E. coli Bacteria TMDL for Turtle Creek in McLean County, North Dakota

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1.0 INTRODUCTION AND DESCRIPTION OF THE WATERSHED

The Turtle Creek watershed is a 129,537 acre sub-watershed of the Painted Woods-Square Butte Creek sub-basin (hydrologic unit code 10130101) located in central North Dakota (Figure 1). The Section 303(d) listed reach of Turtle Creek, which is the focus of this report, is a 27.46 mile segment beginning in the northeastern portion of McLean County just below Lake Ordway downstream to its confluence with the Missouri River south of Washburn, North Dakota. The Turtle Creek Section 303(d) listed segment lies within the Northwestern Glaciated Plains (42) level III ecoregion.

Table 1. General Characteristics of the Turtle Creek Watershed.

Legal Name	Turtle Creek
Stream Classification	Class III
Major Drainage Basin	Missouri
8-Digit Hydrologic Unit	10130101
County	McLean
Level III Ecoregions	Northwestern Glaciated Plains (42)
Watershed Area (acres)	129,537

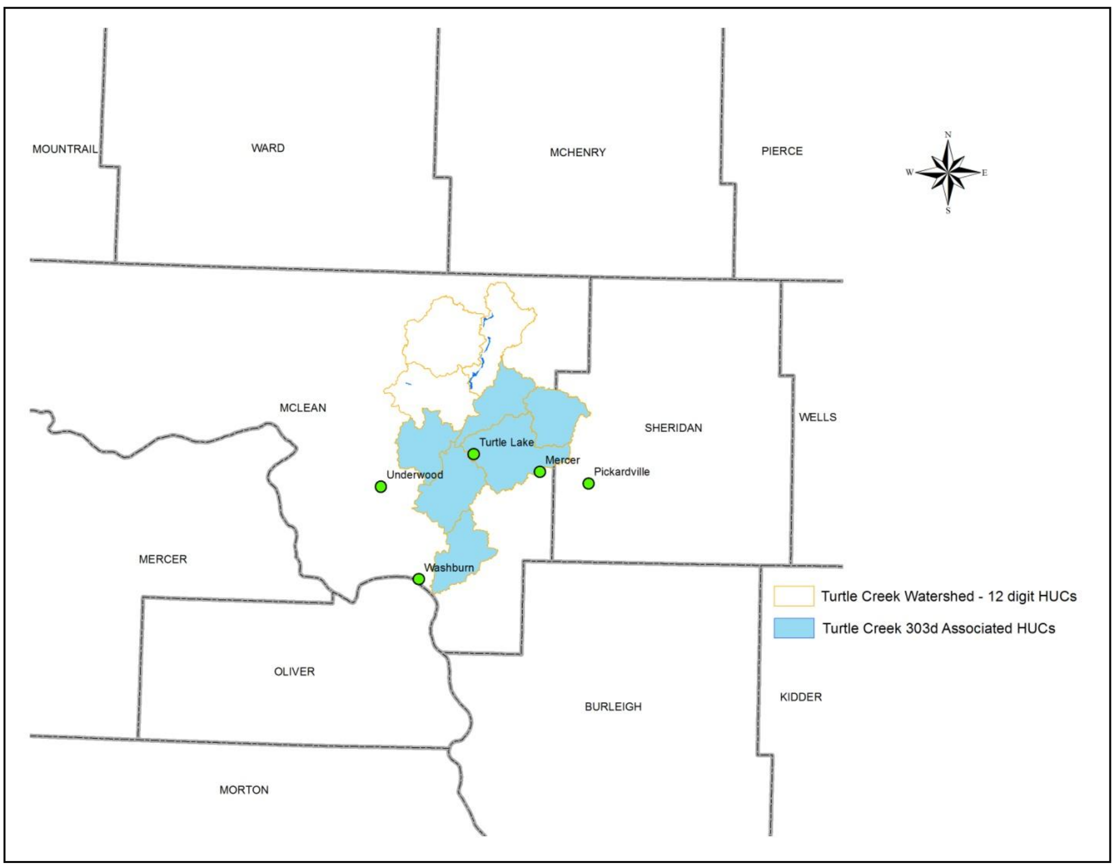

Figure 1. Turtle Creek Watershed in North Dakota.

1.1 Clean Water Act Section 303(d) Listing Information

Based on the 2014 Section 303(d) List of Impaired Waters Needing TMDLs (NDDoH, 2014), the North Dakota Department of Health (NDDoH) has identified a 27.46 mile segment (ND-10130101-020-S_00) of the Turtle Creek from below Lake Ordway downstream to its confluence with the Missouri River as not supporting for recreational uses. The impairments are due to Escherichia coli (E. coli) (Table 2, Figure 2).

Table 2. Turtle Creek Section 303(d) Listing Information for Assessment Unit ID ND-10130101-020-S_00 (NDDoH, 2014).

Assessment Unit ID	ND-10130101-020-S_00
Waterbody Description	Turtle Creek from Lake Ordway downstream to its confluence with the Missouri River
Size	27.46 miles
Designated Use	Recreation
Use Support	Not Supporting
Impairment	Escherichia coli (E. coli) bacteria
TMDL Priority	High

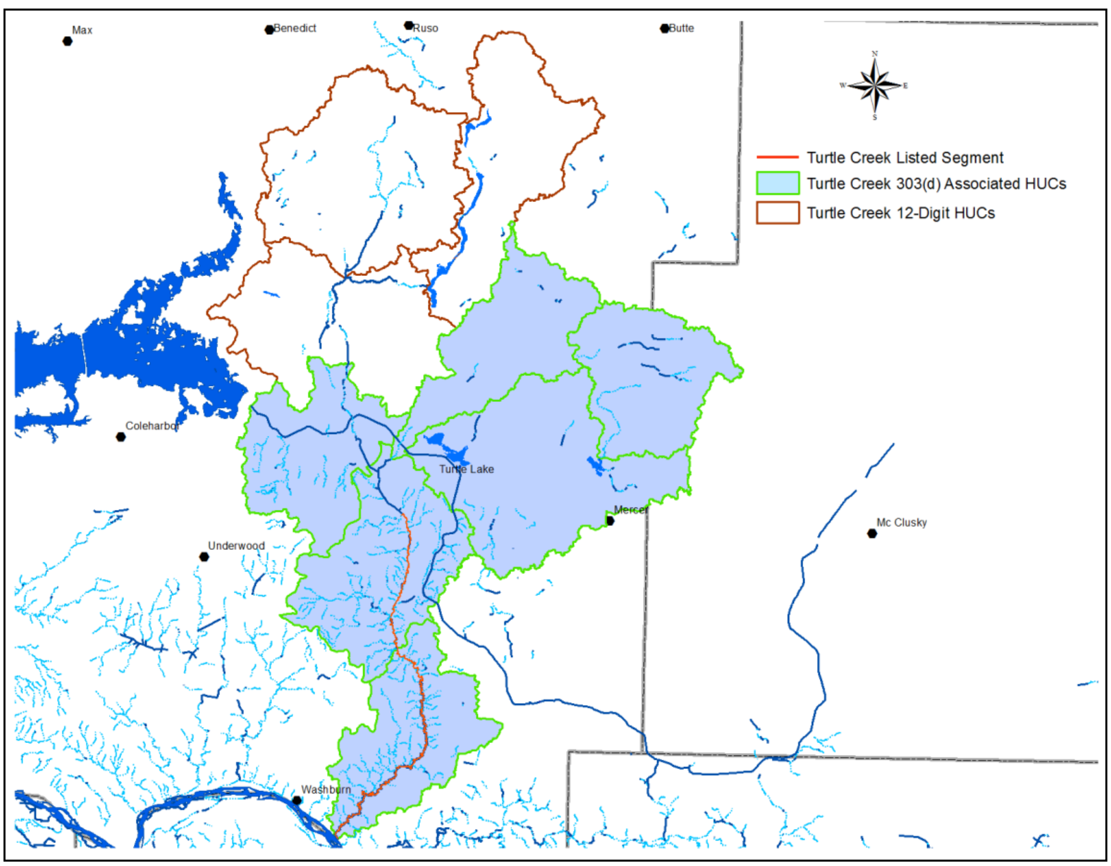

Figure 2. Turtle Creek TMDL Listed Segment.

1.2 Ecoregions

The watershed for the Section 303(d) listed segment highlighted in this TMDL lies within the Northwestern Glaciated Plains level III ecoregion. The Northwestern Glaciated Plains ecoregion marks the westernmost extent of continental glaciation. The youthful morainal landscape has significant surface irregularity and high concentrations of wetlands. The rise in elevation along the eastern boundary defines the beginning of the Great Plains. Land use is transitional between the intensive dryland farming to the east and the predominance of cattle ranching and farming to the west (USGS, 2013).

Specifically, the upper portion of the Turtle Creek watershed lies within the Missouri Coteau (42a) and Collapsed Glacial Outwash (42b) level IV ecoregions. The rolling hummocks of the Missouri Coteau enclose countless wetland depressions or potholes. During its slow retreat, the Wisconsinan glacier stalled on the Missouri escarpment for thousands of years, melting slowly beneath a mantle of sediment to create the characteristic pothole topography of the Missouri Coteau. Land use on the Missouri Coteau is a mixture of tilled agriculture in flatter areas and grazing land on steeper slopes. Areas of the Collapsed Glacial Outwash ecoregion formed from gravel and sand deposited by glacial meltwater and precipitation runoff over stagnant ice. Many large, shallow lakes are found in these areas; these lakes and wetlands tend to be slightly to very alkaline depending upon the flowpath of groundwater moving through the permeable outwash deposits (USGS, 2013).

