged site (385371) is located on the Turtle River downstream from the index station (05082625) (Figure 7).

Streamflow data for the index station (05082625) was obtained from the USGS Water Science Center website. The index station (05082625) streamflow data was then divided by the drainage area to determine streamflows per unit area at the index station. Those values are then multiplied by the drainage area for the ungauged site to obtain estimated flow statistics for the ungauged site.

Mean daily discharge for TMDL segments ND-09020307-024-S_00 and ND-09020307-031-S_00 were developed using stage and discharge data obtained from water quality sampling sites 385368 and 385369 for the years of 2006 and 2007.

5.2 Flow Duration Curve Analysis

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

A basic flow duration curve runs from high to low (0 to 100 percent) along the x-axis with the corresponding flow value on the y-axis (Figure 8). 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 8, a flow duration interval of twenty five (25) percent, associated with a stream flow of 7.5 cfs, implies that 25 percent of all observed mean daily discharge values equal or exceed 7.5 cfs.

Once the flow duration curve is developed for the stream site, flow duration intervals can be defined which can be used as a general indicator of hydrologic condition (i.e. wet vs dry conditions and to what degree). These intervals (or zones) provide additional insight about conditions and patterns associated with the impairment (fecal coliform bacteria in this case) (EPA, 2007).

As depicted in Figure 8, the flow duration curve for site 385368, representing TMDL segment ND-09020307-024-S_00, was divided into four zones, one representing high flows (0-4 percent), moist conditions (4-40 percent), dry conditions (40-80 percent) and one for low flows (80-99 percent). Based on the flow duration curve analysis, no flow occurred 1 percent of the time (99-100 percent).

Similarly, as depicted in Figure 9, the flow duration curve for water quality site 385369, representing TMDL segment ND-09020307-031-S_00, was also divided into four zones, one representing high flows (0-20 percent), another for moist conditions (20-55 percent), dry conditions (50-90 percent), and one for low flows (90-99 percent). Based on the flow duration curve analysis, no flow (or zero flow) occurred 1 percent of the time (99-100 percent).

In Figure 10, the flow duration curve for water quality site 385370, representing TMDL segment ND-09020307-021-S_00, had flow zones signifying high flows (0-10 percent), another for moist conditions (10-30 percent), dry conditions (30-75 percent), and one for low flows (75-99 percent), while no flow (or zero flow) occurred 1 percent of the time (99-100 percent).

The flow duration curve for water quality site 385371, representing TMDL segment ND-09020307-019-S_00, identified flow zones characterizing high flows (0-18 percent), another for moist conditions (18-45 percent), dry conditions (45-90 percent), and one for low flows (90-99 percent), while no flow (or zero flow) occurred 1 percent of the time (99-100 percent) (Figure 11).

These flows intervals were defined by examining the range of flows for the site for the period of record and then by looking for natural breaks in the flow record based on the flow duration curve plot (Figures 8-11). 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.

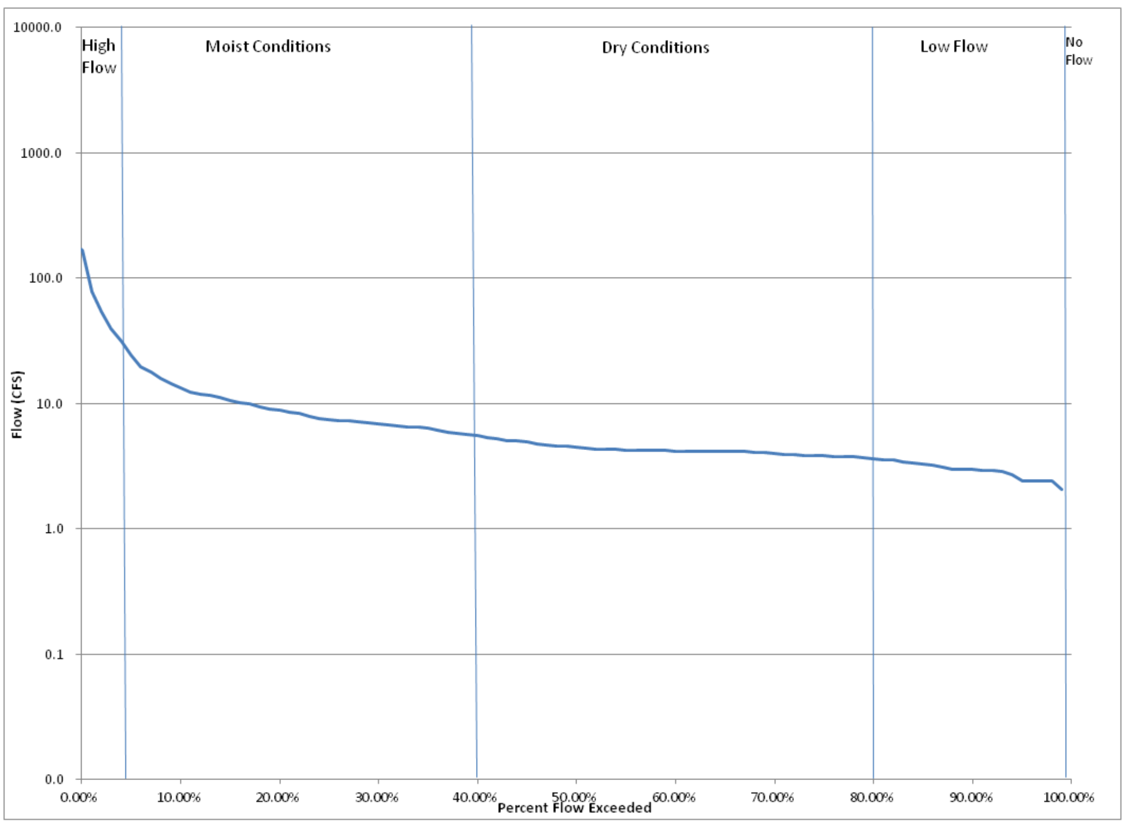


Figure 8. Flow Duration Curve for the South Branch Turtle River Monitoring Station 385368; Located near Larimore, North Dakota.

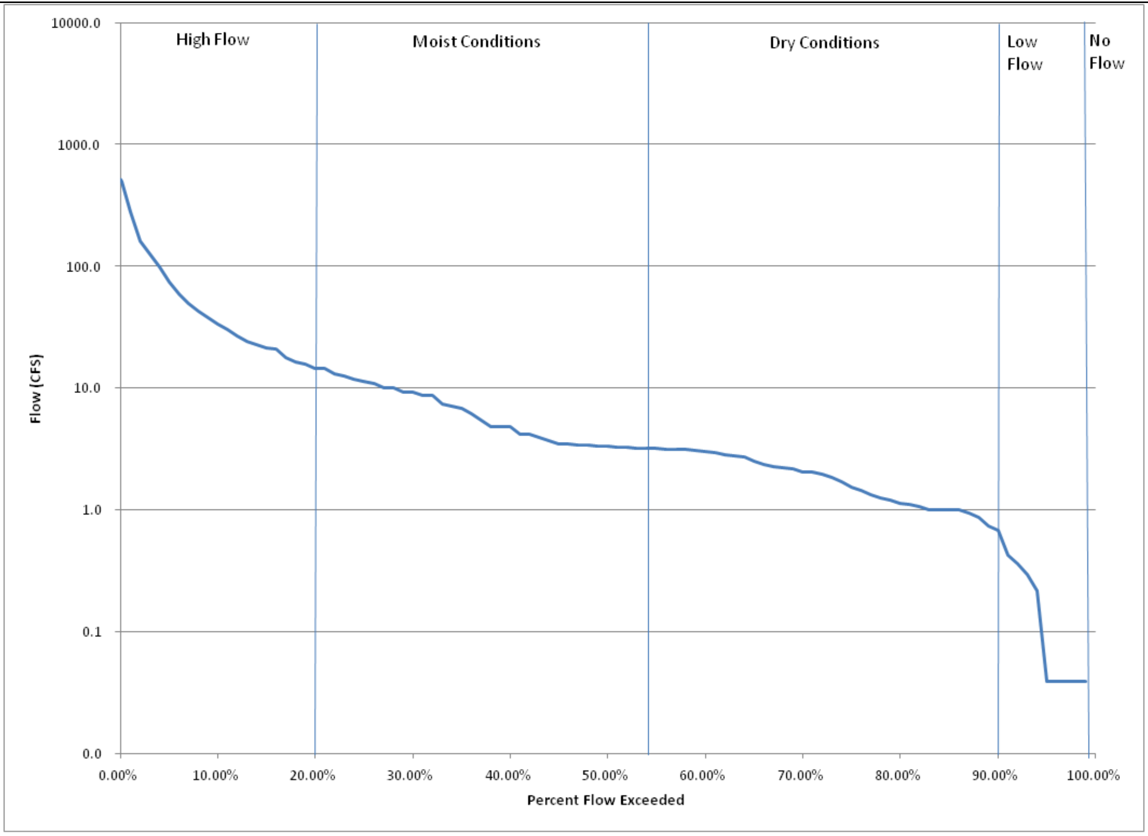


Figure 9. Flow Duration Curve for the North Branch Turtle River Monitoring Station 385369; Located near Larimore, North Dakota.

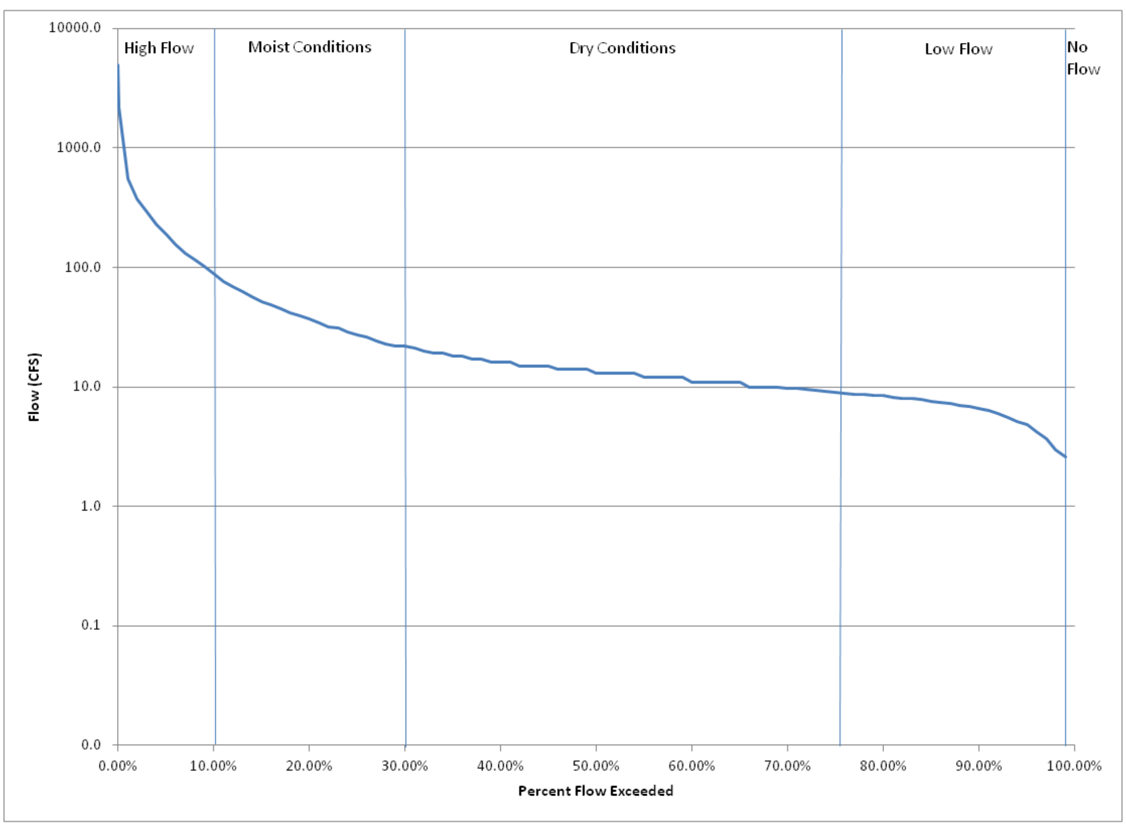


Figure 10. Flow Duration Curve for the Turtle River Monitoring Station 385370; Located near Arvilla, North Dakota.

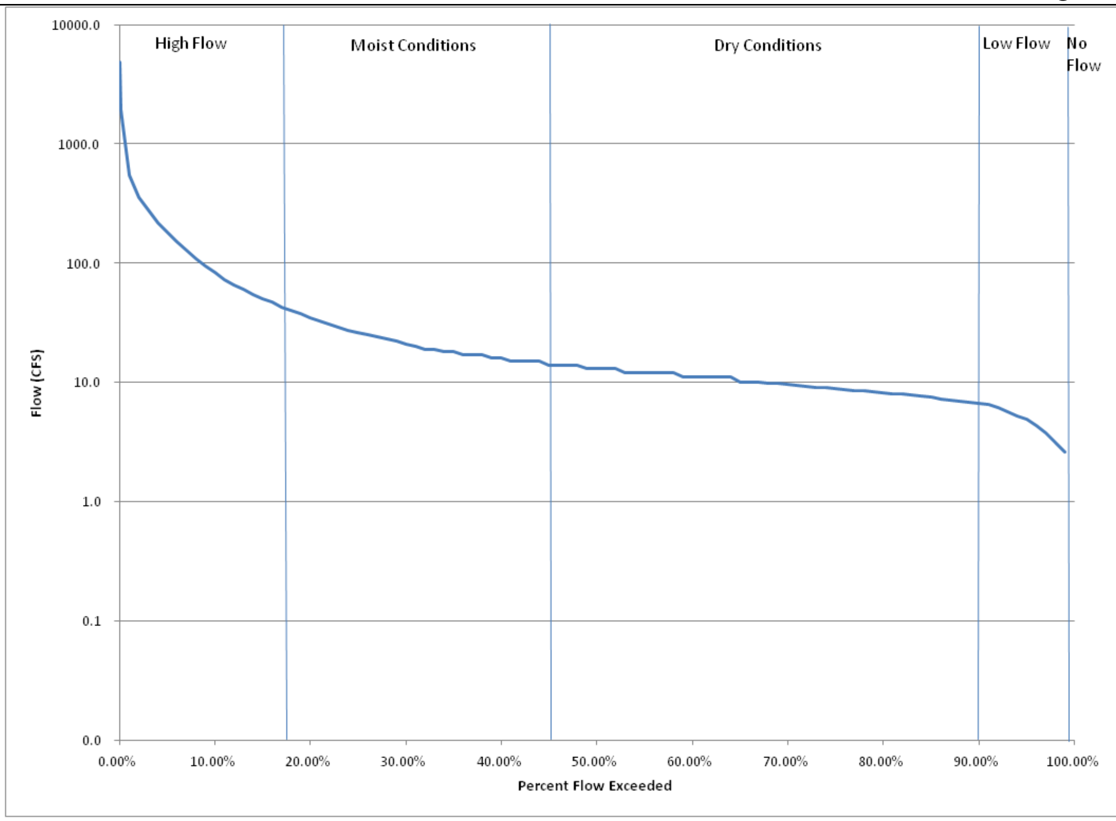


Figure 11. Flow Duration Curve for the Turtle River Monitoring Station 385371; Located near Mekinok, North Dakota.

5.3 Load Duration Analysis

An important factor in determining NPS pollution loads is variability in stream flows and loads associated with high and low flow. To better correlate the relationship between the pollutant of concern and the hydrology of the Section 303(d) TMDL listed segments, a load duration curve was developed for each of the Turtle River TMDL listed segments. The load duration curves for the four TMDL listed reaches were derived using the fecal coliform bacteria TMDL target of 200 CFU/100 mL and the flows generated as described in Sections 5.1 and 5.2. Additional load duration curves were also developed to comply with the current State water quality standard for E. coli bacteria based on its TMDL target of 126 CFU/100 mL (Figures 13, 15, 17 and 19).

