Fecal Coliform Bacteria TMDL for Oak Creek in Bottineau County, North Dakota

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1.0 INTRODUCTION AND DESCRIPTION OF THE WATERSHED

Oak Creek is a subwatershed of the Willow Creek watershed. The Oak Creek watershed is located in Bottineau County, in north central North Dakota (Figure 1). Oak Creek is 82.4 miles long on the North Dakota side of the United States/Canadian border. The headwaters lie in a series of small lakes and wetlands in Manitoba, Saskatchewan, Canada, but a defined stream system is lacking there. The headwater region of Oak Creek in North Dakota is considered to be Lake Metigoshe in northern Bottineau County (Figure 2). The Oak Creek watershed has an area of 88,807 acres. The watershed flows south and empties into Willow Creek for a short distance before Willow Creek empties into the Mouse (Souris) River. Table 1 summarizes some of the geographical, hydrological and physical characteristics of Oak Creek.

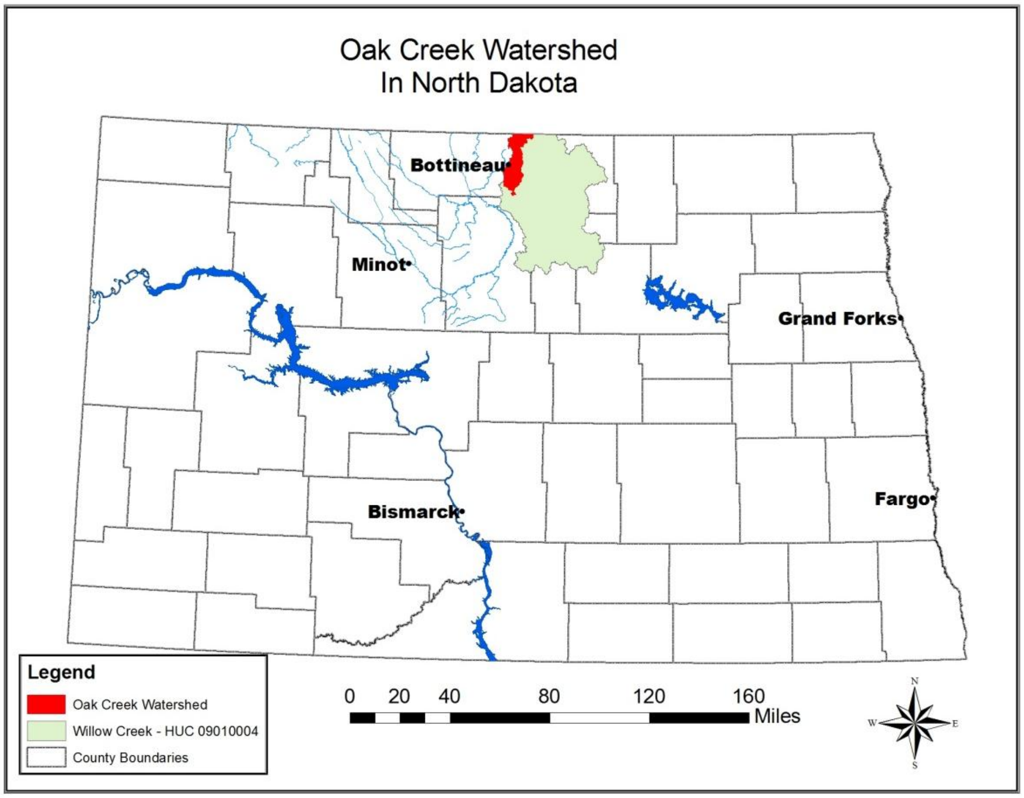

Figure 1. Location of Oak Creek and Its Watershed in North Dakota.

Table 1. General Characteristics of Oak Creek and Its Watershed.

Legal Name	Oak Creek
Stream Classification	Class III
Major Drainage Basin	Souris River
8-Digit Hydrologic Unit	09010004
Counties	Bottineau County
Ecoregions	Northern Glaciated Plains (Level III), Turtle Mountain, Glacial Lake Basin, Glacial Lake Delta, Northern Black Prairie (Level IV)
Watershed Area (acres)	88,807