The Section 303(d) listed segment of Turtle Creek lies within the Missouri Coteau Slope (42c) level IV. Unlike the Missouri Coteau (42a) where there is a paucity of streams, the Missouri Coteau Slope has a simple drainage pattern and fewer wetland depressions. Due to the level to gently rolling topography, there is more cropland in the Missouri Coteau Slope (42c) than in the Missouri Coteau (42a). Cattle graze on the steeper land that occurs along drainages (USGS, 2013).

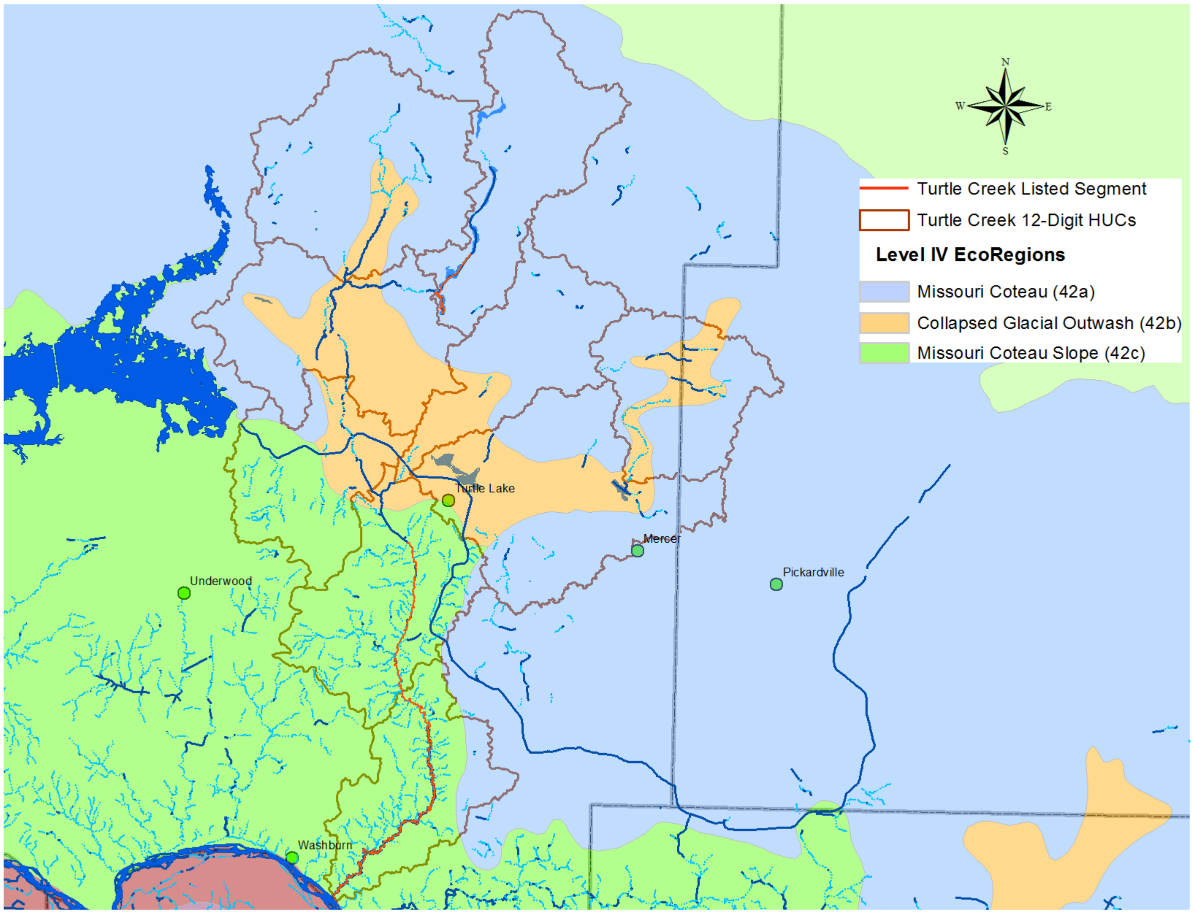

Figure 3. Level IV Ecoregions in the Turtle Creek Watershed and TMDL Listed Segment.

1.3 Land Use

The dominant land use in the Turtle Creek watershed is row crop agriculture. According to the 2010 National Agricultural Statistical Service (NASS, 2010) land survey data, approximately 42 percent of the contributing watershed is active cropland, 38 percent watershed is pasture/grassland/hayland, ten (10) percent water/wetlands, four (4) percent developed/open space, and five (5) percent in other land uses. The majority of the crops grown consist of soybeans, corn, spring wheat, sunflowers, and dry beans (Figure 4).

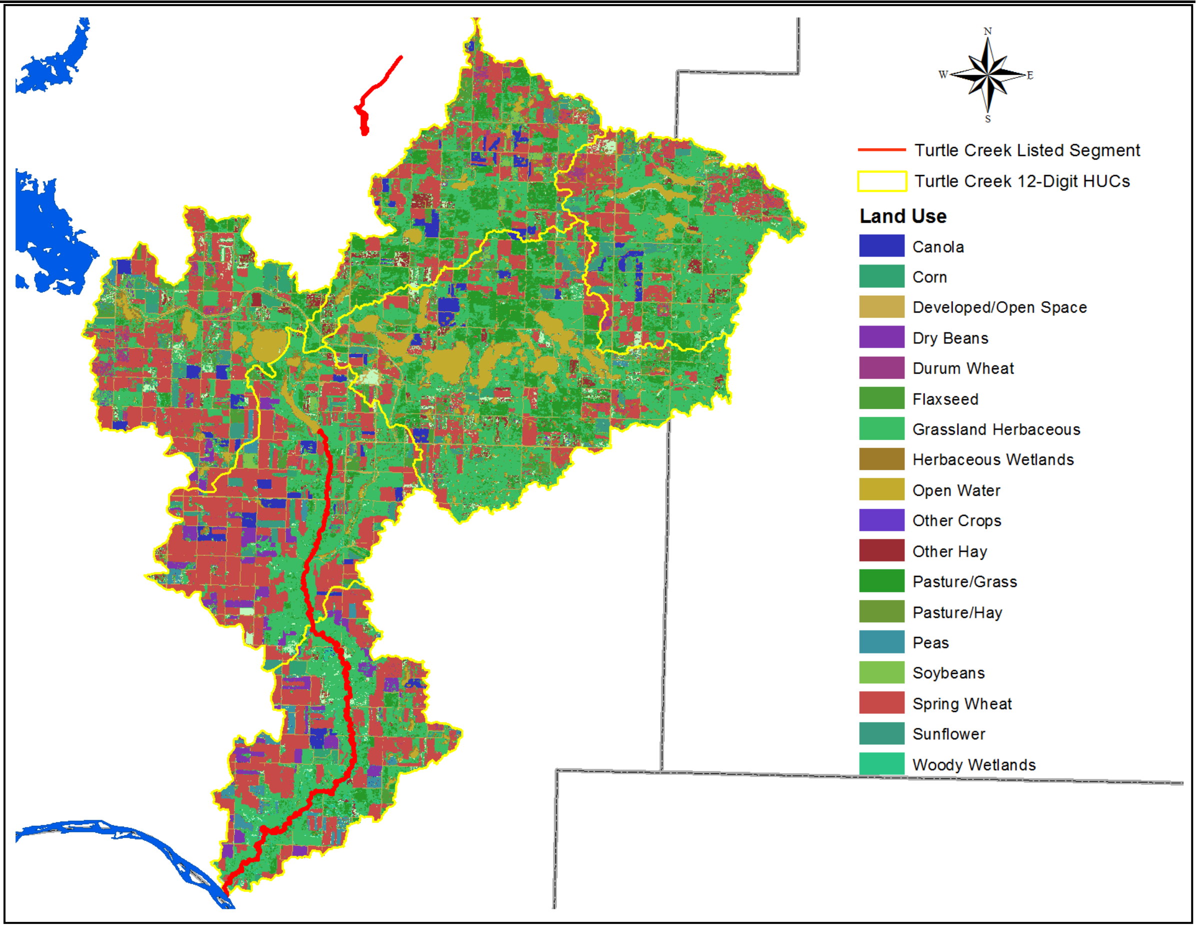

Figure 4. Land Use in the Turtle Creek Watershed (NASS, 2010).

1.4 Climate and Precipitation

Figures 5 and 6 show the average monthly precipitation and average temperature for the Turtle Lake, ND (McLean County) High Plains Regional Climate Center station from 1912 - 2013. McLean County has a subhumid climate characterized by warm summers with frequent hot days and occasional cool days. Average temperatures range from 12° F in winter to 67° F in summer. Precipitation occurs primarily during the warm period and is normally heavy in later spring and early summer. Average total precipitation is 17.12 inches annually.