Observed in-stream total fecal coliform bacteria data obtained from monitoring sites 385368, 385369, 385370, and 385371 in 2006 and 2007 (Appendix A) were converted to a pollutant load by multiplying total fecal coliform bacteria concentrations by the mean daily flow and a conversion factor. These loads are plotted against the percent exceeded of the flow on the day of sample collection (Figures 12, 14, 16, and 18). Points plotted above the 200 CFU/100 mL target curve exceed the previous State water quality target. Points plotted below the curve are meeting the previous State water quality target of 200 CFU/100 mL.

For each flow interval or zone, a regression relationship was developed between the samples which occur above the TMDL target (200 CFU/100 mL) curve and the corresponding percent exceeded flow. The load duration curve for site 385368, 385369, 385370, and 385371 depicting the regression relationship for each flow interval are provided in Figures 12, 14, 16, and 18. As there were no fecal coliform bacteria concentrations above the TMDL target in the high and low flow regimes for site 385368, a regression relationship and existing load could not be calculated for this flow regime.

The regression lines for the moist and dry condition flows for site 385368 were then used with the midpoint of the percent exceeded flow for that interval to calculate the existing total fecal coliform bacteria load for that flow interval. For example, in the example provided in Figure 12, the regression relationship between observed fecal coliform bacteria loading and percent exceeded flow for the moist condition, and dry condition flow interval are:

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

Where the midpoint of the moist condition interval from 4 to 40 percent is 22 percent, the existing fecal coliform bacteria load is:

Fecal coliform bacteria load (10^7 CFUs/day) = antilog (4.23 + (-1.55*0.22))
= 7,682 x 10^7 CFUs/day

Where the midpoint of the dry condition interval from 40 to 80 percent is 60 percent, the existing fecal coliform bacteria load is:

Fecal coliform bacteria load (10^7 CFUs/day) = antilog (3.64 + (0.07*0.60))
= 4,822 x 10^7 CFUs/day

The midpoint for the flow intervals is also used to estimate the TMDL target load. In the case of the previous examples, the TMDL target load for the midpoints or 22 and 60 percent exceeded flow derived from the 200 CFU/100 mL TMDL target curves are 4,093 x 10^7 CFUs/day and 2,045 x 10^7 CFUs/day, respectively.

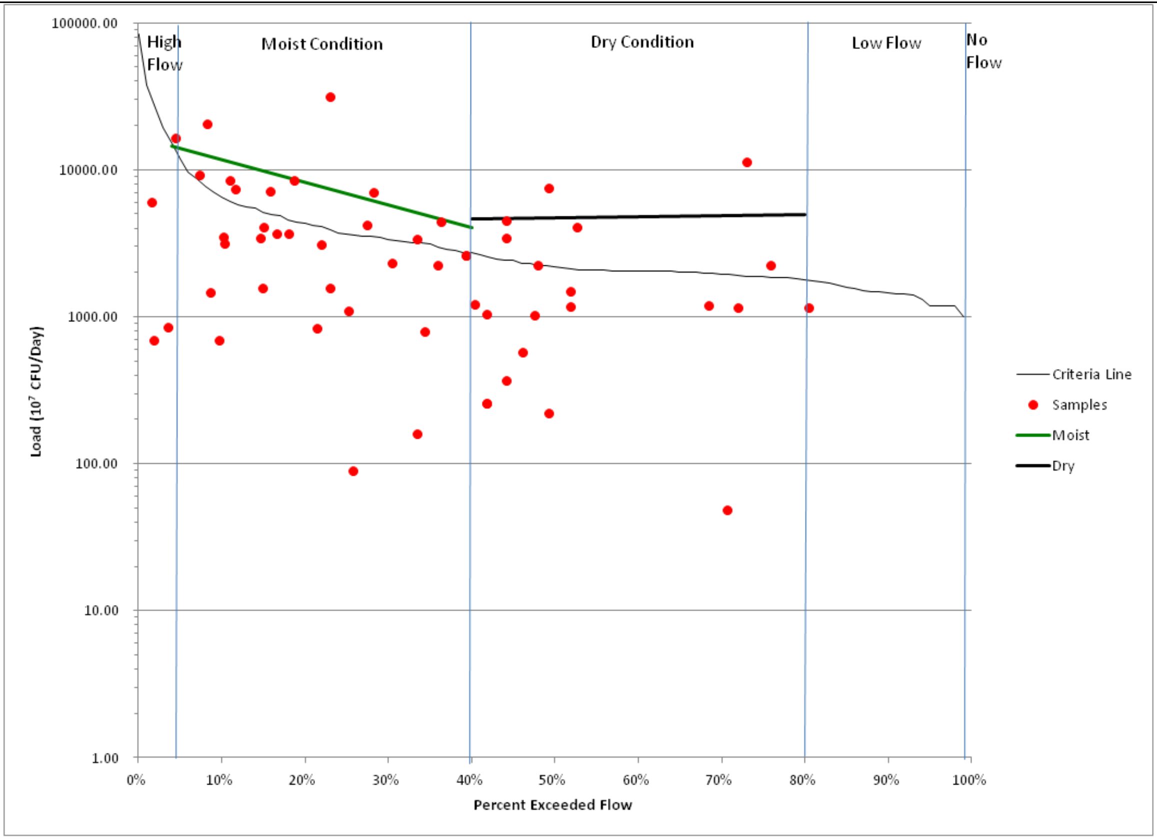


Figure 12. Fecal Coliform Bacteria Load Duration Curve for the South Branch Turtle River Monitoring Station 385368. The curve reflects flows collected from 2006-2007.

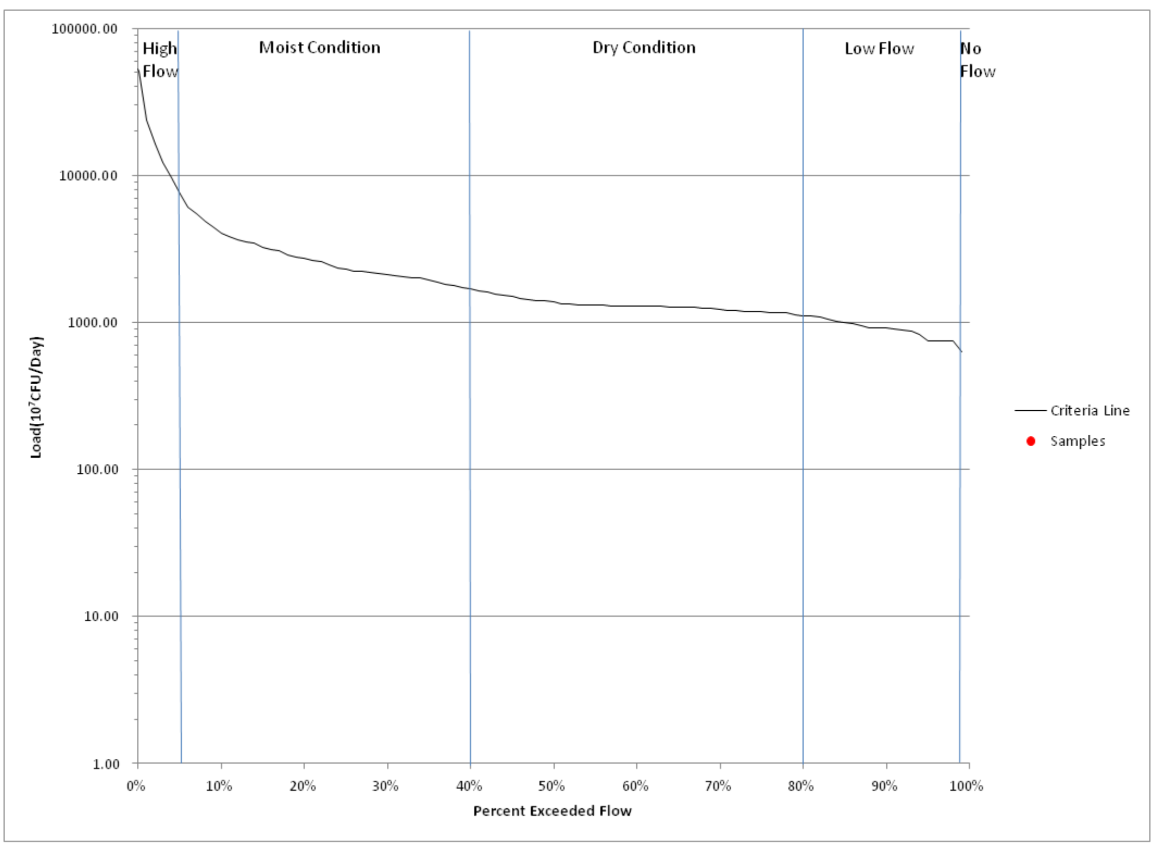


Figure 13. E. coli Bacteria Load Duration Curve for the South Branch Turtle River Monitoring Station 385368. The curve reflects flows collected from 2006-2007.

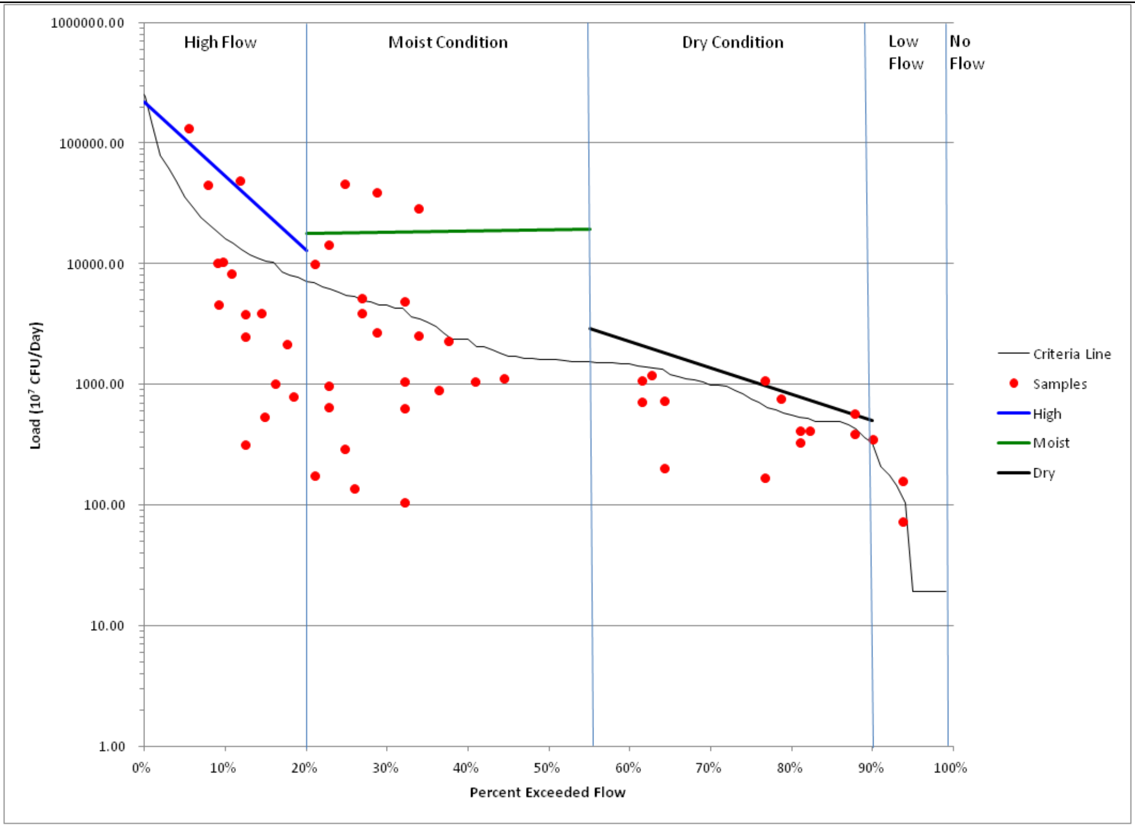


Figure 14. Fecal Coliform Bacteria Load Duration Curve for the North Branch Turtle River Monitoring Station 385369. The curve reflects flows collected from 2006-2007.

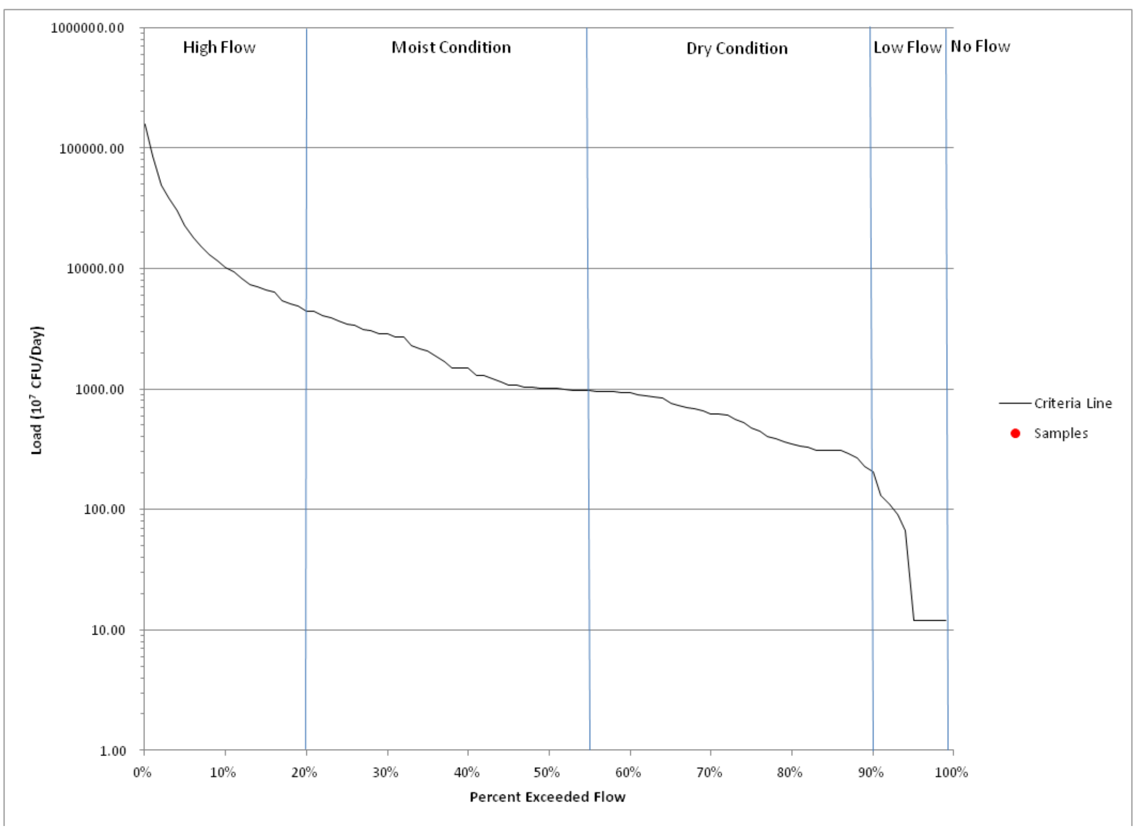


Figure 15. E. coli Bacteria Load Duration Curve for the North Branch Turtle River Monitoring Station 385369. The curve reflects flows collected from 2006-2007.