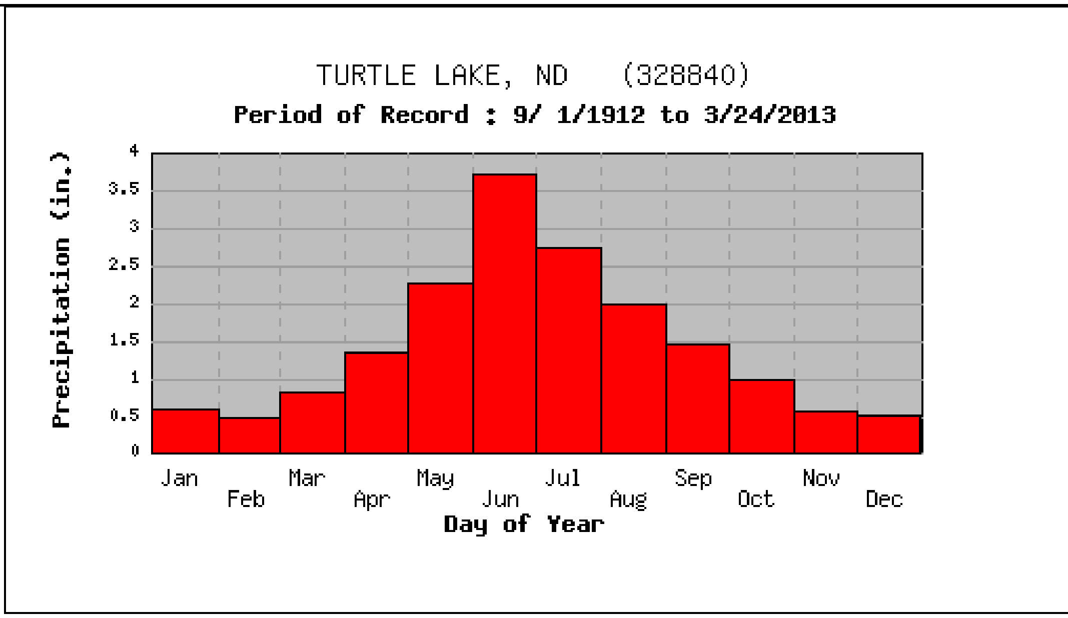

Figure 5. Average Monthly Precipitation at Turtle Lake, North Dakota from 1912 - 2013 (High Plains Regional Climate Center).

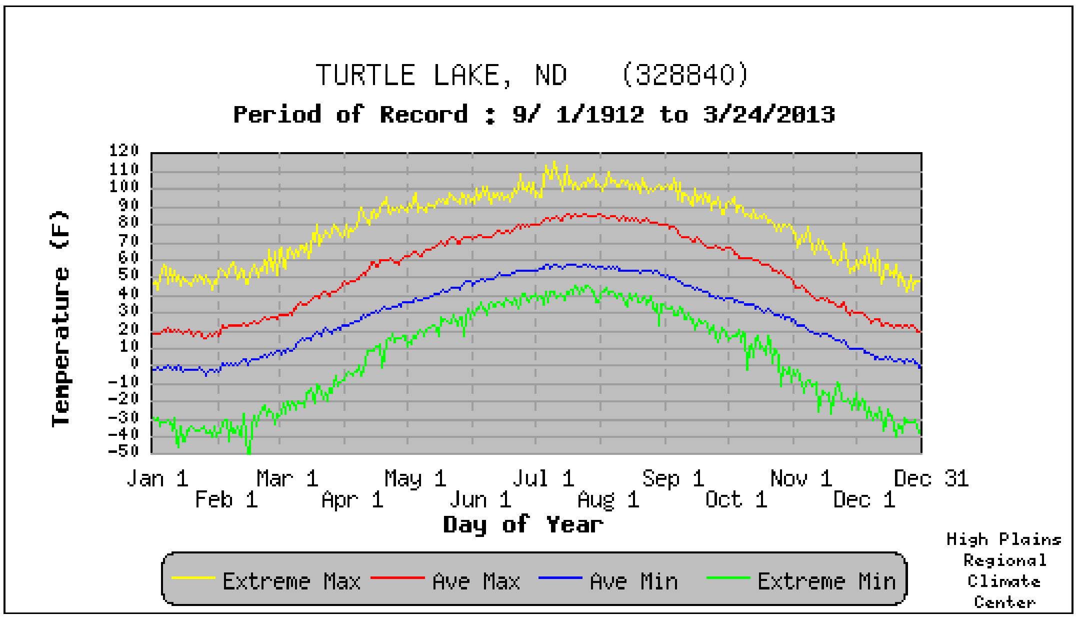

Figure 6. Average Monthly Air Temperature Maximums and Minimums at Turtle Lake, North Dakota from 1912-2013 (High Plains Regional Climate Center).

1.5 Available Data

1.5.1 E. coli Bacteria Data

E. coli bacteria samples were collected at two locations within the TMDL listed reach (Figure 7). Monitoring site 385550 is located on Highway 200, two miles downstream of Lake Ordway. Monitoring site 385551 is located on the County Highway 21, two miles east of Washburn. Sites 385550 and 385551 were monitored weekly when flow conditions were present during the recreation season (May-September) in 2010 and 2011.

Each monitoring station was sampled by personnel from the South McLean Soil Conservation District.

Tables 3 and 4 provide a summary of E. coli geometric mean concentrations, the percentage of samples exceeding 409 CFU/100 mL for each month and the recreational use assessment by month. The geometric mean E. coli bacteria concentration and the percent of samples over 409 CFU/100 mL were calculated for each month (May-September) by pooling samples results for each month in both 2010 and 2011.

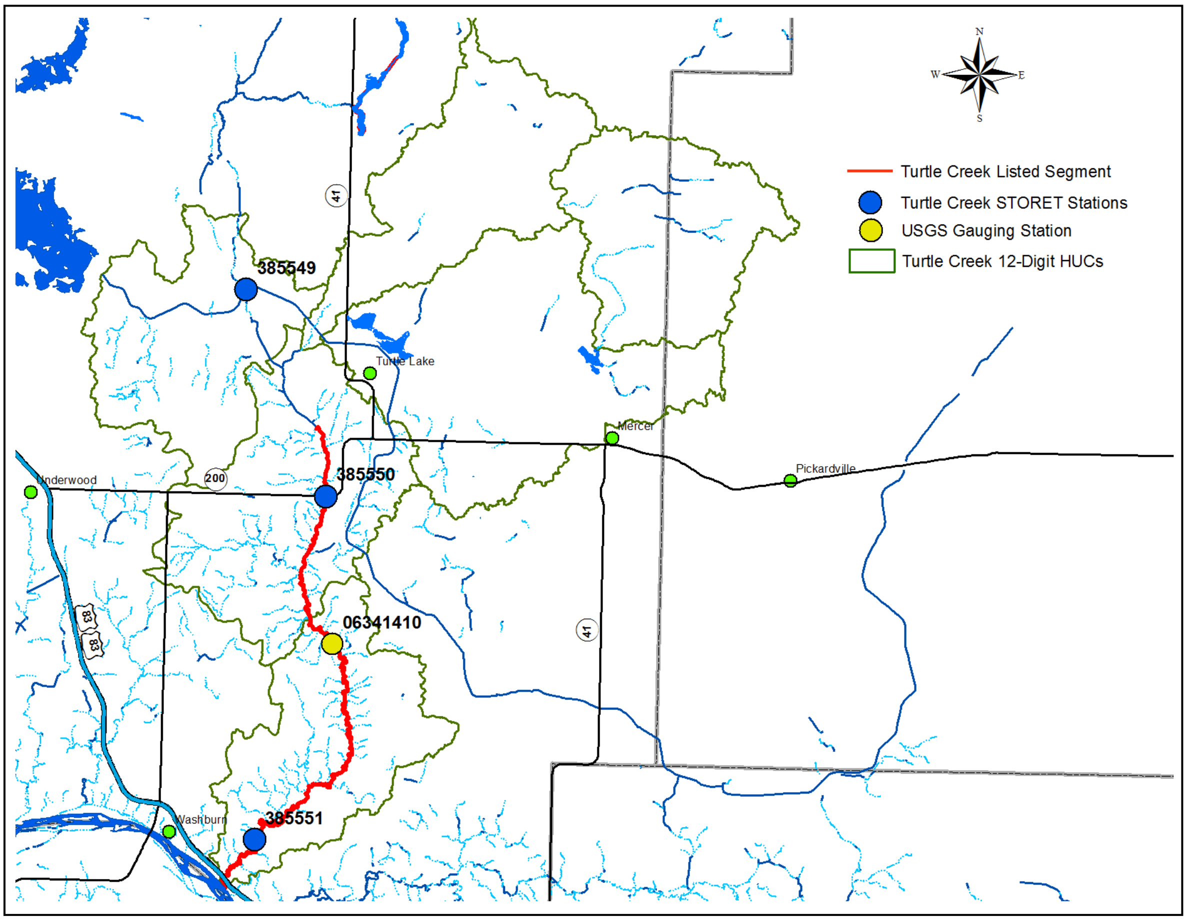

Figure 7. Turtle Creek Monitoring Sites and USGS Gauging station.

Table 3. Summary of E. coli Bacteria Data for Site 385550 Data Collected in 2010 and 2011.

Month	N	Geometric Mean Concentration (CFU/100 mL)	Percentage of Samples Exceeding 409 CFU/100 mL	Recreational Use Assessment
May	4	22.58	0%	Fully Supporting
June	10	108.5	10%	Fully Supporting but Threatened
July	7	74.58	0%	Fully Supporting
August	9	115.93	0%	Fully Supporting
September	6	448.89	50%	Not Supporting

Table 4. Summary of E. coli Bacteria Data for Site 385551 Data Collected in 2010 and 2011.

Month	N	Geometric Mean Concentration (CFU/100 mL)	Percentage of Samples Exceeding 409 CFU/100 mL	Recreational Use Assessment
May	3	66.94	33%	Fully Supporting but Threatened
June	10	420.36	50%	Not Supporting
July	7	399.20	29%	Not Supporting
August	9	179.02	44%	Not Supporting
September	6	632.63	50%	Not Supporting

Levels of bacteria varied throughout the watershed. All sites experienced elevated levels of E. coli bacteria in excess of state water quality guidelines. Also, both sites exceeded the state standards where more than 10% of the samples exceeded 409 CFU/100 mL for E. coli bacteria. There were large peaks in bacteria concentrations at all sites in mid to late summer. It should be noted that all samples were analyzed for E. coli based on an "raw" undiluted samples. In some cases, the E. coli concentration in the undiluted sample exceeded the analytical reporting limit of 800 CFU/100 mL and the result was reported as "too numerous to count." In these cases the sample was diluted 1:10 and the result from the diluted sample was used in the calculations of the geometric mean and load duration curve.

<u>1.5.2 Hydraulic Discharge</u>

Due to an extreme spring runoff event and subsequent damage to stage and flow equipment in 2010 and 2011, daily discharge records could not be directly estimated for the downstream sampling site 385551. Therefore, the daily stream discharge record was developed using using the Drainage Area Ratio Method (Ries et al., 2000) and daily discharge data obtained from USGS station 06341410 located in between sites 385550 and 385551 (Figure 7).

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 E.coli 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, 2014).

- 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, 2014).

2.2 Numeric Water Quality Standards

The Turtle Creek is a Class III stream. The NDDoH definition of a Class III stream is shown below (NDDoH, 2014).

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

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Table 5 provides a summary of the current numeric E. coli criteria as it applies to Class III streams. The E. coli bacteria standard applies only during the recreation season from May 1 to September 30.

Table 5. North Dakota E. coli Bacteria Water Quality Standards for Class III Streams.

Parameter	Standard	
	Geometric Mean[1]	Maximum[2]
E. coli Bacteria	126 CFU/100 mL	409 CFU/100 mL

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

3.0 TMDL TARGET

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 TMDL target for the Turtle Creek segment is based on the State water quality standards for E. coli bacteria. The E. coli bacteria water quality standard of 126 CFUs/100 mL is now the current applicable water quality standard for bacteria and the TMDL target for the impaired TMDL segment. In addition, no more than ten percent of the samples may exceed 409 CFUs/100 mL for E. coli bacteria. While the 126 CFUs/100 mL E. coli criterion is intended to be expressed as a 30-day geometric mean, for purposes of this TMDL, it is expressed as the daily average concentration based on individual grab samples. Expressing the E. coli TMDL in this way will ensure the TMDL will result in the target being met during all flow regimes, the criterion 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

While there are no point sources which discharge directly to the impaired stream segment, the city of Turtle Lake has a two cell sewage lagoon located in the Turtle Creek watershed. There have been three reported discharges to this wetland under the city's NDPDES permit. Due to the limited nature of the discharges and the unlikely chance of the discharge reaching the Turtle Creek, which is seven miles southwest of the wetland, no waste load allocation will be provided in the TMDL.

There are two permitted animal feeding operations (AFOs) in the target watershed of the Turtle Creek. The AFOs are zero discharge facilities and are not deemed a significant point source of E. coli bacteria loadings to the Turtle Creek.

4.2 Nonpoint Source Pollution Sources

The TMDL listed segment which is the focus of this report is experiencing E. coli bacteria pollution from nonpoint sources located in the watershed. Livestock production is not the dominant agricultural practice in the watershed, but unpermitted animal feeding operations

(AFOs), “hobby farms” with fewer than 100 animals, and livestock grazing, watering and manure application in close proximity to the Turtle Creek and its tributaries may exist and could be a contributor. Due to the close proximity of these unpermitted AFOs, “hobby farms”, and livestock grazing and watering near the creek, it is likely that these sources contribute to E. coli bacteria loading to Turtle Creek.

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

Wildlife may also contribute to the 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.

Septic system failure might also contribute to E. coli bacteria loading to Turtle Creek. Septic system 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 (USEPA, 2002).

5.0 TECHNICAL ANALYSIS

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

The loading capacity or total maximum daily load (TMDL) is the amount of a pollutant (e.g. E. coli bacteria) a waterbody can receive and still meet and maintain water quality standards and beneficial uses. The following technical analysis addresses the reductions necessary to achieve the water quality standard target for E. coli bacteria of 126 CFU/100 mL with a margin of safety.

5.1 Mean Daily Stream Flow

In central North Dakota, rain events are variable generally occurring during the months of April through 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 site 385551, representing TMDL segments ND-10130101-020-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 (385551) is located immediately downstream from the index station (06341410) on the same stream reach.

Streamflow data for the index station (06341410) for the period 1986-2003 was obtained from the USGS Water Science Center website. The index station (06341410) 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 (Emerson, Vecchia, and Dahl, 2005) to obtain estimated flow statistics for the ungauged site.

5.2 Flow Duration Curve Analysis

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

A basic flow duration curve runs from high to low (0 to 100 percent) along the x-axis with the corresponding flow value on the y-axis (Figure 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 19.6 cfs, implies that 25 percent of all observed mean daily discharge values equal or exceed 19.6 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 (E. coli bacteria in this case) (USEPA, 2007).

As depicted in Figure 8, the flow duration curve for site 385551, representing TMDL segment ND-10130101-020-S_00, was divided into five zones, one representing high flows (0-7 percent), wet conditions (8-36 percent), moist conditions (37-68 percent) low flows (69-87 percent) and no flows (88-100 percent).

These flows intervals were defined by examining the range of flows for the site for the period of record and then by looking for natural breaks in the flow record based on the flow duration curve plot (Figure 8). A secondary factor in determining the flow intervals used in the analysis is the number of E. coli. bacteria observations available for each flow interval.

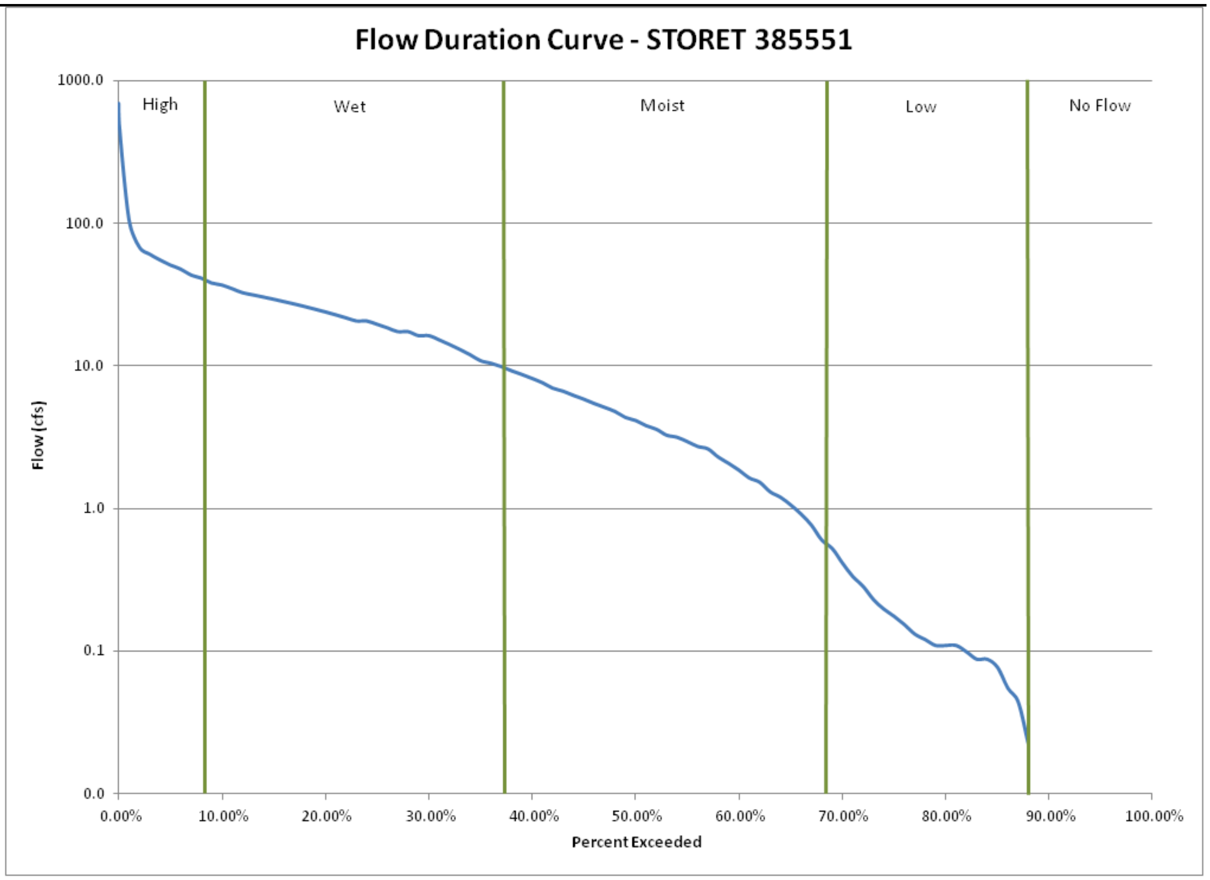

Figure 8. Flow Duration Curve for the Turtle Creek Monitoring Station 385551 Located near Turtle Lake, North Dakota.