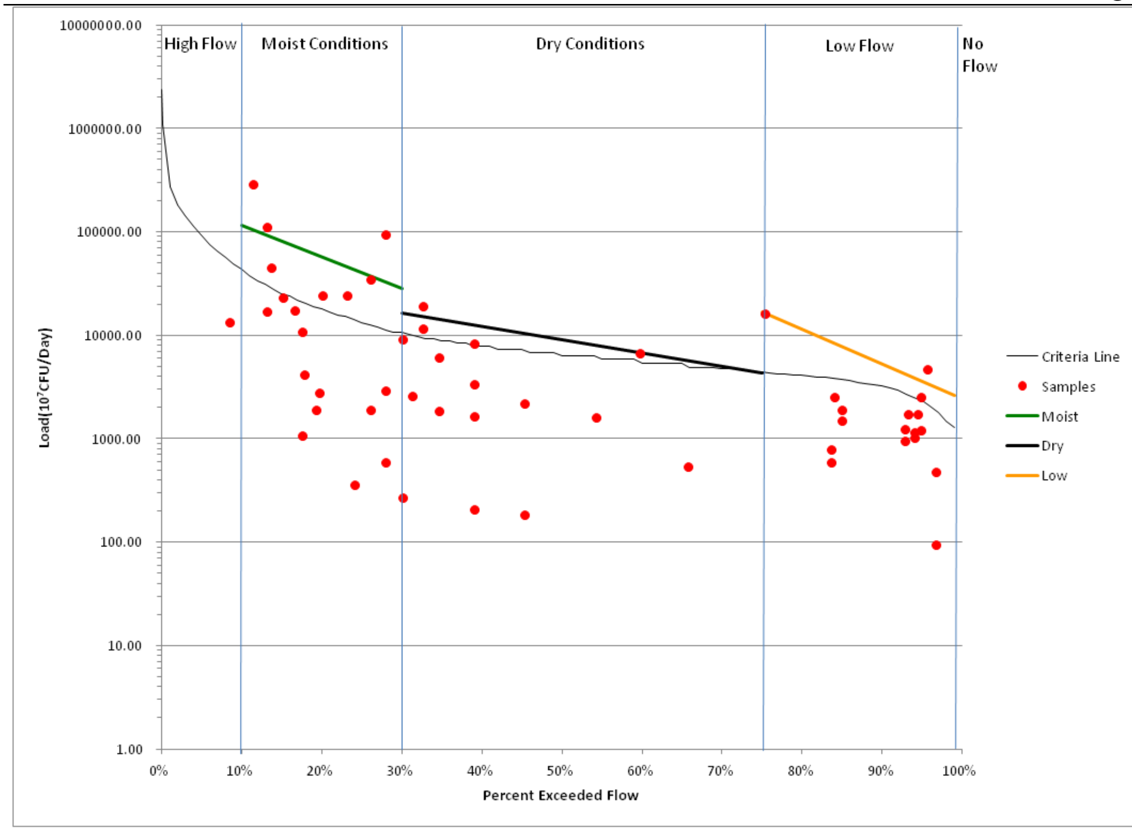


Figure 16. Fecal Coliform Bacteria Load Duration Curve for the Turtle River Monitoring Station 385370. The curve reflects flows collected from 1992-2007.

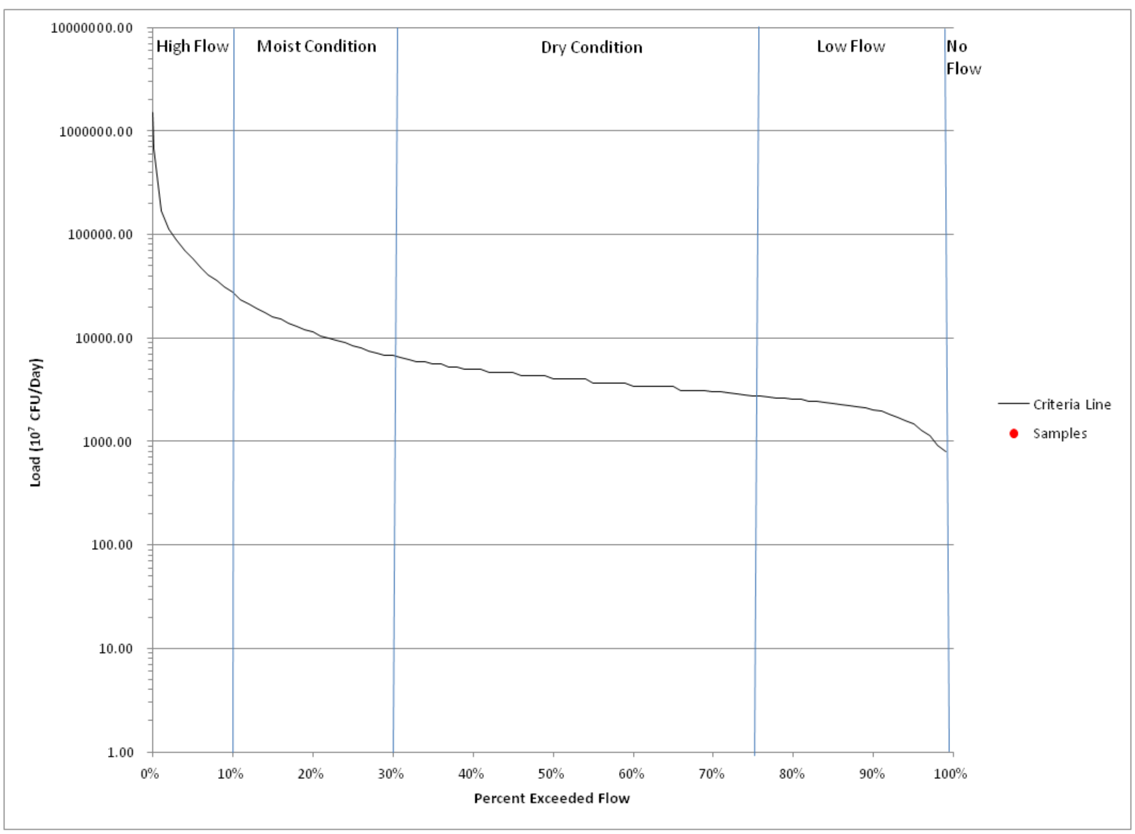


Figure 17. E. coli Bacteria Load Duration Curve for the Turtle River Monitoring Station 385370. The curve reflects flows collected from 1992-2007.

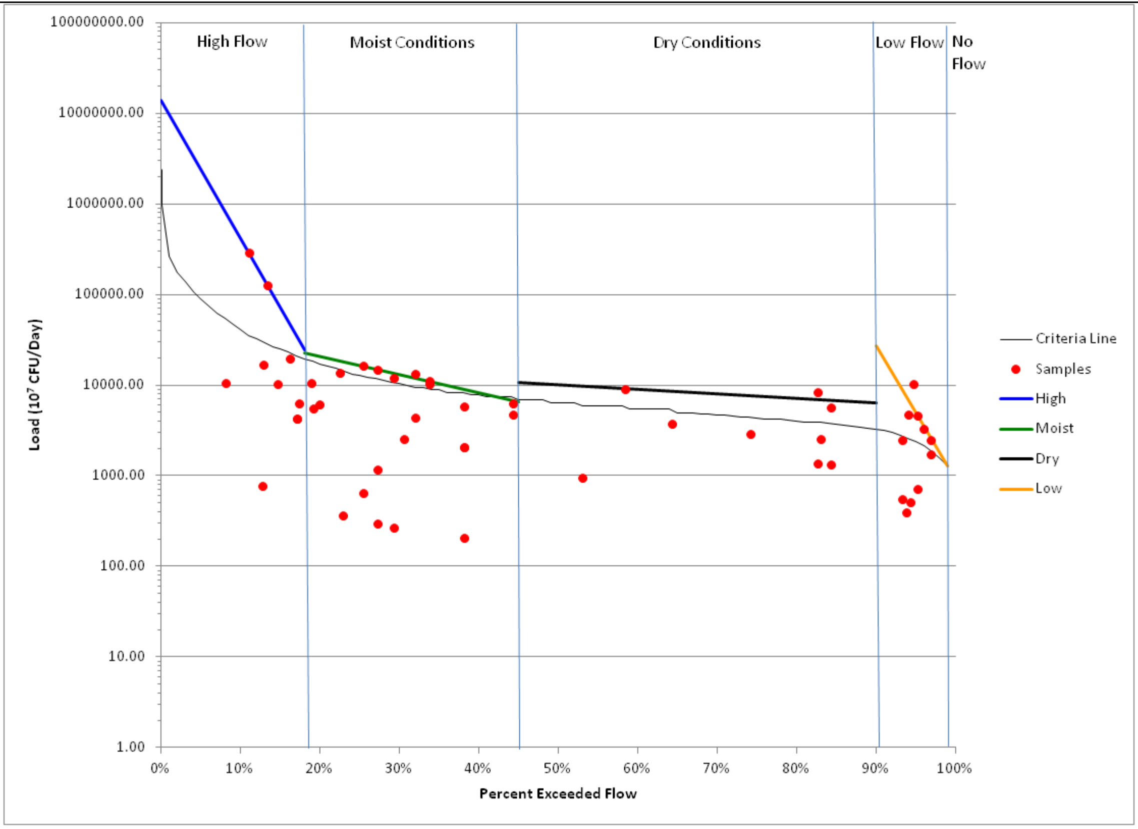


Figure 18. Fecal Coliform Bacteria Load Duration Curve for the Turtle River Monitoring Station 385371. The curve reflects flows collected from 1992-2007.

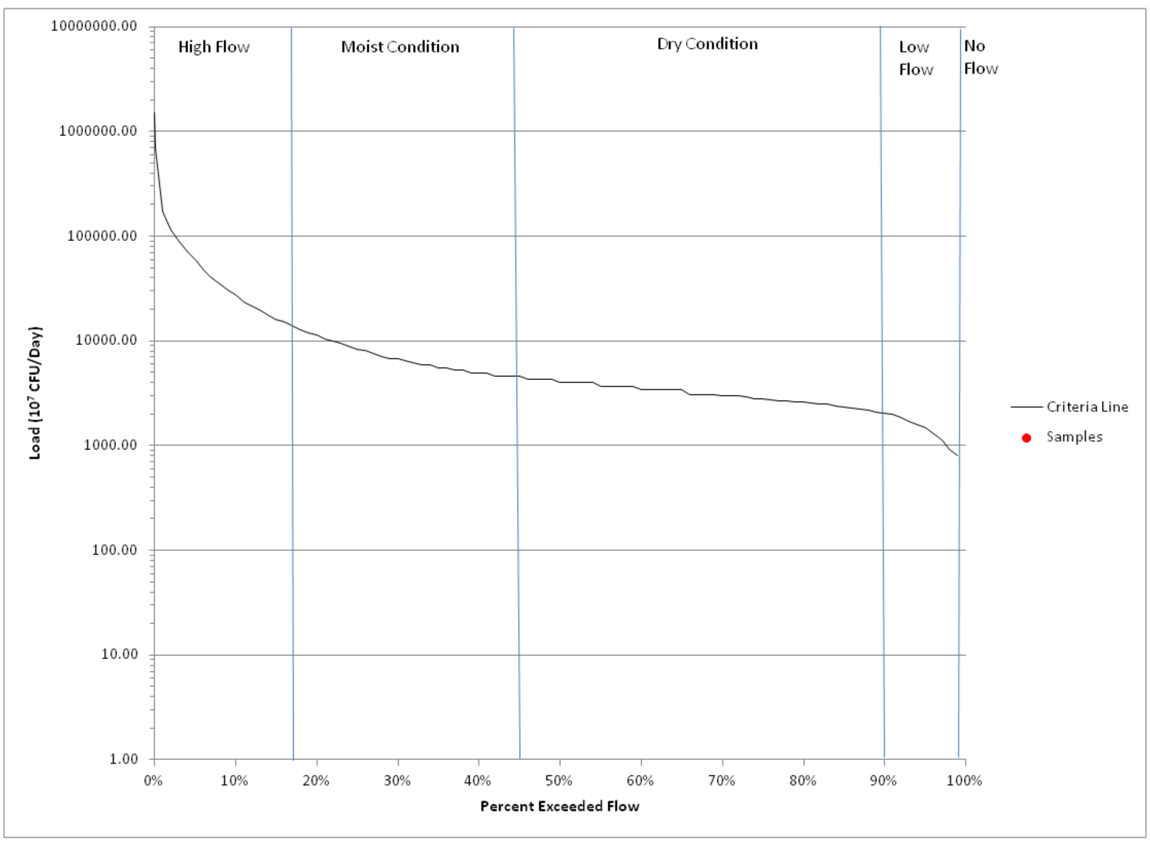


Figure 19. E. coli Bacteria Load Duration Curve for the Turtle River Monitoring Station 385371. The curve reflects flows collected from 1992-2007.

5.4 Loading Sources

The load reductions needed for the Turtle River fecal coliform bacteria TMDL can generally be allotted to nonpoint sources. As described in Section 4.1, Point Source Pollution Sources, there are no point sources which discharge directly to the TMDL listed segments of the Turtle River, ND-09020307-019-S_00 and ND-09020307-021-S_00, the South Branch of the Turtle River, ND-09020307-024-S_00, and the North Branch of the Turtle River, ND-09020307-031-S_00.

While there are no point sources which discharge directly to the any of the impaired streams segments, there are two point NDPDES permitted facilities located in the Turtle River watershed. The city of Larimore has a single cell sewage lagoon located in the South Branch Turtle River watershed. There have been no reported discharges under it's NDPDES permit. Due to the limited nature of the discharges and location to the Turtle River, no waste load allocation will be provided in the TMDL

The other NDPDES point source discharge located in the Turtle River watershed are the Grand Forks Air Force Base's (GFAFB's) wastewater stabilization ponds (i.e., sewage lagoons) which are located and permitted to discharge into Kelly Slough (ND-09020307-016-S_00) Once treated wastewater is discharged from the GFAFB's wastewater stabilization ponds, the discharge flows through a series of wetlands and intermittent stream segments for approximately 2.5 miles before reaching the Turtle River. Since Kelly Slough, including the wastewater discharge, enters the Turtle River at the downstream end the two TMDL listed Turtle River segments, no waste load allocation will be provided in the TMDL.

Based on the data available, the general focus of BMPs and load reductions for the listed waterbody should be on household septic systems, unpermitted animal feeding operations, and riparian grazing adjacent to or in close proximity to the Turtle River.

One of the more important concerns regarding nonpoint sources is variability in stream flows. Variable stream flows often cause different source areas and loading mechanisms to dominate (Cleland, 2003). As previously described, exceedences of the fecal coliform bacteria standard was observed in two flow regimes (i.e., Moist and Dry Conditions) at site 385368, representing assessment unit ND-09020307-031-S_00 (Figure 12), in three flow regimes (i.e., High Flow, Moist and Dry Conditions) at site 385369, representing assessment unit ND-09020307-024-S_00 (Figure 14), in three flow regimes (i.e., Moist Condition, Dry Condition, and Low Flow) at site 385370, representing assessment unit ND-09020307-021-S_00 (Figure 16), and in four flow regimes (i.e. High, Moist and Dry Conditions, and Low Flow), at site 385371, representing assessment unit ND-09020307-019-S_00 (Figure 18).

By relating runoff characteristics to each flow regime one can infer which sources are most likely to contribute to fecal coliform bacteria loading. "Wastes from failing septic systems enter surface waters either as overland flow or via groundwater. Although loading to streams is likely to be a continual source, wet weather events can increase the rate of transport of pollutants (i.e., fecal coliform bacteria) from failing septic systems because of the wash-off effect from runoff and the increased rate of groundwater recharge" (Bureau of Water, 2010). Animals grazing in the riparian area contribute fecal coliform bacteria by depositing manure where it has an immediate impact on water quality. Due to the close proximity of manure to the stream or by direct deposition in the stream, riparian grazing impacts water quality at high flow or under moist and dry conditions (Table 11). In contrast, intensive grazing of livestock in the upland and not in the riparian area has a high potential to impact water quality at high flows and under moist conditions impact at moderate flows (Table 11). Exclusion of livestock from the riparian area eliminates the potential of direct manure deposit and therefore is considered to be of high importance at all flows. However, intensive grazing in the upland creates the potential for manure accumulation and availability for runoff at high flows and a high potential for total fecal coliform bacteria contamination.

Table 11. Nonpoint Sources of Pollution and Their Potential to Pollute at a Given Flow Regime.

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

Note: Potential importance of nonpoint source area to contribute 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 (EPA) regulations require that "TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numerical water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality." The margin of safety (MOS) can be either incorporated into conservative assumptions used to develop the TMDL (implicit) or added to a separate component of the TMDL (explicit).