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 the Turtle Creek TMDL listed segment. The load duration curve for the TMDL listed reach was derived using the E. coli bacteria TMDL target of 126 CFU/100 mL and the flows generated as described in Sections 5.1 and 5.2. (Figure 9).

Observed in-stream total E. coli bacteria data obtained from monitoring site 385551 (Appendix A) were converted to a pollutant load by multiplying total E. coli 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 9). Points plotted above the 126 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 126 CFU/100 mL.

For each flow interval or zone, a regression relationship was developed between the samples which occur above the TMDL target (126 CFU/100 mL) curve and the corresponding percent exceeded flow. The load duration curve for site 385551 depicting the regression relationship for each flow interval is provided in Figure 9. As there were no E. coli bacteria concentrations above the TMDL target in the low and no flow regimes for site 385551, a regression relationship and existing load could not be calculated for these flow regimes. The regression lines for the high, moist and dry condition flows for site 385551 were used with the midpoint of the percent exceeded flow for that interval to calculate the existing total E. coli bacteria load for that flow interval. For example, in the example provided in Figure 9, the regression relationship between observed E. coli bacteria loading and percent exceeded flow for the moist condition, and dry condition flow interval are:

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

Where the midpoint of the high flow condition interval from 0 to 7 percent is 3.5 percent, the existing E. coli bacteria load is:

E. coli bacteria load (10^7 CFUs/day) = antilog (5.28 + (-6.58*0.35))
= 113,409 x 10^7 CFUs/day

Where the midpoint of the moist condition interval from 8 to 35 percent is 21.5 percent, the existing E. coli bacteria load is:

E. coli bacteria load (10^7 CFUs/day) = antilog (5.28 + (-3.59*0.215))
= 31,041 x 10^7 CFUs/day

Where the midpoint of the dry condition interval from 36 to 65 percent is 50.5 percent, the existing E. coli bacteria load is:

E. coli bacteria load (10^7 CFUs/day) = antilog (5.01 + (-2.38*0.505))
= 5,781 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 (3.5, 22 and 52.5 percent) exceeded flow derived from the 126 CFU/100 mL TMDL target curves are 17,641 x 10^7 CFUs/day, 6,721 x 10^7 CFUs/day and 1,075 x 10^7 CFUs/day respectively.

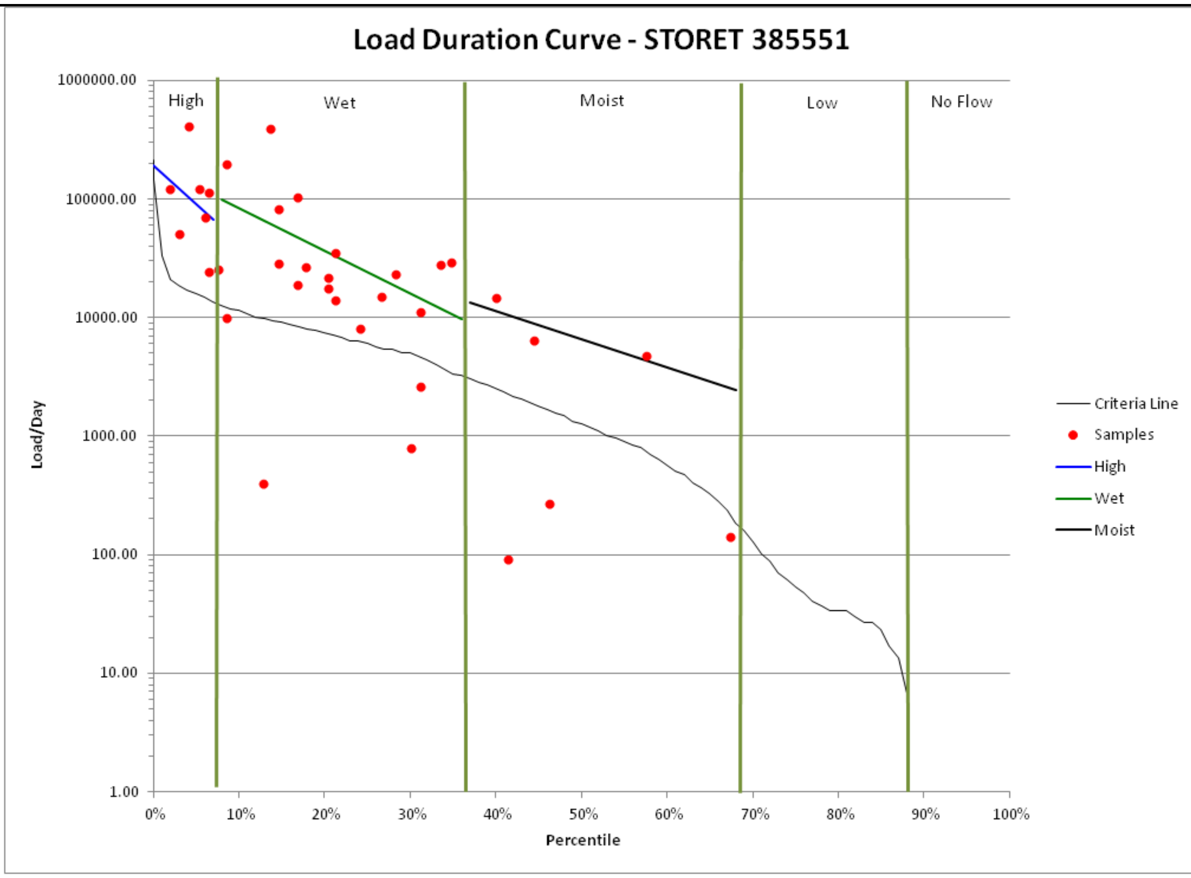

Figure 9. E. coli Bacteria Load Duration Curve for the Turtle Creek Monitoring Station 385551.

5.4 Loading Sources

The load reductions needed for the Turtle Creek E. coli 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 stream segment (ND-10130101-020-S_00). Furthermore, the one permitted point source, the City of Turtle Lake, discharges to a wetland which is then connected to a tributary which is located seven mile northeast of Turtle Creek.

Based on the nonpoint source described in Section 4.2, 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 Creek.

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 E. coli bacteria standard were observed in three flow regimes (i.e., High flow, Wet and Moist Conditions) at site 385551, representing assessment unit ND-10130101-020-S_00 (Figure 9).

By relating runoff characteristics to each flow regime one can infer which sources are most likely to contribute to E. coli 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 E. coli 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 6). 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 6). 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 E. coli bacteria contamination.

Table 6. Nonpoint Sources of Pollution and Their Potential to Pollute at a Given Flow Regime.

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

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

6.0 MARGIN OF SAFETY AND SEASONALITY

6.1 Margin of Safety

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency (EPA) regulations require that "TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numerical water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality." The margin of safety (MOS) can be either incorporated into conservative assumptions used to develop the TMDL (implicit) or added to a separate component of the TMDL (explicit).

To account for the uncertainty associated with known sources and the load reductions necessary to reach the TMDL target of 126 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 TMDL included in this report address seasonality because the flow duration curve for the Turtle Creek (ND-10130101-020-S_00 was developed using seventeen years (1986-2003) of discharge 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 E. coli bacteria loads during the season covered by the standard.

7.0 TMDL

Table 7 provides an outline of the critical elements of the bacteria TMDL for the listed segment. The E. coli TMDL for the Turtle Creek (ND-10130101-020-S_00) is summarized in Table 8. The TMDL provides a summary of average daily loads by flow regime necessary to meet the water quality target (i.e. TMDL). The TMDL for the segment and flow regime provides an estimate of the existing daily load, and an estimate of the average daily loads necessary to meet the E. coli bacteria water quality 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 7. TMDL Summary for the Turtle Creek Segment ND-10130101-020-S_00.

Category	Description	Explanation
Beneficial Use Impaired	Recreation	Contact Recreation (i.e. swimming, fishing)
Pollutant	E. Coli Bacteria	See Section 2.1
TMDL Target	126 CFU/100 mL	Based on North Dakota water quality standards
WLA		There are no contributing point sources in the watershed.
LA	Nonpoint Source Contributions	Loads are a result of nonpoint sources (i.e., rangeland, pasture land, etc.)
Margin of Safety (MOS)	Explicit	10 percent

TMDL = LC = WLA + LA + MOS

where

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

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

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

MOS = margin of safety, or an accounting of 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 8. E. coli Bacteria TMDL (10^7 CFU/day) for the South Branch Turtle Creek Waterbody ND-10130101-020-S_00.

	Flow Regime			
	High Flow	Moist Condition	Dry Condition	Low Flow
Existing Load	113,409	31,041	5,781	NA
TMDL	17,641	6,721	1,075	37
WLA	0	0	0	NA
LA	15,895	6,049	967	NA
MOS	1,746	672	108	NA

8.0 ALLOCATION

Since there are no known point source discharges to the TMDL listed segments, the entire E. coli 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, (USEPA, 2001). This TMDL plan is put forth as a recommendation for what needs to be accomplished for the Turtle Creek and associated watersheds to restore and maintain its recreational uses. Water quality monitoring should continue in order to measure

BMP effectiveness and determine through adaptive management if loading allocation recommendations need to be adjusted.

Nonpoint source pollution is the sole contributor to elevated E. coli bacteria levels in the Turtle Creek watershed. The E. coli bacteria samples and load duration curve analysis of the impaired reach identified the high, moist and dry condition flow regimes for TMDL segment ND-10130101-020-S_00 as the time of E. coli bacteria exceedences for the 126 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 9-11 that will mitigate the effects of E. coli 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 E. coli bacteria loading to Turtle Creek. The following describe in detail those BMPs that will reduce E. coli bacteria levels in Turtle Creek.

Table 9. 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 E. coli bacteria. Land application of septic system sludge, although unlikely, may also be a source of contamination.

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

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

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 10) 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 E. coli bacteria loading originating from confined animal feeding areas (Table 10). 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 10. Bacterial Water Quality Response to Four Grazing Strategies (Tiedemann et al., 1988).

Grazing Strategy		Geometric Mean E. coli 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, E. coli bacteria to streams. The effectiveness of filter strips and other BMPs in removing E. coli bacteria is quite successful. Results from a study by Pennsylvania State University (1992) as presented by USEPA (1993) (Table 11), suggest that vegetative filter strips are capable of removing up to 55 percent of E. coli bacteria loading to rivers and streams (Table 11). 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 11. Relative Gross Effectiveness[a] of Confined Livestock Control Measures (Pennsylvania State University, 1992).

Practice[b] Category	Runoff[c] Volume	Total[d] Phosphorus (%)	Total[d] Nitrogen (%)	Sediment (%)	E. coli (%)
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 letter was sent to the following agencies and/or organizations notifying them that the draft report was available for review and public comment. Those included in the mailing were as follows:

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

In addition to notifying specific agencies of this draft TMDL report's availability, the report was posted on the North Dakota Department of Health, Division of Water Quality web site at: http://www.ndhealth.gov/WQ/SW/Z2_TMDL/TMDLs_Under_PublicComment/B_Under_Public_Comment.htm . A 30 day public notice soliciting comment and participation was also published in the McLean County Indepentent.

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

10.0 MONITORING

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

To ensure that the BMP's that are implemented and the technical assistance that is provided as a part of any watershed restoration program are successful in reducing 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).

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

11.0 TMDL IMPLEMENTATION STRATEGY

In response to the Turtle Creek Watershed Assessment and in anticipation of this completed TMDL, local sponsors successfully applied for and received Section 319 funding for the Turtle Creek watershed project. Beginning in November 2013, local sponsors began providing technical assistance and implementing BMPs designed to reduce E. coli loadings and to help restore the beneficial uses of Turtle Creek (i.e., recreation). As the watershed restoration project progresses, water quality data are collected to monitor and track the effects of BMP implementation as well as to judge overall success of the project in reducing 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).

Also, as a part of any implementation plan for this TMDL, it is recommended that permitted point sources (i.e. CAFOs, AFOs, and NDPDES permit holders) in the watershed be inspected to ensure that they are being operated in compliance with their permit conditions, and to verify that they are not a significant E. coli bacteria source. Currently, it is the policy of the NDDoH that all permitted CAFOs (greater than or equal to 1000 animal units) be inspected annually. Permitted AFOs (<1000 animal units) in the Turtle Creek watershed are inspected on an as needed basis.

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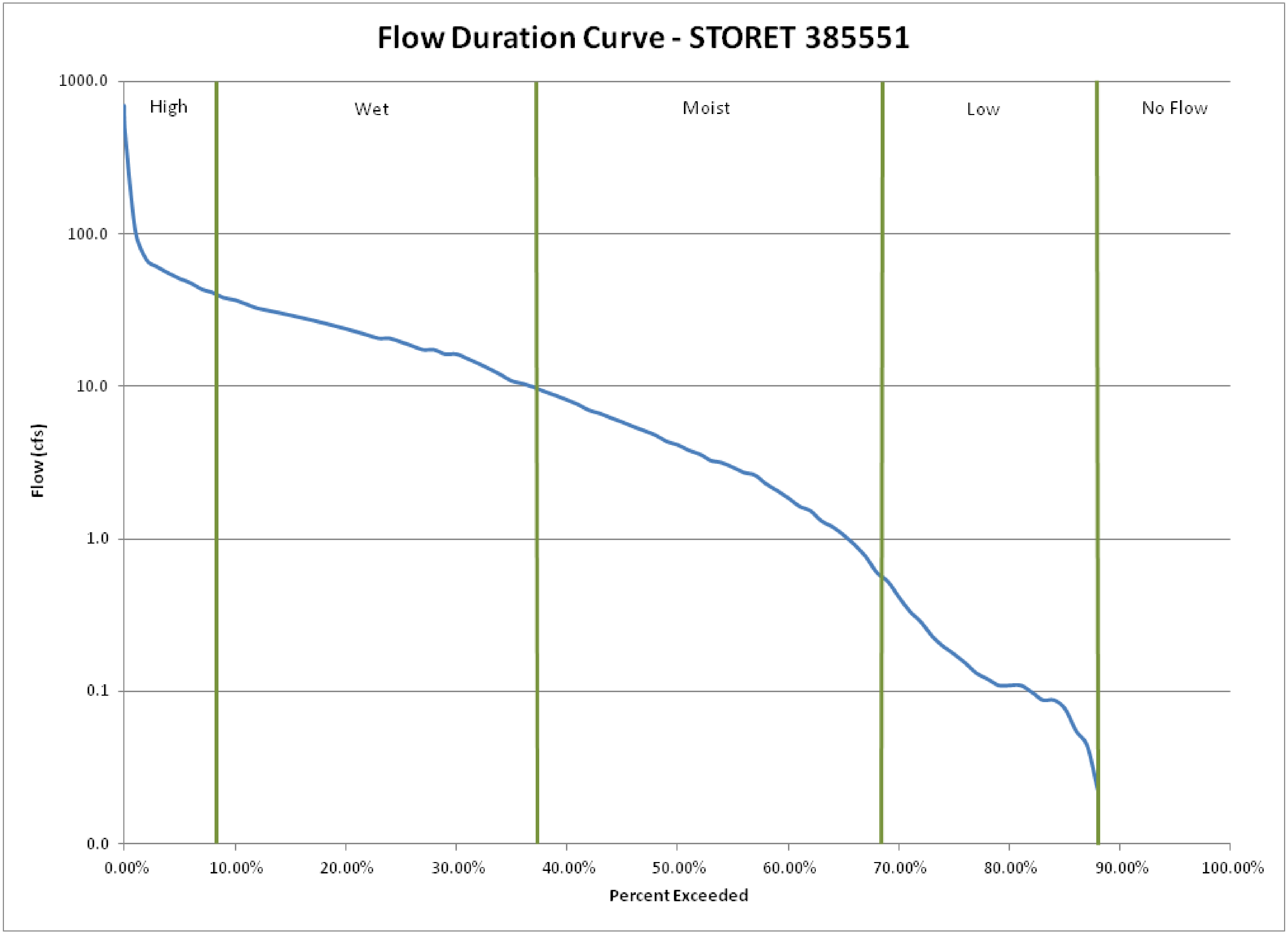
Appendix A
Summary of E. coli Bacteria Data Collected for Sites 385550 and 3855511 in 2010 and 2011

385550	May		June		July		August		September	
	5/3/2010	10	6/2/2010	40	7/7/2010	80	8/3/2010	70	9/1/2010	310
	5/11/2010	10	6/8/2010	20	7/13/2010	60	8/10/2010	210	9/7/2010	5300
	5/17/2010	20	6/15/2010	340	7/20/2010	90	8/18/2010	60	9/14/2010	190
	5/24/2010	130	6/21/2010	250	7/26/2010	110	8/25/2010	190	9/21/2010	420
			6/28/2010	350	7/11/2011	30	8/1/2011	70	9/29/2010	520
			6/1/2011	120	7/19/2011	50	8/9/2011	80	9/6/2011	120
			6/6/2011	80	7/26/2011	180	8/15/2011	140		
			6/13/2011	450			8/23/2011	240		
			6/20/2011	220			8/29/2011	120		
			6/27/2011	10						
Geometric Mean	22.58		108.50		74.58		115.93		448.89	
% Exceeded 409	0%		10%		0%		0%		50%	
Recreational Use	FS		FST		FS		FS		NS	
# of Samples	4		10		7		9		6	