To account for the uncertainty associated with known sources and the load reductions necessary to reach the TMDL target of 200 CFU/100 mL, a ten percent explicit margin of safety was used for these TMDLs. The MOS was calculated as ten percent of the TMDL.

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 TMDLs which are included in this report address seasonality because the flow duration curve for the South and North Branch of the Turtle River (ND-09020307-031-S_00 and ND-09020307-024-S_00) were developed using 2006 and 2007 flow data, and the Turtle River segments ND-09020307-021-S_00 and ND-09020307-019-S_00 were developed using 25 years of USGS gauge data encompassing all 12 months of the year. Additionally, the water quality standard is seasonally based on the recreation season from May 1 to September 30 and controls will be designed to reduce fecal coliform bacteria loads during the seasons covered by the standard.

7.0 TMDL

Table 12 provides an outline of the critical elements of the bacteria TMDL for the four TMDL listed segments. TMDLs for the South Branch Turtle River (ND-09020307-031-S_00), North Branch Turtle River (ND-09020307-024-S_00), Turtle River segment ND-09020307-021-S_00, and Turtle River segment ND-09020307-019-S_00 are summarized in Tables 13 through 16, respectively, while Tables 17 through 20 provide a summary of the E. coli TMDLs for these four TMDL listed segments. Please refer to Section 3.0 for justification and explanation of developing an E. coli TMDL target for the four TMDL listed segments. The TMDLs provide a summary of average daily loads by flow regime necessary to meet the water quality target (i.e. TMDL). The TMDL for each segment and flow regime provide an estimate of the existing daily load, and an estimate of the average daily loads necessary to meet the primary E. coli bacteria water quality target and the secondary fecal coliform bacteria target (i.e. TMDL load). The TMDL load includes a load allocation from known nonpoint sources and a 10 percent margin of safety.

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

Table 12. TMDL Summary for the Turtle River.

Category	Description	Explanation
Beneficial Use Impaired	Recreation	Contact Recreation (i.e. swimming, fishing)
Pollutants	Fecal Coliform Bacteria E. coli Bacteria	See Section 2.1
Secondary Fecal coliform Bacteria TMDL Target	200 CFU/100 ml	Based on the previous state water quality standard for fecal coliform bacteria.
Primary E. coli Bacteria TMDL Target	126 CFU/100 mL	Based on the current state water quality standard for E. coli bacteria. Monitoring will be conducted to determine compliance with the current water quality standard of 126 CFU/100 mL.
Significant Sources	Nonpoint Sources	No contributing Point Sources in Subwatershed
Margin of Safety (MOS)	Explicit	10 percent

TMDL = LC = WLA + LA + MOS

where

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

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

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

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

Table 13. Fecal Coliform Bacteria TMDL (10^7 CFU/day) for the South Branch Turtle River Waterbody ND-09020307-024-S_00 as represented by Site 385368.

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
Existing Load		7,682	4,822	
TMDL	26,147[1]	4,092	2,044	1,457[1]
WLA	No Reduction Needed	0	0	No Reduction Needed
LA		3,682.8	1839.6	
MOS		409.2	204.4	

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

Table 14. Fecal Coliform Bacteria TMDL (10^7 CFU/day) for the North Branch Turtle River Waterbody ND-09020307-031-S_00 as represented by Site 385369.

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
Existing Load	52,990	18,578	1,198	
TMDL	16,206	2,680	926	105[1]
WLA	0	0	0	No Reduction Needed
LA	14585.4	2,412	833.4	
MOS	1,620.6	268	92.6	

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

Table 15. Fecal Coliform Bacteria TMDL (10^7 CFU/day) for the Turtle River Waterbody ND-09020307-021-S_00 as represented by Site 385370.

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
Existing Load		57,120	8,350	6,570
TMDL	93,251[1]	18,107	6,361	3,523
WLA	No Reduction Needed	0	0	0
LA		16,296.3	6,324.9	3,170.7
MOS		1,810.7	636.1	352.3

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

Table 16. Fecal Coliform Bacteria TMDL (10^7 CFU/day) for the Turtle River Waterbody ND-09020307-019-S_00 as represented by Site 385371.

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
Existing Load	578,415	12,025	8,278	5,957
TMDL	46,491	9,787	4,893	2,495
WLA	0	0	0	0
LA	41,841.9	8,808.3	4,403.7	2,245.9
MOS	4,649.1	978.7	489.3	249.5

Table 17. E. coli Bacteria TMDL (10^7 CFU/day) for the South Branch Turtle River Waterbody ND-09020307-024-S_00.

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
TMDL	12,153	2,446	1,288	924
WLA	0	0	0	0
LA	10,937.7	2,201.4	1,159.2	831.6
MOS	1,215.3	244.6	128.8	92.4

Table 18. E. coli Bacteria TMDL (10^7 CFU/day) for the North Branch Turtle River Waterbody ND-09020307-031-S_00.

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
TMDL	10,210	2,083	764	229
WLA	0	0	0	0
LA	9,189	1,874.7	687.6	206.1
MOS	1,021	208.3	76.4	22.9

Table 19. E. coli Bacteria TMDL (10^7 CFU/day) for the Turtle River Waterbody ND-09020307-019-S_00.

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
TMDL	58,748	11,407	4,008	2,220
WLA	0	0	0	0
LA	52,873.2	10,266.3	3,607.2	1,998
MOS	5,874.8	1,140.7	400.8	222

Table 20. E. coli Bacteria TMDL (10^7 CFU/day) for the Turtle River Waterbody ND-09020307-021-S_00.

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
TMDL	31,704	6,474	3,083	1,480
WLA	0	0	0	0
LA	28,533.6	5,827	3,045	1,332
MOS	3,170.4	647.4	308.3	148

8.0 ALLOCATION

Since there are no known point source discharges to the TMDL listed segments, the entire fecal coliform bacteria load for these TMDLs were allocated to nonpoint sources in the watersheds. The entire nonpoint source load is allocated as a single load because there is not enough detailed source data to allocate the load to individual uses (e.g., septic systems, animal feeding, riparian grazing, and waste management).

To achieve the TMDL targets identified in the report, it will require the wide spread support and voluntary participation of landowners and residents in the watershed. The TMDLs described in this report are a plan to improve water quality by implementing best management practices (BMPs) through non-regulatory approaches. BMPs are methods, measures, or practices that are determined to be a reasonable and cost effective means for a land owner to meet nonpoint source pollution control needs, (EPA, 2001). This TMDL plan is put forth as a recommendation for what needs to be accomplished for the Turtle River and associated watersheds to restore and maintain its recreational uses. Water quality monitoring should continue in order to measure BMP effectiveness and determine through adaptive management if loading allocation recommendations need to be adjusted.

Nonpoint source pollution is the sole contributor to elevated fecal coliform bacteria levels in the Turtle River watersheds. The fecal coliform bacteria samples and load duration curve analysis of the impaired reach identified the moist and dry condition flow regimes for TMDL segment ND-09020307-024-S_00; high flow, moist and dry conditions for ND-09020307-031-S_00; moist, dry and low flow conditions for ND-09020307-021-S_00; and high flow, moist, dry and low flow conditions for ND-09020307-019-S_00 as the time of fecal coliform bacteria exceedences for the 200 CU/100 mL target. To reduce NPS pollution for the high, moderate, and low flow regimes, specific BMPs are described in Sections 8.1, 8.2 and 8.3 and Tables 21-23 that will mitigate the effects of fecal coliform bacteria loading to the impaired reaches.

Controlling nonpoint sources is an immense undertaking requiring extensive financial and technical support. Provided that technical/financial assistance is available to stakeholders, these BMPs have the potential to significantly reduce total fecal coliform bacteria loading to Turtle River. The following describe in detail those BMPs that will reduce fecal coliform bacteria levels in Turtle River.

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

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

8.1 Household Septic Systems

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

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

8.2 Livestock Management Recommendations

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

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 and alternative water source. Installing water wells and tanks satisfies this need. Installing water tanks provides a quality water source and keeps animals from wading and defecating in streams. This will reduce the probability of pathogenic infections to livestock and the public.

Prescribed grazing- This practice is used to increase ground cover and ground stability by rotating livestock throughout multiple fields. Grazing with a specified rotation minimizes overgrazing and resulting erosion. The Natural Resource Conservation Service (NRCS) recommends grazing systems to improve and maintain water quality and quantity. Duration, intensity, frequency, and season of grazing can be managed to enhance vegetation cover and litter, resulting in reduced runoff, improved infiltration, increased quantity of soil water for plant growth, and better manure distribution and increased rate of decomposition, (NRCS, 1998). In a study by Tiedemann et al. (1998), as presented by USEPA (1993), the effects of four grazing strategies on bacteria levels in thirteen watersheds in Oregon were studied during the summer of 1984. Results of the study (Table 22) showed that when livestock are managed at a stocking rate of 19 acres per animal unit month, with water developments and fencing, bacteria levels were reduced significantly.

Waste management system- Waste management systems can be effective in controlling up to 90 percent of fecal coliform bacteria loading originating from confined animal feeding areas (Table 23). A waste management system is made up of various components designed to control non point source pollution from concentrated animal feeding operations (CAFOs) and animal feeding operations (AFOs). Diverting clean water from the feeding area and containing dirty water from the feeding area in a pond are typical practices of a waste management system. Manure handling and application of manure is designed to be adaptive to environmental, soil, and plant conditions to minimize the probability of contamination of surface water.

Table 22. Bacterial Water Quality Response to Four Grazing Strategies (Tiedemann et al., 1988).

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

8.3 Other Recommendations

Vegetative filter strip- Vegetated filter strips are used to reduce the amount of sediment, particulate organics, dissolved contaminants, nutrients, and in the case of this TMDL, fecal coliform bacteria to streams. The effectiveness of filter strips and other BMPs in removing fecal coliform bacteria is quite successful. Results from a study by Pennsylvania State University (1992a) as presented by USEPA (1993) (Table 20), suggest that vegetative filter strips are capable of removing up to 55 percent of fecal coliform bacteria loading to rivers and streams (Table 23). The ability of the filter strip to remove contaminants is dependent on field slope, filter strip slope, erosion rate, amount and particulate size distribution of sediment delivered to the filter strip, density and height of vegetation, and runoff volume associated with erosion producing events (NRCS, 2001).

Table 23. Relative Gross Effectiveness[a] of Confined Livestock Control Measures (Pennsylvania State University, 1992a).

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

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

9.0 PUBLIC PARTICIPATION

To satisfy the public participation requirement of this TMDL, a hard copy of the TMDLs for the Turtle River, North Branch Turtle River and South Branch Turtle River, and a request for comment were mailed to participating agencies, partners, and to those who requested a copy.

Those included in the mailing of a hard copy were as follows:

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

In addition to mailing copies of this TMDL report to interested parties, the TMDL was posted on the North Dakota Department of Health, Division of Water Quality web site at http://www.ndhealth.gov./WQ/SW/Z2 TMDL/TMDLs Under PublicComment/B Under Public Commment.html . A 30 day public notice soliciting comment and participation was also published in the Grand Forks Herald.

There were no comments received during the public comment period. US EPA Region 8 did provide a review of the draft TMDL (Appendix E). This review provides an evaluation of the TMDL against a set of minimum submission requirements required for TMDLs submitted to US EPA Region 8.

10.0 MONITORING

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

To insure that the best management practices (BMP's) and technical assistance that are implemented as part of the Section 319 Turtle River watershed project are successful in reducing fecal coliform and E. coli bacteria loadings to levels prescribed in this TMDL, water quality monitoring will be conducted in accordance with an approved Quality Assurance Project Plan (QAPP).

11.0 TMDL IMPLEMENTATION STRATEGY

In response to the Turtle River Watershed Assessment and in anticipation of this completed TMDL, local sponsors successfully applied for and received Section 319 funding for the Turtle River watershed project. Beginning in May 2009, local sponsors have been providing technical assistance and implementing BMPs designed to reduce fecal bacteria and E. coli loadings and to help restore the beneficial uses of Turtle River (i.e., recreation). As the watershed restoration project progresses, water quality data are collected to monitor and track the effects of BMP implementation as well as to judge overall success of the project in reducing fecal coliform and E. coli bacteria loadings. A QAPP will be developed as part of this watershed restoration project that details the how, when and where monitoring will be conducted to gather the data needed to document success in meeting the TMDL implementation goal(s). As the data are gathered and analyzed, watershed restoration tasks will be adapted, if necessary, to place BMPs where they will have the greatest benefit to water quality and in meeting the TMDL goal(s).

12.0 REFERENCES

Bureau of Water, 2010. Total Maximum Daily Load Document: Caw Caw Swamp Watershed Fecal Coliform Bacteria, Indicator for Pathogens. South Carolina Department of Health and Environmental Control, Columbia, SC.

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

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

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

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

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

NASS. 2007. *North Dakota Agricultural Statistics Service*. Available at http://www.nass.usda.gov/Statistics_by_State/North_Dakota/index.asp.

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

NDDoH. 2011. *Standards of Quality for Waters of the State.* Chapter 33-16-02 of the North Dakota Century Code. North Dakota Department of Health, Division of Water Quality. Bismarck, North Dakota.

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

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

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

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

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

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

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

Appendix A
Fecal Coliform Bacteria Data Collected for Sites 385368, 385369, 385370, and 385371 for 2006 and 2007

Site 385368 South Branch Turtle River near Larimore, ND

	May		June		July		August		September	
	01-May-06	20	01-Jun-06	190	05-Jul-06	370	07-Aug-06	120	05-Sep-06	130
	03-May-06	40	05-Jun-06	190	10-Jul-06	1600	14-Aug-06	200	20-Sep-06	20
	08-May-06	130	07-Jun-06	90	17-Jul-06	390	21-Aug-06	680	25-Sep-06	110
	11-May-06	160	12-Jun-06	50	24-Jul-06	1200	30-Aug-06	240	04-Sep-07	380
	16-May-06	5	19-Jun-06	20	31-Jul-06	140	06-Aug-07	160	13-Sep-07	90
	18-May-06	10	26-Jun-06	280	02-Jul-07	400	13-Aug-07	150	17-Sep-07	5
	22-May-06	20	04-Jun-07	110	12-Jul-07	210	20-Aug-07	150	24-Sep-07	120
	24-May-06	40	11-Jun-07	240	16-Jul-07	300	28-Aug-07	250		
	30-May-06	30	18-Jun-07	540	23-Jul-07	80				
	03-May-07	50	26-Jun-07	280	30-Jul-07	240				
	07-May-07	100								
	09-May-07	60								
	14-May-07	80								
	16-May-07	60								
	21-May-07	140								
	23-May-07	150								
	29-May-07	280								
	31-May-07	220								
N	18		10		10		8		7	
Geometric Mean	57		143		337		208		67	
% Exceeded	0%		10%		30%		13%		0%	
Recreational Use Assessment	FS		FS		NS		NS		FS	

Site 385369 North Branch Turtle River near Larimore, ND

	May		June		July		August		September	
	01-May-06	60	01-Jun-06	1600	05-Jul-06	110	07-Aug-06	100	05-Sep-06	250
	03-May-06	5	05-Jun-06	140	10-Jul-06	50	14-Aug-06	170	20-Sep-06	120
	08-May-06	10	07-Jun-06	1600	17-Jul-06	150	21-Aug-06	160	25-Sep-06	250
	11-May-06	20	12-Jun-06	60	24-Jul-06	210	30-Aug-06	320	06-Aug-07	1600
	16-May-06	20	19-Jun-06	90	31-Jul-06	220	06-Aug-07	1600	13-Aug-07	230
	18-May-06	20	26-Jun-06	130	02-Jul-07	450	13-Aug-07	230	20-Aug-07	150
	22-May-06	10	04-Jun-07	110	12-Jul-07	200	20-Aug-07	150	28-Aug-07	170
	24-May-06	5	11-Jun-07	810	16-Jul-07	280	28-Aug-07	170		
	30-May-06	110	18-Jun-07	410	23-Jul-07	50				
	03-May-07	30	26-Jun-07	720	30-Jul-07	120				
	07-May-07	40								
	09-May-07	70								
	14-May-07	30								
	16-May-07	5								
	21-May-07	5								
	23-May-07	50								
	29-May-07	110								
	31-May-07	50								
N	18		10		10		8		7	
Geometric Mean	23		303		150		231		255	
% Exceeded	0%		50%		10%		13%		14%	
Recreational Use	FS		NS		FS		NS		NS	

Site 385370 Turtle River near Arvilla, ND

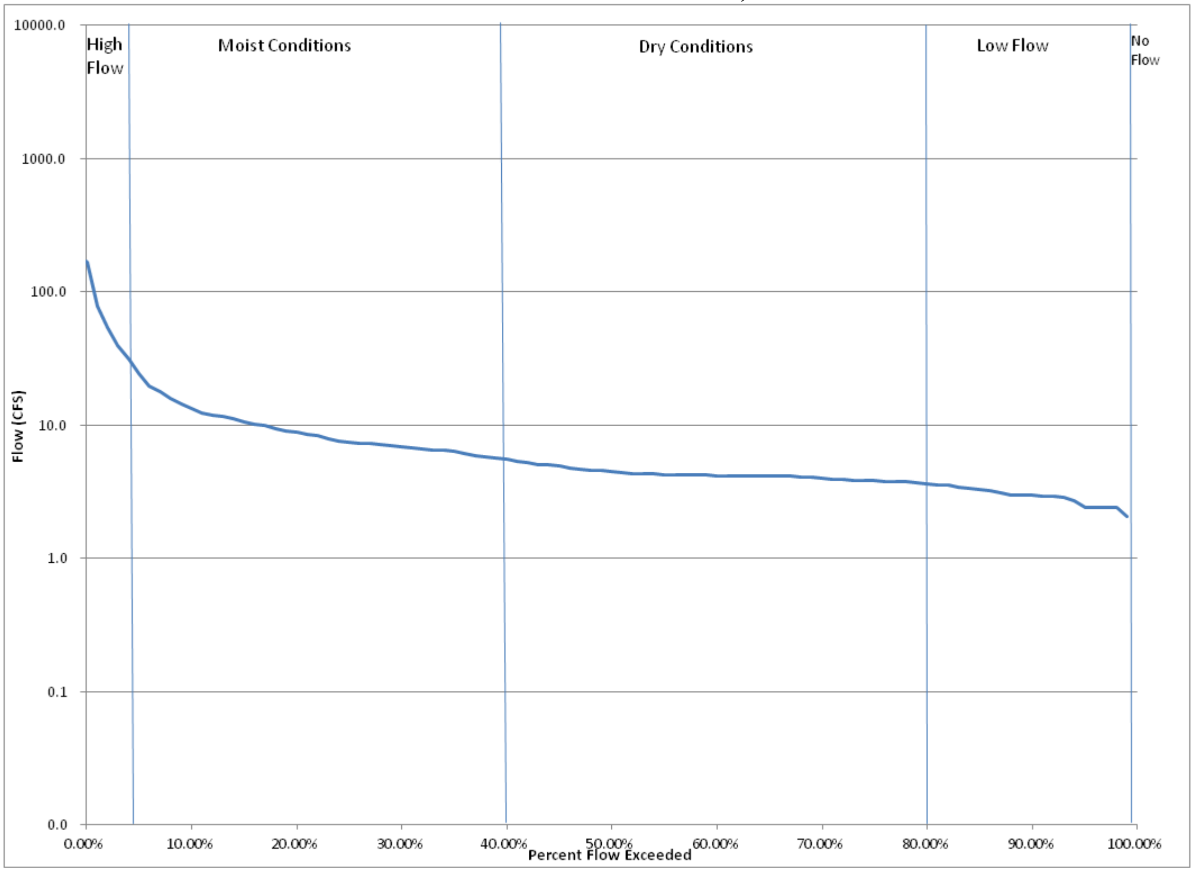
	May		June		July		August		September	
	01-May-06	100	01-Jun-06	130	05-Jul-06	100	07-Aug-06	10	05-Sep-06	210
	03-May-06	10	05-Jun-06	5	10-Jul-06	70	14-Aug-06	100	20-Sep-06	90
	08-May-06	30	07-Jun-06	60	17-Jul-06	80	21-Aug-06	140	25-Sep-06	130
	10-May-06	270	12-Jun-06	50	24-Jul-06	430	30-Aug-06	90	04-Sep-07	130
	16-May-06	5	19-Jun-06	20	31-Jul-06	50	06-Aug-07	170	13-Sep-07	40
	18-May-06	10	26-Jun-06	740	02-Jul-07	1600	13-Aug-07	200	17-Sep-07	80
	22-May-06	5	04-Jun-07	110	12-Jul-07	390	20-Aug-07	240	24-Sep-07	30
	24-May-06	30	11-Jun-07	50	16-Jul-07	540	28-Aug-07	230		
	30-May-06	40	18-Jun-07	1600	23-Jul-07	320				
	03-May-07	5	26-Jun-07	150	30-Jul-07	310				
	07-May-07	40								
	09-May-07	20								
	14-May-07	50								
	16-May-07	50								
	21-May-07	40								
	23-May-07	80								
	29-May-07	180								
	31-May-07	730								
N	18		10		10		8		7	
Geometric Mean	36		91		229		111		84	
% Exceeded	6%		20%		30%		0%		0%	
Recreational Use Assessment	FS		FSBT		NS		FS		FS	

Site 385371 Turtle River near Mekinok, ND

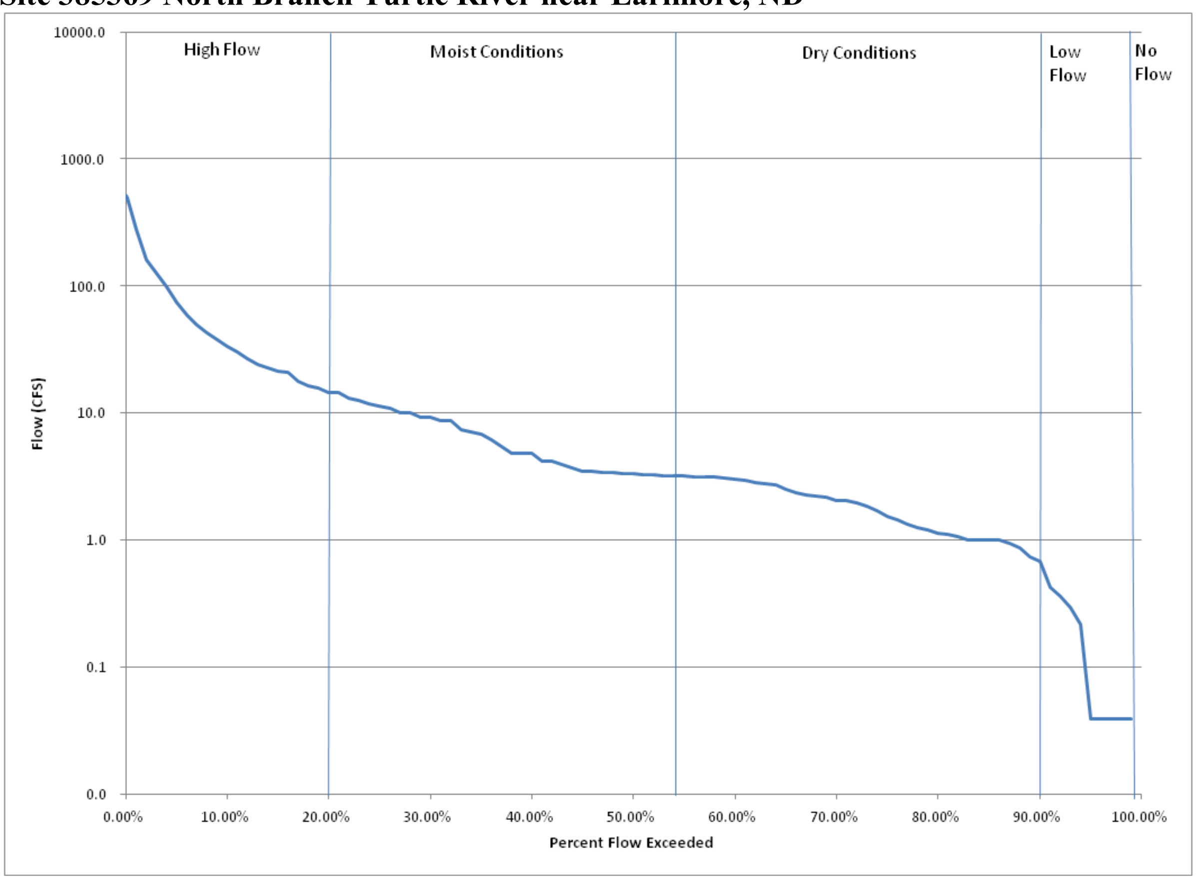
	May		June		July		August		September	
	01-May-06	40	01-Jun-06	220	05-Jul-06	70	07-Aug-06	260	05-Sep-06	60
	03-May-06	40	05-Jun-06	170	10-Jul-06	40	14-Aug-06	380	19-Sep-06	360
	08-May-06	60	07-Jun-06	130	17-Jul-06	40	21-Aug-06	830	25-Sep-06	30
	11-May-06	70	12-Jun-06	30	24-Jul-06	300	30-Aug-06	180	04-Sep-07	130
	15-May-06	5	19-Jun-06	140	31-Jul-06	180	06-Aug-07	220	13-Sep-07	430
	18-May-06	5	26-Jun-06	130	02-Jul-07	250	13-Aug-07	140	17-Sep-07	300
	22-May-06	5	04-Jun-07	5	12-Jul-07	90	20-Aug-07	270	24-Sep-07	70
	24-May-06	10	11-Jun-07	40	16-Jul-07	260	28-Aug-07	310		
	30-May-06	240	18-Jun-07	1600	23-Jul-07	180				
	03-May-07	5	26-Jun-07	170	30-Jul-07	880				
	07-May-07	60								
	09-May-07	110								
	14-May-07	20								
	16-May-07	50								
	21-May-07	50								
	23-May-07	50								
	29-May-07	80								
	31-May-07	110								
N	18		10		10		8		7	
Geometric Mean	32		104		150		280		134	
% Exceeded	0%		10%		10%		13%		14%	
Recreational Use Assessmen	FS		FS		FS		NS		FSBT	

Appendix B
Flow Duration Curves for Sites 385368, 385369, 385370 and 385371

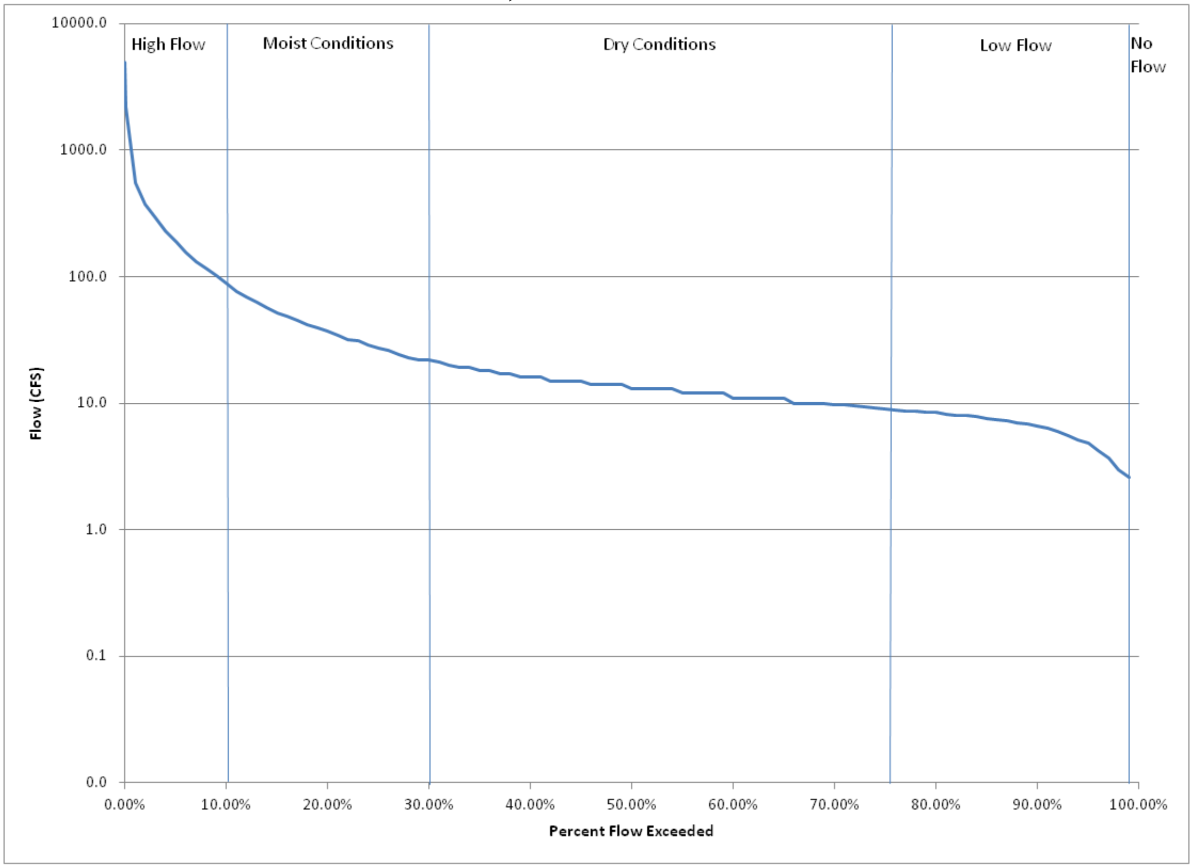
Site 385368 South Branch Turtle River near Larimore, ND



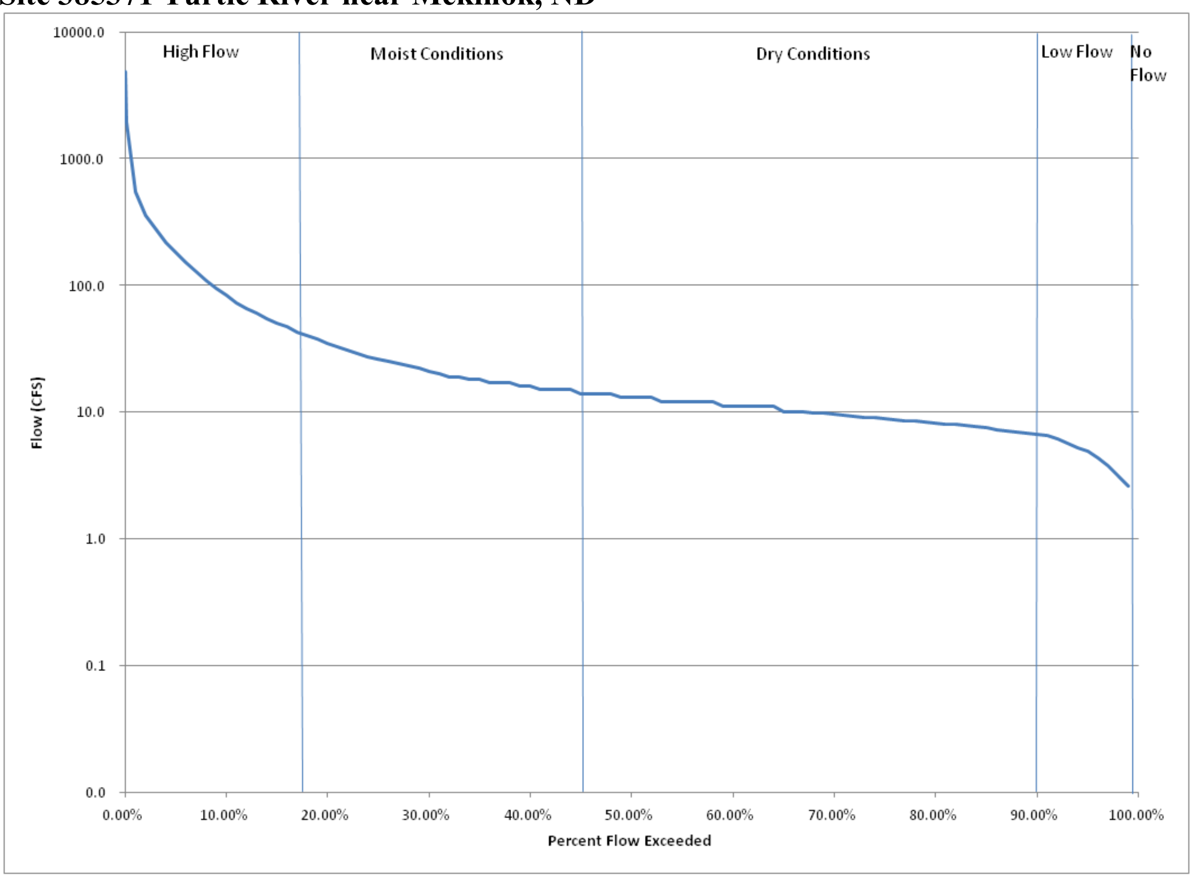
Site 385369 North Branch Turtle River near Larimore, ND