385551	May		June		July		August		September	
	5/3/2010	20	6/2/2010	300	7/7/2010	300	8/3/2010	1100	9/1/2010	380
	5/11/2010	10	6/8/2010	160	7/13/2010	340	8/10/2010	10	9/7/2010	5100
	5/25/2010	1500	6/15/2010	710	7/20/2010	240	8/18/2010	210	9/14/2010	630
			6/21/2010	600	7/26/2010	1000	8/25/2010	100	9/21/2010	370
			6/29/2010	1000	7/11/2011	400	8/1/2011	70	9/29/2010	330
			6/1/2011	80	7/19/2011	550	8/9/2011	20	9/6/2011	430
			6/6/2011	780	7/26/2011	300	8/15/2011	800		
			6/13/2011	2000			8/23/2011	730		
			6/20/2011	270			8/29/2011	1000		
			6/27/2011	250						
Geometric Mean	66.94		420.36		399.20		179.02		632.63	
% Exceeded 409	33%		50%		29%		44%		50%	
Recreational Use	FST		NS		NS		NS		NS	
# of Samples	3		10		7		9		6	

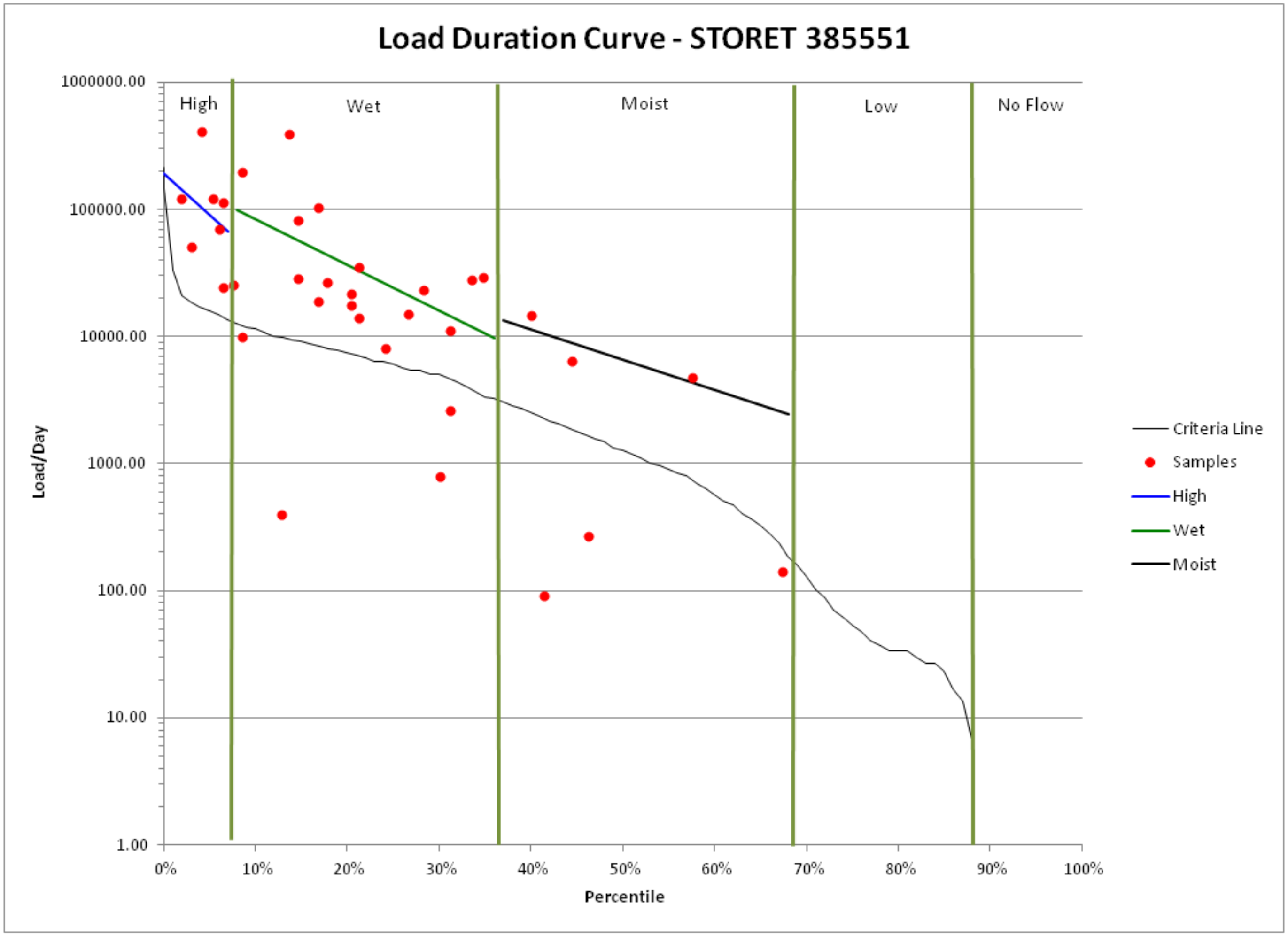
[1]FS=Fully Supporting, [2]FST=Fully Supporting, but Threatened, [3]NS=Nonsupporting.

Appendix B
Flow Duration Curve for Site 385551


Flow Duration Curve - STORET 385551
High
Wet
Moist
Low
No Flow
1000.0
100.0
10.0
1.0
0.1
0.0
Flow (cfs)
0.00%
10.00%
20.00%
30.00%
40.00%
50.00%
60.00%
70.00%
80.00%
90.00%
100.00%
Percent Exceeded

Appendix C
Load Duration Curve, Estimated Load, TMDL Target, and Percentage of Reduction Required for Site 385551

	Load (kg/Day)				Load (kg/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
High	3.50%	113408.51	17641.32	25.55	2897587.35	450735.64	84.44%
Wet	22.00%	31040.80	6721.14	102.20	3172369.91	686900.67	78.35%
Moist	52.50%	5780.76	1075.38	113.15	654092.94	121679.55	81.40%



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

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
1595 Wynkoop Street
Denver, CO 80202-1129
Phone 800-227-8917
www.epa.gov/region08

APR 26 2016

Ref: 8EPR-EP

Dave Glatt, Chief
Environmental Health Section
North Dakota Department of Health
918 East Divide Avenue
Bismarck, North Dakota 58501-1947

Re: Approval of the Turtle Creek *E. coli* TMDL; ND-10130101-020-S_00

Dear Mr. Glatt,

The U.S. Environmental Protection Agency has completed review of the total maximum daily load (TMDL) submitted by your office for the water body listed in the enclosure to this letter. In accordance with the Clean Water Act (33 U.S.C. §1251 *et. seq.*), the EPA approves all aspects of the TMDL referenced above as developed for the water quality limited water body as described in Section 303(d)(1). Based on our review, the EPA feels the separate elements of the TMDL listed in the enclosed table adequately address the pollutant of concern as given in the table, taking into consideration seasonal variation and a margin of safety.

Thank you for submitting this TMDL for our review and approval. If you have any questions, please contact Brent Truskowski on my staff at (303) 312-6235.

Sincerely,

Martin Hestmark
Assistant Regional Administrator
Office of Ecosystems Protection
and Remediation

Enclosures:
1. Turtle Creek *E. coli* TMDL Summary Table
2. Turtle Creek *E. coli* TMDL Decision Document

cc: Mr. Mike Ell,
North Dakota Department of Health, Division of Water Quality

Waterbody and Stream Description	Waterbody ID	Cause of Impairment	Pollutant Addressed by TMDL	State Action	TMDL End Points		Wasteload Allocation		Load Allocation		MOS	TMDL
					Indicator	Threshold Values	WLA	Permitted Facility (Permit Number)	Probable Source	LA		
Turtle Creek from Lake Ordway downstream to its confluence with the Missouri River.	ND-10130101-020-S_00	*Escherichia coli*	*E. coli*	TMDL	*E. coli* concentration	Geometric mean <= 126 CFU/100 mL	0 CFU/100 mL	N/A - The three permitted facilities in the watershed are not likely to contribute to the load in the impaired segment of Turtle Creek. See Enclosure 2, Section 4.1.	Nonpoint sources (i.e. rangeland, pastureland, etc.)	6,049 x 10^7 CFU/day	672 x 10^7 CFU/day	6,721 x 10^7 CFU/day

Notes:

Impairment causes are taken from NDDoH's 2014 303(d) list

Geometric mean - The State water quality standard for *E. coli* bacteria is a geometric mean concentration of 126 CFU/100 mL during the recreation season of May 1st through September 30th

CFU = colony forming units

WLA = wasteload allocation

LA = load allocation

MOS = margin of safety

The load shown represent the load during the moist flow regime as defined by the load duration curve for Turtle Creek, ND-10130101-020-S_00 (see Figure 9 and Table 8 in the TMDL document).