Site 385370 Turtle River near Arvilla, ND



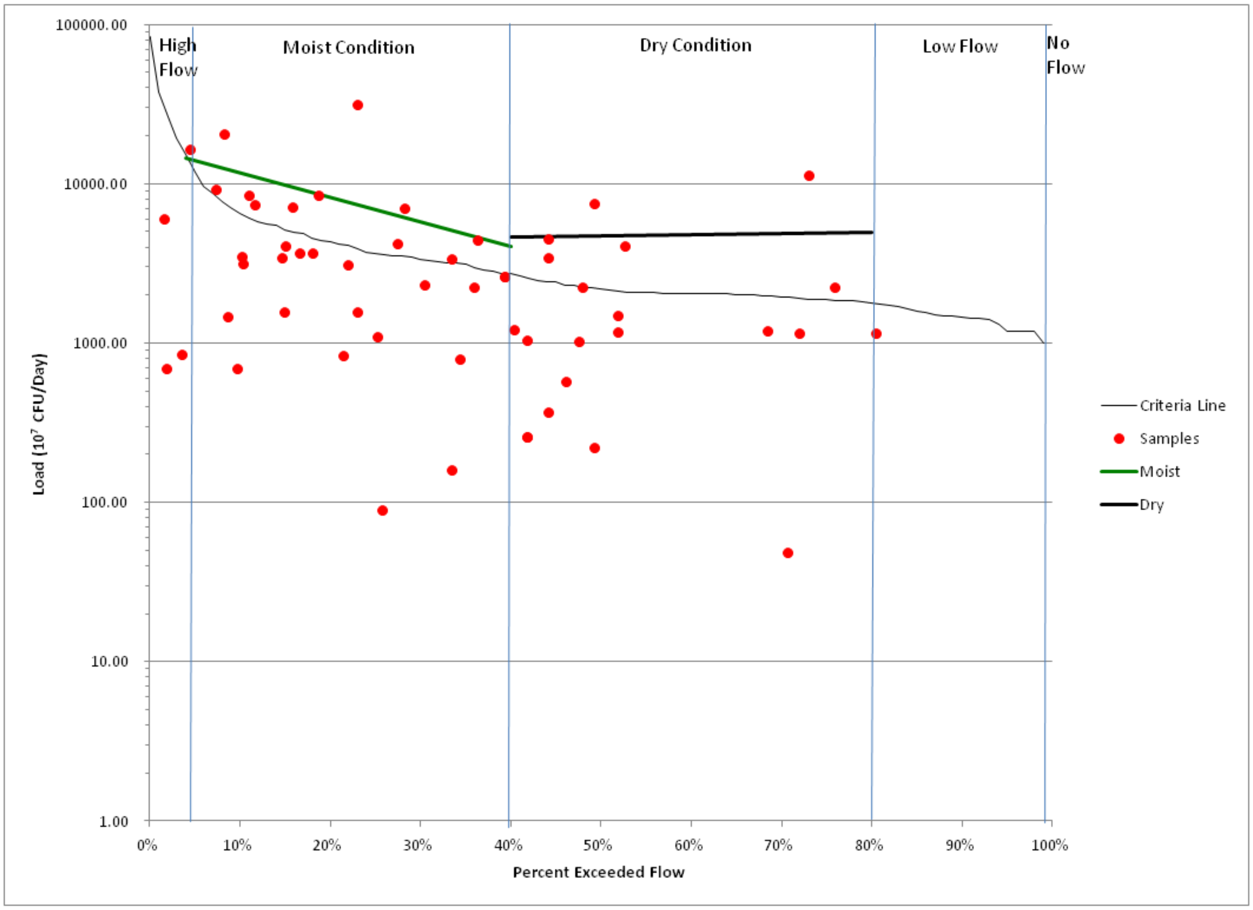
Site 385371 Turtle River near Mekinok, ND



Appendix C
Load Duration Curve, Estimated Loads, TMDL Targets, and Percentage of Reduction Required for Sites 385368, 385369, 385370, and 385371

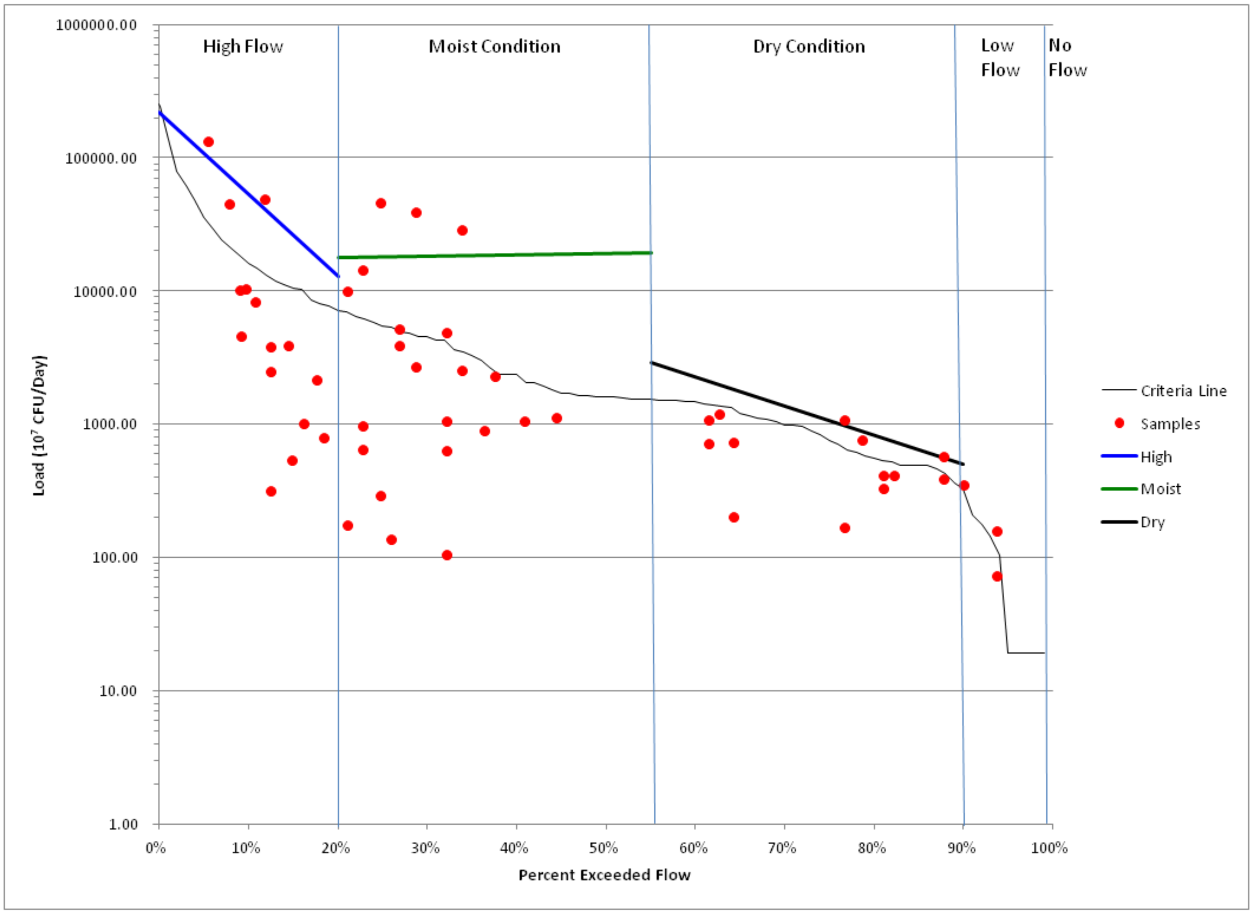
Site 385368 South Branch Turtle River near Larimore, ND

	Load (10^7 CFUs/Day)				Load (10^7 CFUs/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
Moist	22.00%	7682.49	4092.73	131.40	1009478.85	537784.64	46.73%
Dry	60.00%	4822.06	2044.51	146.00	704021.31	298498.28	57.60%
			Total	277	1713500	836283	51.19%



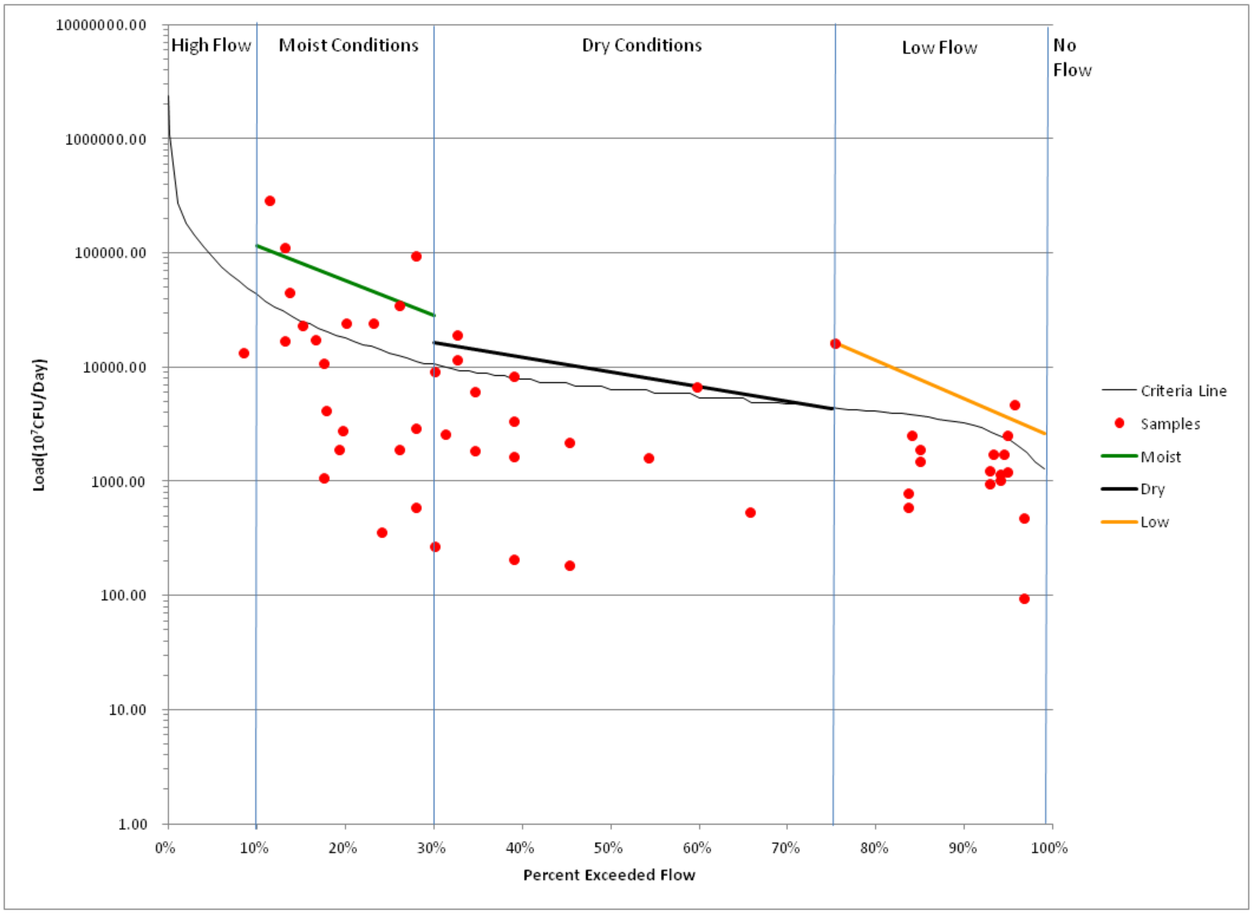
Site 385369 North Branch Turtle River near Larimore, ND

	Load (10^7 CFUs/Day)				Load (10^7 CFUs/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
High	10.00%	52990.34	16206.53	73.00	3868294.67	1183076.34	69.42%
Moist	37.50%	18578.48	2680.38	127.75	2373400.55	342418.79	85.57%
Dry	72.50%	1198.27	926.99	127.75	153078.84	118423.35	22.64%
			Total	329	6394774	1643918	74.29%



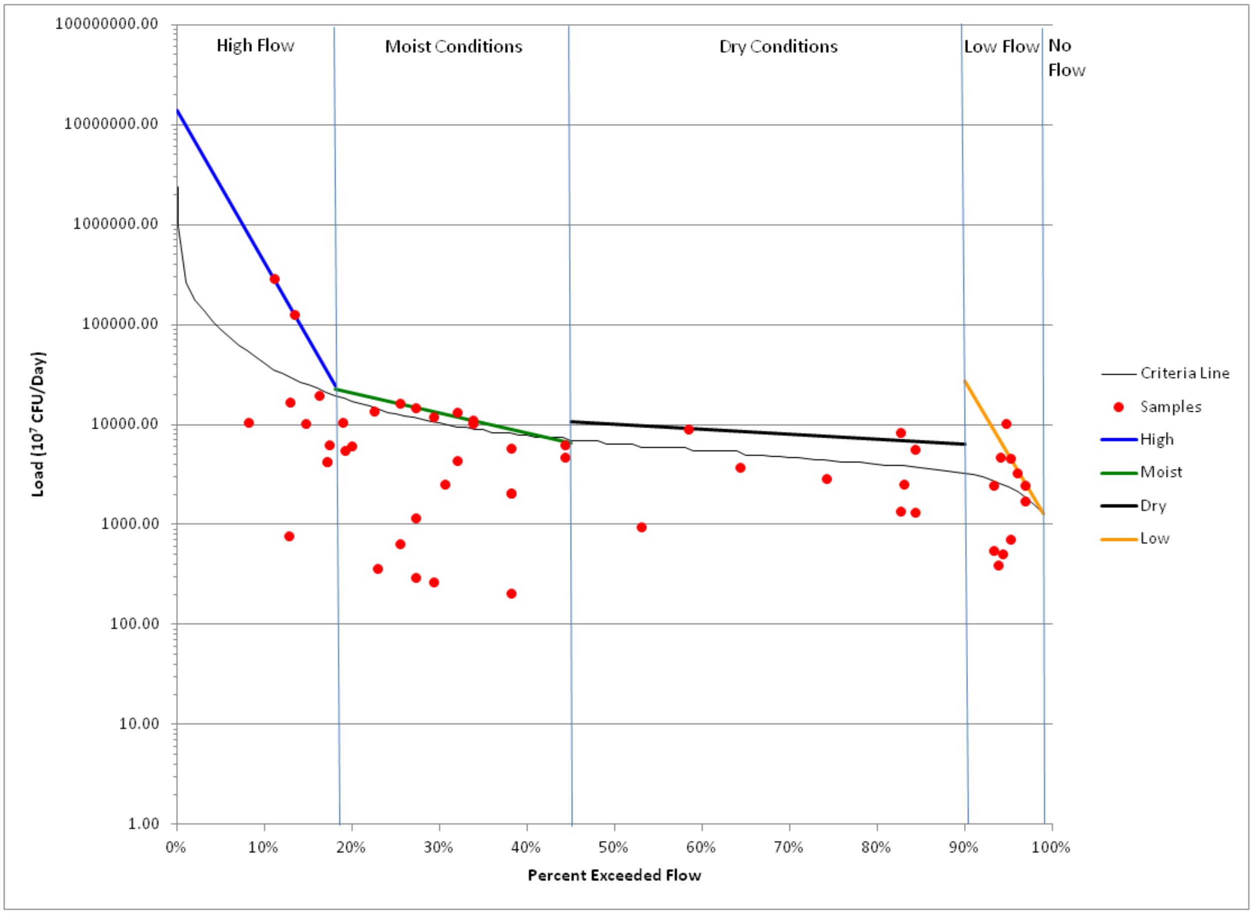
Site 385370 Turtle River near Arvilla, ND

	Load (10^7 CFUs/Day)				Load (10^7 CFUs/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
Moist	20.00%	57120.14	18107.05	73.00	4169770.51	1321814.73	68.30%
Dry	52.50%	8350.79	6361.94	164.25	1371616.89	1044948.13	23.82%
Low	87.00%	6570.70	3523.53	87.60	575593.00	308661.60	46.38%
			Total	325	6116980	2675424	56.26%



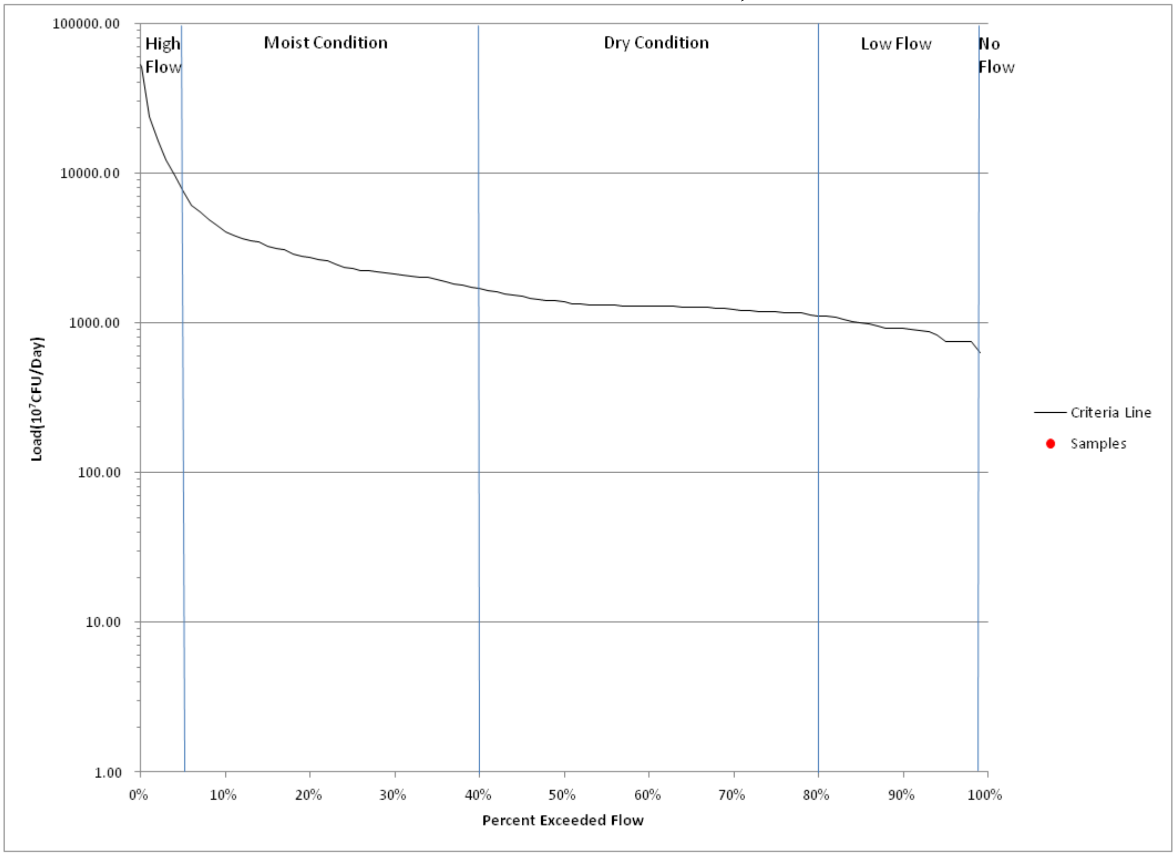
Site 385371 Turtle River near Mekinok, ND

	Load (10^7 CFUs/Day)				Load (10^7 CFUs/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
High	9.00%	578415.41	46491.08	65.70	38001892.76	3054463.77	91.96%
Moist	31.50%	12025.56	9787.60	98.55	1185118.55	964567.51	18.61%
Dry	67.50%	8278.19	4893.80	164.25	1359693.13	803806.26	40.88%
Low	94.50%	5957.60	2495.84	32.85	195707.13	81988.24	58.11%
			Total	361	40742412	4904826	87.96%

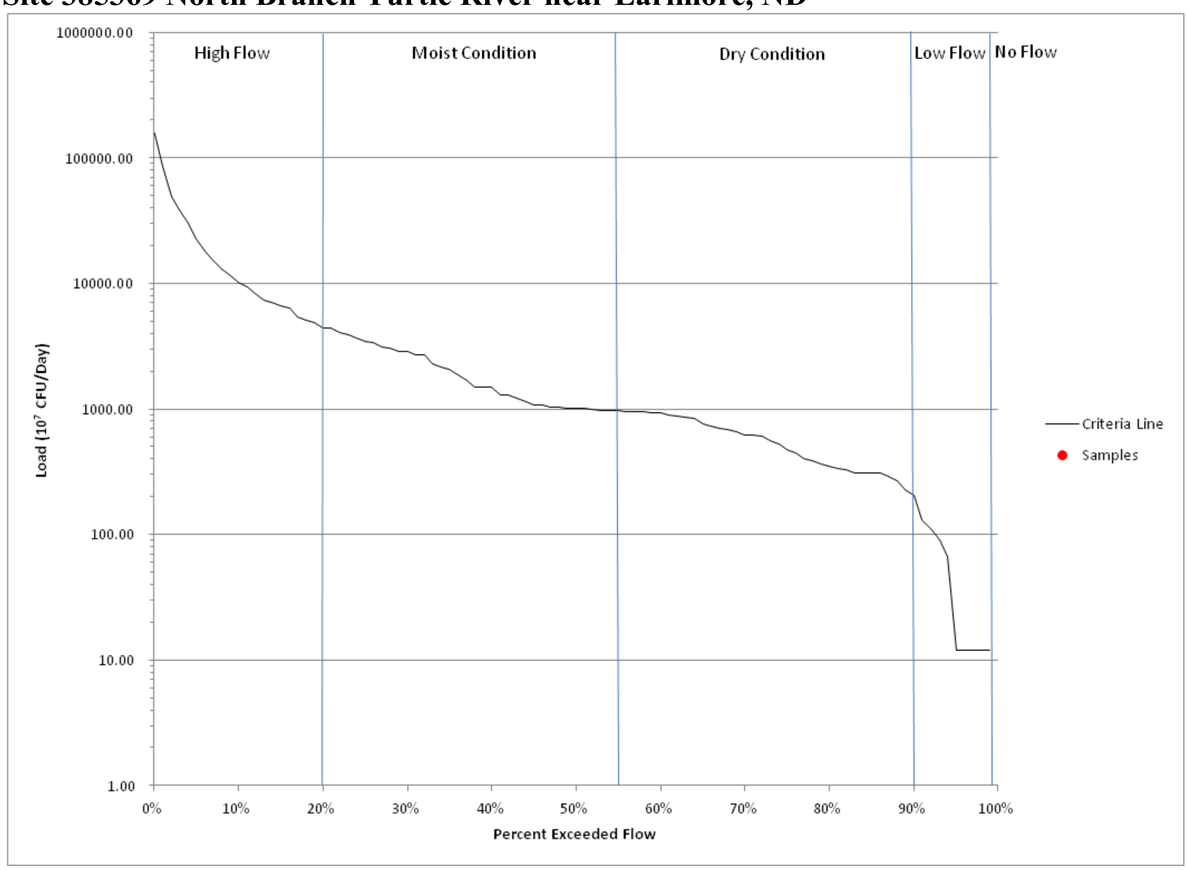


Appendix D
Load Duration Curves for Monitoring Sites 385368, 385369, 385370, and 305371 using the Current State Water Quality Standards for E. coli Bacteria (126 CFU/100 mL)

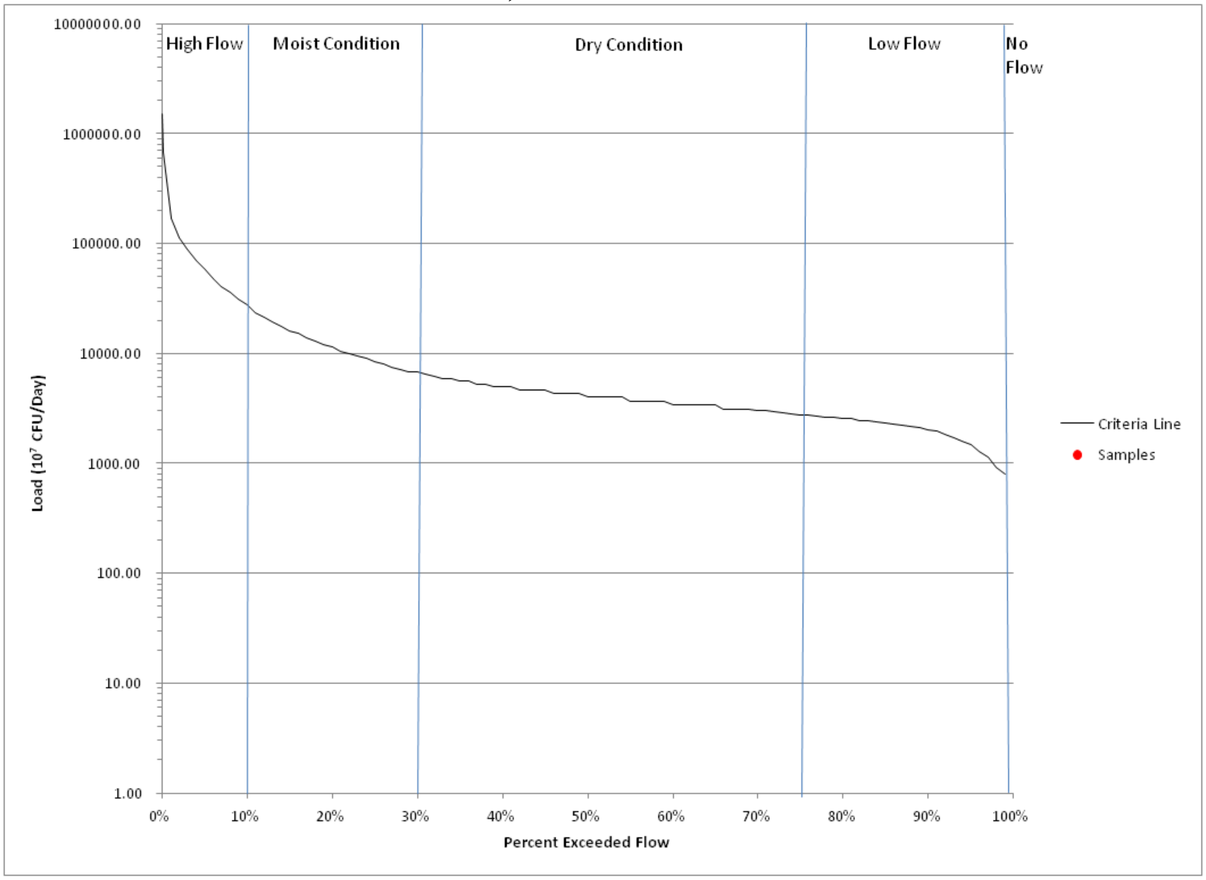
Site 385368 South Branch Turtle River near Larimore, ND



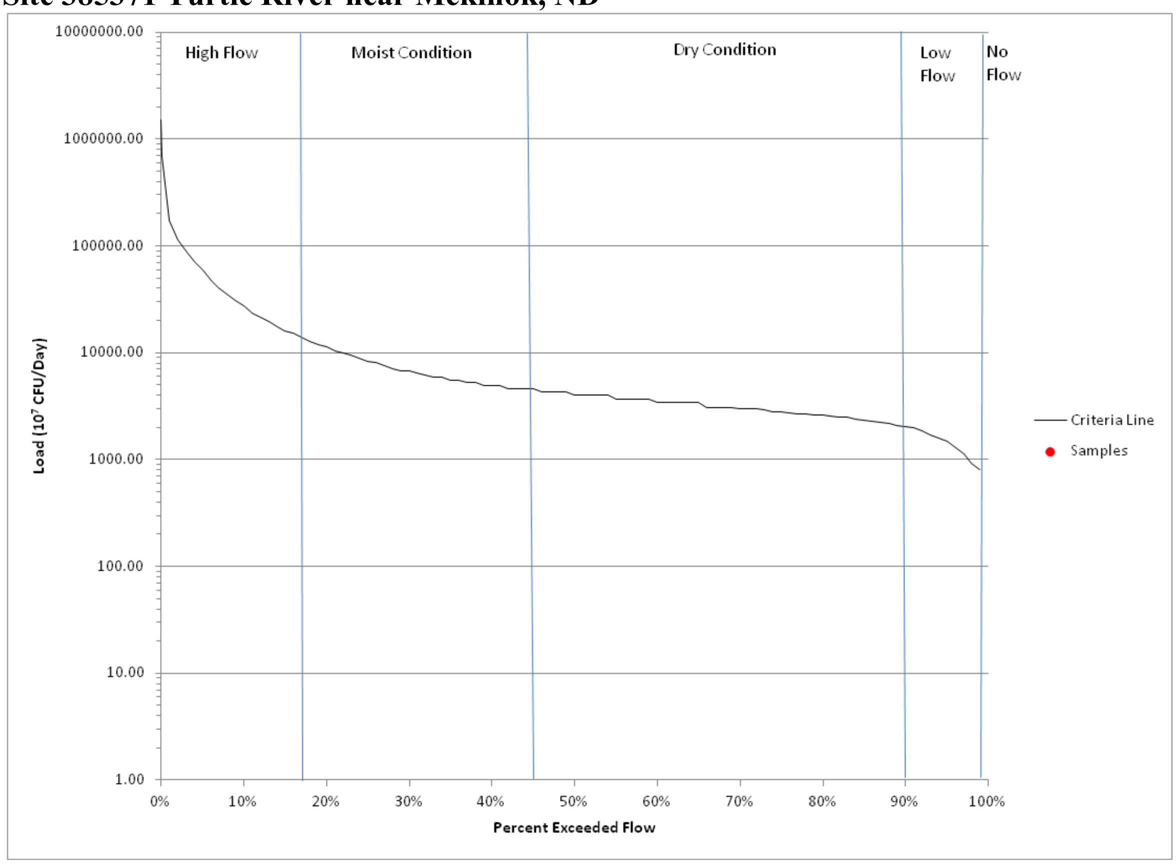
Site 385369 North Branch Turtle River near Larimore, ND



Site 385370 Turtle River near Arvilla, ND



Site 385371 Turtle River near Mekinok, ND



Appendix E
US EPA Region 8 TMDL Review Form and Decision Document

EPA REGION 8 TMDL REVIEW FORM AND DECISION DOCUMENT

TMDL Document Info:

Document Name:	**Fecal Coliform Bacteria TMDLs for the Turtle River, South Branch Turtle River and North Branch Turtle River in Grand Forks County, North Dakota**
Submitted by:	**Mike Ell, North Dakota Department of Health**
Date Received:	**June 3, 2013**
Review Date:	**July 16, 2013**
Reviewer:	**Vern Berry, US Environmental Protection Agency**
Rough Draft / Public Notice / Final Draft?	**Public Notice**
Notes:	

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

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

Approval Notes to the Administrator:

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

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

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

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

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

1. Problem Description

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

1.1 TMDL Document Submittal

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

Review Elements:

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

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

Recommendation:

☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information ☐ N/A

Summary: *The notification of the availability of the public notice draft TMDL document was submitted to EPA via a letter attached to an email received on June 3, 2013. The letter includes the details of the public notice, explains how to obtain a copy of the TMDL, and requests the submittal of comments to NDDoH by July 8, 2013.*

Comments: *None.*

1.2 Identification of the Waterbody, Impairments, and Study Boundaries

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

Review Elements:

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

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

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

Recommendation:

☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:

Physical Setting and Listing History*:*
This TMDL document includes four impaired stream segments within the Turtle River sub-basin (HUC 09020307) in north-eastern North Dakota. These stream segments are part of the larger Red River basin. The four impaired segments are located in Grand Forks County which cover a watershed area of approximately 457,907 acres.