Number of TMDLs Approved:	1
Number of Impairments Addressed by TMDLs:	1
Number of Impairments Proposed for Delisting:	0

ENCLOSURE 2

EPA REGION 8 TMDL REVIEW FORM AND DECISION DOCUMENT

TMDL Document Info:

Document Name:	**E. coli Bacteria TMDL for Turtle Creek in McLean County, North Dakota**
Submitted by:	**North Dakota Department of Health Division of Water Quality**
Date Received:	**December 1, 2015**
Review Date:	**December 2015**
Reviewer:	**Brent Truskowski, EPA Region 8**
Rough Draft / Public Notice / Final Draft?	**Final**
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: *Based on the review presented below, I recommend approval of the final TMDL submitted by the North Dakota Department of Health.*

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

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

Each of the following eight sections describes the factors that EPA Region 8 staff considers when reviewing TMDL documents. Also included in each section is a list of EPA's 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 North Dakota Department of Health sent EPA the *E. coli Bacteria TMDL for Turtle Creek in McLean County, North Dakota* (TMDL document) on September 5, 2014, informing the EPA of its status as a Public Notice Draft. The transmittal letter requested a request for our review by October 9, 2014. EPA provided comments on June 4, 2015. The North Dakota Department of Health revised the TMDL document and submitted it for approval on December 1, 2015.

Comments: No comments.

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: The TMDL document identifies Turtle Creek in McLean County as the waterbody for which the TMDL is being established. In particular the segment is identified as the 27.46 mile segment starting just below Lake Ordway downstream to the confluence with the Missouri River south of Washburn, North Dakota identified with the Assessment Unit ID as ND-10130101-020S_00 by the State. The TMDL document identifies E. coli bacteria as the pollutant impairing the recreational uses in this segment. The TMDL Priority from the State 303(d) list is "high".

In the TMDL document, Figures 1 and 2 show the location of the segment in North Dakota, Figure 3 shows the segment in relation to the Level IV ecoregions, and Figure 4 shows the land use in the Turtle Creek watershed.

Comments: No comments.

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, all TMDL documents must be written to meet the existing water quality standards for that waterbody (CWA §303(d)(1)(C)). *Note: In some circumstances, the load reductions determined to be necessary by the TMDL analysis may prove to be infeasible and may possibly indicate that the existing water quality standards and/or assessment methodologies may be erroneous. However, the TMDL must still be determined based on existing water quality standards. Adjustments to water quality standards and/or assessment methodologies may be evaluated separately, from the TMDL.*

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

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

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

Summary: Section 2.0 of the TMDL document describes the water quality standards which are applicable to the segment. Section 2.1 provides the narrative standards applicable to all waters in the state, including an anti-degradation requirement. Section 2.2 provides the numeric water quality standards for the segment for E. coli. Turtle Creek is identified as a Class III stream, suitable for agriculture and industrial uses.

The current numeric E. coli criteria as it applies to Class III streams is as follows and is applicable only during the recreation season from May 1 to September 30. Note that although the NDDoH E. coli standards are expressed as the number of organisms per 100 mL of the sample, most laboratories report bacteria analytical results as the number of colony forming units per 100 mL (CFU/100 mL)

North Dakota E. coli Bacteria Water Quality Standards for Class III Streams.

Parameter	Standard	
	Geometric Mean[1]	Maximum[2]
E. coli Bacteria	126 CFU/100 mL	409 CFU/100 mL

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

Comments: No comments.

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: Section 3.0 describes the TMDL target as the numeric WQS of 126 CFU/100 mL, the current geometric mean standard for the segment. The target is based on the geometric mean in order to ensure that the target is met for all flow regimes.

Comments: No comments.

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: Section 4.0 of the TMDL document identifies the potential sources of E. coli pollution in the watershed. Section 4.1 states that there are no identified point sources that discharge directly to the listed segment of Turtle Creek. The one municipal wastewater treatment facility in the watershed, Turtle Lake, discharges outside of the impaired segment. There are two permitted animal feeding operations in the watershed, but the operations are zero discharge facilities, and aren't considered to be a significant point source of E. coli loading to the impaired segment by the State.

Section 4.2 of the TMDL document discusses the possible sources of nonpoint source pollution in the segment. The TMDL document identifies septic system failure, wildlife, manure application, and livestock in AFOs and hobby farms as potential sources of E. coli.

The City of Turtle Lake has a two cell sewage lagoon located in the Turtle Creek watershed. There have been discharges from the lagoon under the city's NPDES permit, however the lagoons are located seven miles from Turtle Creek and it is very unlikely that the discharges will reach Turtle Creek since the discharge is into a wetland which then discharges to a tributary which flows to Turtle Creek.

Comments: No comments.

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	=	Waste Load 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, waste load, 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: Section 5.1 of the TMDL document describes the flow data used to set the TMDL. The TMDL document uses sampling from site 385551 to represent the segment, this site however doesn't have a flow gauge. Due to the ungaged site 385551, the TMDL document describes and uses the Drainage-Area Ratio Method developed by USGS to develop flow data for site 385551. The method assumes that the streamflow at an ungauged site such as 385551 is hydrologically similar (same per unit area) to a stream gauging station used as an index. The USGS has a gauged index site (06341410) immediately upstream of monitoring site 385551. Streamflow data for the index station for the period 1986-2003 was obtained from the USGS for the method. The streamflow was divided by the drainage area to obtain streamflow per unit area. These stream flows were then multiplied by the area of the ungauged water quality site to obtain an estimate of streamflow at site 385551.

The estimated streamflow was then used to develop the flow duration curve for the TMDL presented in Figure 8. The Flow Duration Curve was then divided into five flow regimes for the purposes of the TMDL, high flow, wet conditions, moist conditions, low flow, and no flow.

The Flow duration Curve was then used to develop a Load Duration Curve. The Load Duration Curve was derived by multiplying the E.coli concentration by the mean daily flow and a conversion factor. The E. coli bacteria concentrations were obtained from monitoring site 385551.

For each flow interval, a regression relationship was developed between the samples which occur above the TMDL target concentration curve. Section 5.3 provides sample calculations to illustrate this method. The loading capacity for each flow regime is represented by the load value on the Load Duration Curve at the midpoint of the flow regime. Table 8 in the TMDL document includes the E. coli loading capacity (i.e., TMDL load) values, which represent each flow regime of the Load Duration Curve for the listed segment. Section 5.4 allocates the load reductions to nonpoint sources of pollution since there are no known point sources which discharge to the segment. This section also describes the various mechanisms by which contamination can reach the segment from each of the probable nonpoint sources identified.

Comments: No comments.

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: Section 1.5 of the TMDL document summarizes the available data collected for this TMDL, Figure 7 shows the locations of each of the data collection sites. E. coli was collected at two sites in the segment, and flow data was collected at a USGS site in the segment. Flow was estimated at the downstream monitoring site using the Discharge Area Ratio Method with data collected at the USGS site.

E. coli data was collected at both the upstream and downstream monitoring sites. These sites were monitored weekly when flow conditions were present during the recreation season in 2010 and 2011. The E. coli data collected is found in Appendix A. Tables 3 and 4 use a calculated geometric mean of data collected in each month and compare the mean to the recreational use standard of 126 CFU/100 mL and the standard of 10% exceeding 409 CFU/100 mL to determine if the segment is meeting water quality standards for any given month.

Comments: No comments.

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 no point sources that discharge directly to the impaired segment. There is one possible point source in the watershed, a two-cell WWTP in the City of Turtle Lake. According to the TMDL document, the WWTP has had three recorded discharges, however these discharges are to a wetland located seven miles from Turle Creek, and it is unlikely that any discharge would reach the impaired segment of Turtle Creek. The Waste Load Allocation for point sources within the drainage area of the segment was therefore set as zero.

Comments: No comments.

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: There are no point sources that discharge directly to the segment, so all loads ae allocated to non-point sources of pollution. The TMDL document discusses the possible loading as a result of septic systems and livestock. The contribution of septic systems is based on assumption of approximately 28% failure rate. As described in §4.2 of the TMDL document, livestock contributions are assumed to be from unpermitted livestock feeding operations, livestock on stream banks, in streams, and on pasture land. Improper land application of manure is also listed as a possible source of contamination. Table 6 of the TMDL document provides a qualitative estimation of the potential of each of these livestock related non-point sources to contribute to the pollutant load in the segment for each of the flow regimes.

Comments: No comments.

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 waste load 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: An explicit Margin of Safety was calculated as 10% of the TMDL loading capacity as shown for each flow zone in Table 8 of the TMDL document.

Comments: No comments.

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: In §6.2, the TMDL document addresses seasonality and assimilative capacity by including year round flow data, and by using the seasonal WQS to develop the Load Duration Curve.

Comments: No comments.

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 NDDH provided notice to the EPA, NRCS, McLean County Water Resource Board, and the South McLean Soil Conservation District notifying them of a 30 day public comment period. The NDDH also posted the TMDL on the NDDH web site, and published a notice in the McLean County Independent. The final TMDL document includes as Appendix D a copy of the EPA review form with EPA's comments on the draft TMDL document. Appendix E contains responses to each of EPA's comments.

Comments: No comments.

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: The final TMDL document states that water quality monitoring will be conducted as part of a nonpoint source project grant that began implementation in November, 2013.

Comments: No comments.

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: Beginning in November 2013, local sponsors began providing technical assistance and implementing BMPs designed to reduce E. coli loadings and to help restore the beneficial uses of Turtle Creek (i.e., recreation). As the watershed restoration project progresses, water quality data are collected to monitor and track the effects of BMP implementation as well as to judge overall success of the project in reducing E. coli bacteria loadings.

Comments: No comments.

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: In Table 8 of Section 7.0 of the TMDL the E. coli loads are expressed in CFU/day for each of the flow regimes, high, moist, dry, and low flow.

Comments: No comments.