The four impaired segments included in this TMDL document are: 1) Turtle River from its confluence with a tributary NE of Turtle River State Park, downstream to its confluence with Kelly Creek (25.27 miles; ND-09020307-019-S_00); 2) Turtle River from its confluence with South Branch Turtle River downstream to its confluence with a tributary NE of Turtle River State Park (13.9 miles; ND-09020307-021-S_00); 3) South Branch Turtle River downstream to Larimore Dam (18.42 miles; ND-09020307-024-S_00); and 4) North Branch Turtle River from its confluence with Whiskey Creek, downstream to its confluence with South Branch Turtle (15.26 miles; ND-09020307-031-S_00).

This TMDL document addresses the recreational use impairments from fecal coliform bacteria. The other impairment causes will be addressed in separate actions or TMDL documents. The complete impairment information is included in the table below.

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

Class II – Turtle River, Segment 019, 021; South Branch Turtle River Segment 024; and North Branch Turtle River, Segment 031

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

Impairment status:
The 2012 North Dakota Integrated Report identifies two segments of the Turtle River, the North Branch of the Turtle River and the South Branch of the Turtle River as impaired based on the following information:

Stream Segment	**Designated Use / Support Status**	**Impairment Cause**	**TMDL Priority**
Turtle River ND-09020307-019-S_00	*Fish and Other Aquatic Biota; Fully Supporting, but Threatened*	*Combination Benthic/Fishes Bioassessments*	*Low*
		Cadmium	
		Selenium	
	Municipal and Domestic; Fully Supporting, but Threatened	*Selenium*	
		Arsenic	
	Recreation; Fully Supporting, but Threatened	*Fecal coliform*	
Turtle River ND-09020307-021-S_00	*Fish and Other Aquatic Biota; Fully Supporting, but Threatened*	*Cadmium*	*Low*
		Selenium	
	Municipal and Domestic; Fully Supporting, but Threatened	*Selenium*	
		Arsenic	
	Recreation; Fully Supporting, but Threatened	*Fecal coliform*	
South Branch Turtle River ND-09020307-024-S_00	*Fish and Other Aquatic Biota; Fully Supporting, but Threatened*	*Combination Benthic/Fishes Bioassessments*	*Low*
		Cadmium	
		Selenium	
	Recreation; Fully Supporting, but Threatened	*Fecal coliform*	
North Branch Turtle River ND-09020307-031-S_00	*Fish and Other Aquatic Biota; Fully Supporting, but Threatened*	*Cadmium*	*Low*
		Selenium	
	Recreation; Fully Supporting, but Threatened	*Fecal coliform*	

Comments: *None.*

1.3 Water Quality Standards

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

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

Review Elements:

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

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

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

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

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

Summary: *The Turtle River, Segments 019, 021, South Branch Turtle River Segment 024 and North Branch Turtle River, Segment 031 are impaired based on fecal coliform bacteria concentrations impacting the recreational uses. These segments are classified as fully supporting but threatened for recreational uses due to exceedences of the fecal coliform bacteria standard which was in effect at the time of the TMDL listing. No E. coli data have been collected for these segments.*

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

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

Numeric criteria for E. coli, and the previous criteria for fecal coliform, have been established for North Dakota Class II streams and are presented in the excerpted Table 10 shown below. Discussion of additional applicable water quality standards for these stream segments can be found on pages 12 – 13 of the TMDL document.

Table 10. North Dakota Bacteria Water Quality Standards for Class II Streams.

Parameter	Standard	
	Geometric Mean[1]	Maximum[2]
E. coli Bacteria	126 CFU/100 mL	409 CFU/100 mL
Fecal Coliform*	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.
* Previous State water quality standard.

Comments: *None.*

2. Water Quality Targets

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

Review Elements:

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

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

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

Summary: *The primary water quality targets for these TMDLs are based on the numeric water quality standards for E. coli bacteria established to protect the recreational beneficial uses for the four impaired stream segments in the Turtle River watershed. The secondary water quality targets are based on the previous fecal coliform standards. There are currently no E. coli data available for the four listed TMDL reaches. The Turtle River stream segments are classified as fully supporting but threatened for recreational uses due to exceedences of the fecal coliform bacteria standard which was in effect at the time of the TMDL listing. For this reason, the fecal coliform standards were used as the secondary TMDL targets, while the E.coli standards will be considered the primary TMDL targets.*

Bacteria standards are expressed in coliform forming units (cfu) per 100 milliliters (mL) of the water sample. The E. coli target for each impaired segment is: 126 cfu/100 mL during the recreation season from May 1 to September 30. The fecal coliform target for each impaired segment is: 200 cfu/100 mL during the recreation season from May 1 to September 30. While the *standards are intended to be expressed as the 30-day geometric mean, the targets for each stream segment was used to compare to values from single grab samples. This ensures that the reductions necessary to achieve the targets will be protective of both the acute (single sample value) and chronic (geometric mean of 5 samples) standards.*

Comments: *None.*

3. Pollutant Source Analysis

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

Review Elements:

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

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

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

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

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

Summary: *The TMDL document includes the landuse breakdown for the watershed based on the 2007 National Agricultural Statistics Service (NASS) data. In 2007, the dominant land use in the Turtle River watershed was agriculture. Approximately 57 percent of the landuse in the watershed was cropland, 18 percent was grassland / pastureland, 13 percent was wetlands and the remaining 12 percent was either developed space, barren or woods. The majority of the crops grown consisted of soybeans, corn, spring wheat, sunflowers and dry beans.*

Section 4.0, Significant Sources beginning on page 14, provides the pollutant source analysis for the four listed segments in the Turtle River watershed. There are two wastewater treatment facilities within the larger watershed boundaries. One is located in Larimore, ND and the other is the Grand Forks Air Force Base. The Larimore facility has no reported discharges filed with the NDPDES Program. While the Grand Forks Air Force Base (GFAFB) is partially located in the contributing watershed of TMDL listed segment ND-09020307-019-S_00. The GFAFB lagoons are permitted to discharge into the Kelly Slough which drains to a segment downstream of the listed segment covered in this TMDL document.

There are four permitted animal feeding operations (AFOs) within the drainage area of the listed stream segments of the Turtle River. The NDDoH has permitted one large (1,000 + animal units (AUs)), one medium (301-999 AUs), and two small (0-300 (AUs)) AFOs to operate. All four AFOs are zero discharge facilities and are not deemed a significant point source of fecal coliform or E. coli bacteria loadings to the Turtle River.

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

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

Livestock production is not dominant agricultural practice in the watershed but unpermitted AFOs, livestock grazing and watering in proximity to the listed stream segments and its tributaries do exist and may be a contributor of bacteria within the Turtle River watershed.

Comments: *None.*

4. TMDL Technical Analysis

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

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

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

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

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

Where:

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

Review Elements:

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

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

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

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

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

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

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

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

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

Summary: *The technical analysis should describe the cause and effect relationship between the identified pollutant sources, the numeric targets, and achievement of water quality standards. It should also include a description of the analytical processes used, results from water quality modeling, assumptions and other pertinent information. The technical analysis for the Turtle River watershed TMDLs describes how the fecal coliform and E. coli 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 each Section 303(d) listed waterbody, LDCs were developed for each stream segment.*

Flows for Turtle River segment 019 were determined by utilizing the Drainage-Area Ratio Method (DARM) developed by the USGS. The DARM assumes that the streamflow at the ungauged site is hydrologically similar (same per unit area) to the stream gauging station used as an index. This assumption is justified since the ungauged site (385371) is located on the Turtle River downstream from the index station (USGS gauge 05082625).

Streamflow data for the index station (USGS gauge 05082625) was obtained from the USGS Water Science Center website. This station is located on Turtle River segment 021 and that streamflow data was used to develop the LDC for that segment. Mean daily discharge for segments 024 and 031 were developed using stage and discharge data obtained from water quality sampling sites 385368 and 385369 for the years of 2006 and 2007.

The LDCs were derived for each segment using the discharge record, the fecal coliform and E. coli TMDL targets and the observed bacteria data collected from the four monitoring stations (see Figure 7 of the TMDL document for a map of the monitoring locations).

Observed in-stream fecal coliform bacteria data, obtained from the monitoring stations, were converted to pollutant loads by multiplying fecal coliform bacteria concentrations by the mean daily flow and a conversion factor. These loads were plotted against the percent exceeded of the flow on the day of sample collection (see Figures 8 - 11 in the TMDL document). Points plotted above the 200 cfu/100 mL target curve exceeded the TMDL target. Points plotted below the curve were meeting the previous State water quality standard for fecal coliform of 200 cfu/100 mL.

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

The LDCs represent flow-variable TMDL targets across the flow regimes shown in this TMDL document. For the four Turtle River watershed stream segments covered by this TMDL document, the LDCs are dynamic expressions of the allowable load for any given daily flow. Loading capacities were derived from this approach for each of the listed stream segments at each flow regime. Tables 13 – 20 show the loading capacity load (i.e., TMDL load) for fecal coliform and E. coli for the listed segments in the Turtle River watershed.

Comments: *None.*

4.1 Data Set Description

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

Review Elements:

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

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

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

Summary*: The Turtle River, South Branch Turtle River and North Branch Turtle River TMDL data description and summary are included in the Available Data section (Section 1.5) and in the data tables in Appendix A. Recent water quality monitoring was conducted from May 2006 – September 2007 and included 53 fecal coliform samples at each of the four Turtle River stations 385368, 385369, 385370 and 385371. The data set also includes the flow record from USGS gauging station 05082625 as well as the flow data collected at sampling stations 385368 and 385369. The flow data, the fecal coliform data and the TMDL targets, were used to develop the fecal coliform load duration curves for the four segments of the Turtle River watershed. No E. coli samples have been collected in this watershed, but the flow record and the E. coli target was used to create LDCs for the four impaired stream segments.*

Comments: *None.*

4.2 Waste Load Allocations (WLA):

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

Review Elements:

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

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

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

Summary: *There are two wastewater treatment facilities within the larger watershed boundaries of the Turtle River watershed. One is located in Larimore, ND and the other is the Grand Forks Air Force Base. The Larimore facility has no reported discharges filed with the NDPDES Program. Grand Forks Air Force Base (GFAFB) is partially located in the contributing watershed of TMDL listed segment ND-09020307-019-S_00. However, the GFAFB lagoons are permitted to discharge into the Kelly Slough which drains to a segment downstream of the listed segment.*

There are four permitted animal feeding operations (AFOs) within the drainage area of the listed stream segments of the Turtle River. The NDDoH has permitted one large (1,000 + animal units (AUs)), one medium (301-999 AUs), and two small (0-300 (AUs)) AFOs to operate. All four AFOs are zero discharge facilities and are not deemed a significant point source of fecal coliform or E. coli bacteria loadings to the Turtle River.

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

Comments: *None.*

4.3 Load Allocations (LA):

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

Review Elements:

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

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

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

Summary: *The TMDL document includes the landuse breakdown for the watershed based on the 2007 National Agricultural Statistics Service (NASS) data. In 2007, the dominant land use in the Turtle River watershed was agriculture. Approximately 57 percent of the landuse in the watershed was cropland, 18 percent was grassland / pastureland, 13 percent was wetlands and the remaining 12 percent was either developed space, barren or woods. The majority of the crops grown consisted of soybeans, corn, spring wheat, sunflowers and dry beans.*

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

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

Livestock production is not dominant agricultural practice in the watershed but unpermitted AFOs, livestock grazing and watering in proximity to the listed stream segments and its tributaries do exist and may be a contributor of bacteria within the Turtle River watershed.

By relating runoff characteristics to each flow regime one can infer which sources are most likely to contribute to fecal coliform bacteria loading. "Wastes from failing septic systems enter surface waters either as overland flow or via groundwater. Although loading to streams is likely to be a continual source, wet weather events can increase the rate of transport of pollutants (i.e., fecal coliform bacteria) from failing septic systems because of the wash-off effect from runoff and the increased rate of groundwater recharge" (Bureau of Water, 2010). Animals grazing in the riparian area contribute fecal coliform bacteria by depositing manure where it has an immediate impact on water quality. Due to the close proximity of manure to the stream or by direct deposition in the stream, riparian grazing impacts water quality at high flow or under moist and dry conditions.

Source specific data are limited so aggregate LAs are assigned to nonpoint sources with a ranking of important contributors under various flow regimes provided as seen in the following excerpted table. Aggregate load allocations for each of the impaired segments in the Turtle River watershed are included in Tables 13 - 20 of the TMDL document.

Table 11. Nonpoint Sources of Pollution and Their Potential to Pollute at a Given Flow Regime.

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

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

Comments: *None.*

4.4 Margin of Safety (MOS):

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

Review Elements:

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

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

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

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

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

Summary: *The Turtle River, South Branch Turtle River and North Branch Turtle River TMDL document includes explicit MOSs for each of the listed segments in the watershed. The MOSs were derived by calculating 10 percent of the loading capacity for each segment. The explicit MOSs for the Turtle River watershed segments are included in Tables 13 - 20 of the TMDL document.*

Comments: *None.*

4.5 Seasonality and variations in assimilative capacity:

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

Review Elements:

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

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

Summary: *By using the load duration curve approach to develop the TMDL allocations seasonal variability in fecal coliform loads are taken into account. The highest steam flows typically occur during late spring, and the lowest stream flows typically occur during the winter months. The TMDL also considers seasonality because the fecal coliform criteria are in effect from May 1 to September 30, as defined by the recreation season in North Dakota.*

Comments: *None.*

5. Public Participation

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

Review Elements:

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

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

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

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

Comments: *None.*

6. Monitoring Strategy

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

Review Elements:

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

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

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

Summary: *To insure that the best management practices (BMP's) and technical assistance that are implemented as part of the Section 319 Turtle River watershed project are successful in reducing fecal coliform and E. coli bacteria loadings to levels prescribed in this TMDL, water quality monitoring will be conducted in accordance with an approved 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.

Review Elements:

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

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

Summary: *In response to the Turtle River Watershed Assessment and in anticipation of this completed TMDL, local sponsors successfully applied for and received Section 319 funding for the Turtle River watershed project. Beginning in May 2009, local sponsors have been providing technical assistance and implementing BMPs designed to reduce fecal bacteria and E. coli loadings and to help restore the beneficial uses of Turtle River (i.e., recreation). As the watershed restoration project progresses, water quality data are collected to monitor and track the effects of BMP implementation as well as to judge overall success of the project in reducing fecal coliform and E. coli bacteria loadings. A QAPP will be developed as part of this watershed restoration project that details the how, when and where monitoring will be conducted to gather the data needed to document success in meeting the TMDL implementation goal(s). As the data are gathered and analyzed, watershed restoration tasks will be adapted, if necessary, to place BMPs where they will have the greatest benefit to water quality and in meeting the TMDL goal(s).*

Comments: *None.*

8. Daily Loading Expression

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

Review Elements:

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

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

Summary: *The Turtle River, South Branch Turtle River and North Branch Turtle River TMDL document includes daily loads expressed as colony forming units per day for the listed stream segments in the watershed. The daily TMDL loads for each segment are included in TMDL section (Section 7.0) of the document.*

Comments: *None.*