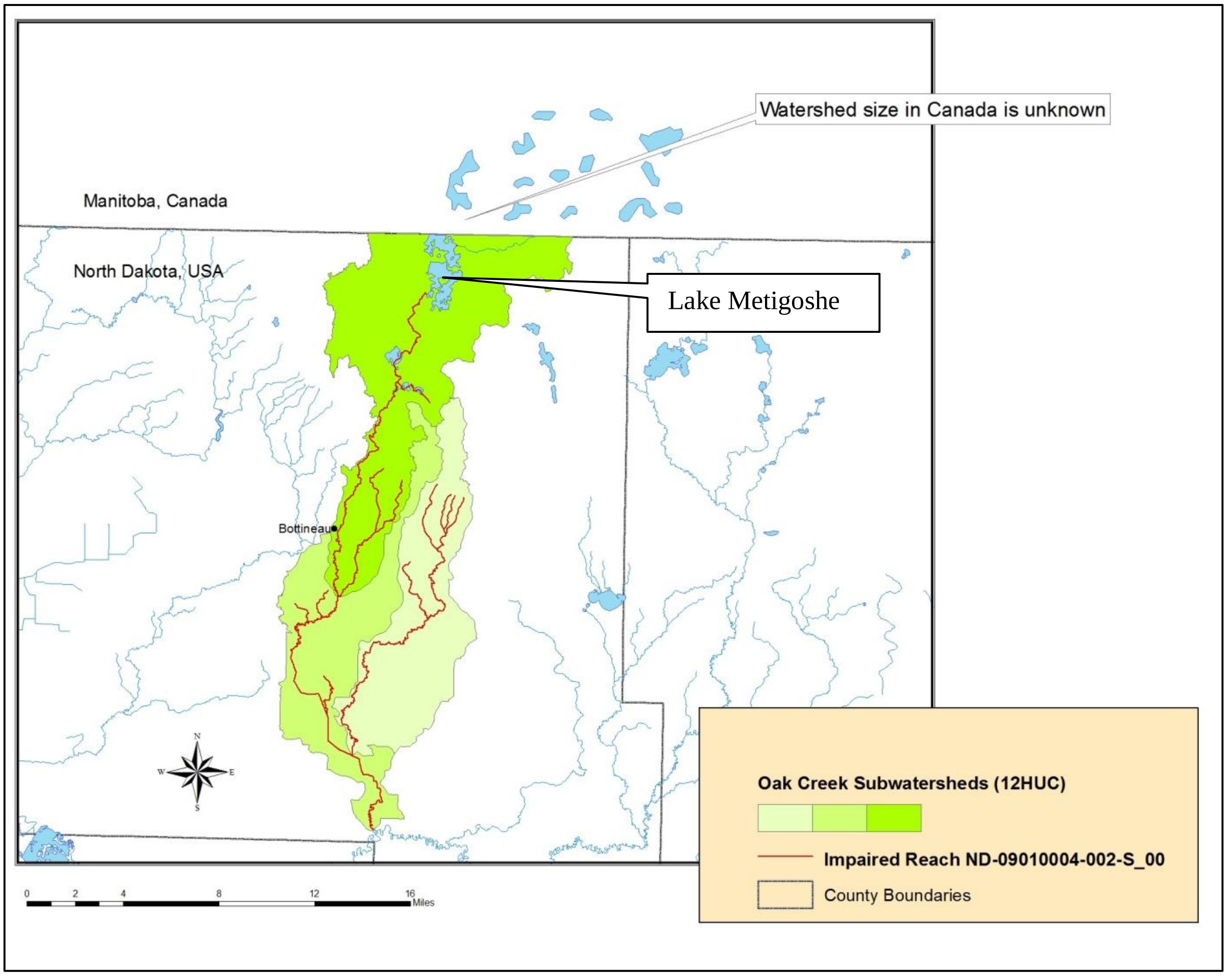

Figure 2. Impaired Reach ND-09010004-002-S_00 (Oak Creek) and Its Watershed.

1.1 Clean Water Act Section 303(d) Listing Information

Based on the 2010 Section 303(d) list of impaired waters needing TMDLs, the North Dakota Department of Health (NDDoH) has identified Oak Creek as fully supporting, but threatened for recreational beneficial use due fecal coliform bacteria

Table 2. 2010 Section 303(d) TMDL Listing Information for Oak Creek.

Assessment Unit ID	ND-09010004-002-S_00
Waterbody Description	Oak Creek, including all tributaries. Located in Bottineau County
Size	82.4 miles
Impaired Designated Uses	Recreation
Use Support	Fully Supporting, but Threatened
Impairment	Fecal Coliform Bacteria
Priority	High

1.2 Ecoregions

Oak Creek is located within the Northern Glaciated Plains level III ecoregion and is split across four level IV ecoregions. The watershed is comprised of approximately 45 percent of the Turtle Mountain (46b), 30 percent of the Glacial Lake Basins (46c), 14 percent of the Northern Black Prairie (46g), and 11 percent of the Glacial Lake Deltas (46d) ecoregions (Figure 3).

The Northern Glaciated Plains are characterized by a flat to gently rolling landscape composed of glacial drift. The subhumid conditions foster a grassland transition between the tall and shortgrass prairie. High concentrations of temporary and seasonal wetlands create favorable conditions for waterfowl. The Turtle Mountain (46b) level IV ecoregion is an undulating landscape with abundant wetlands similar to the Missouri Coteau. However, the Turtle Mountains contain larger, deeper, and more numerous lakes. Additionally, this ecoregion receives about ten inches more precipitation than the surrounding drift plains; thus supports a forest cover of aspen, birch, burr oak, elm and ash. The forest soils are erodible and poorly suited for cropland, though there is some clearing for pastureland. The Glacial Lake Basins (46c) ecoregion was once occupied by proglacial lakes formed when major stream or river drainages were blocked by glacial ice during the Pleistocene. The smooth topography, even flatter than the surrounding drift plains, resulted from the slow buildup of water-laid sediments. The level, deep soils on the lake plains are intensively cultivated. The Glacial Lake Deltas (46d) ecoregion was deposited by rivers entering the glacial lake basins. The heaviest sediments, mostly sand and fine gravel, formed delta fans at the river inlets. As the lake floors were exposed during withdrawal of the glacial ice, wind reworked the sand in some areas into dunes, which have a thin vegetative cover and are at high risk for wind erosion. The Northern Black Prairie (46g) ecoregion represents a broad phenological transition zone marking the introduction from the north of a boreal influence in climate. Aspen and birch appear in wooded areas, willows grow on wetland perimeters, and rough rescue becomes evident in grassland associations. This ecoregion has the shortest growing season and the lowest January temperatures of any level IV ecoregion in the Dakotas (USGS, 2006).

Though the till soil is very fertile, agricultural success is subject to annual climatic fluctuations. The soils present belong to the Order Mollisols and are comprised of many different series. Many of the soils are droughty and used mainly for pasture. (USEPA, et al. 1998)

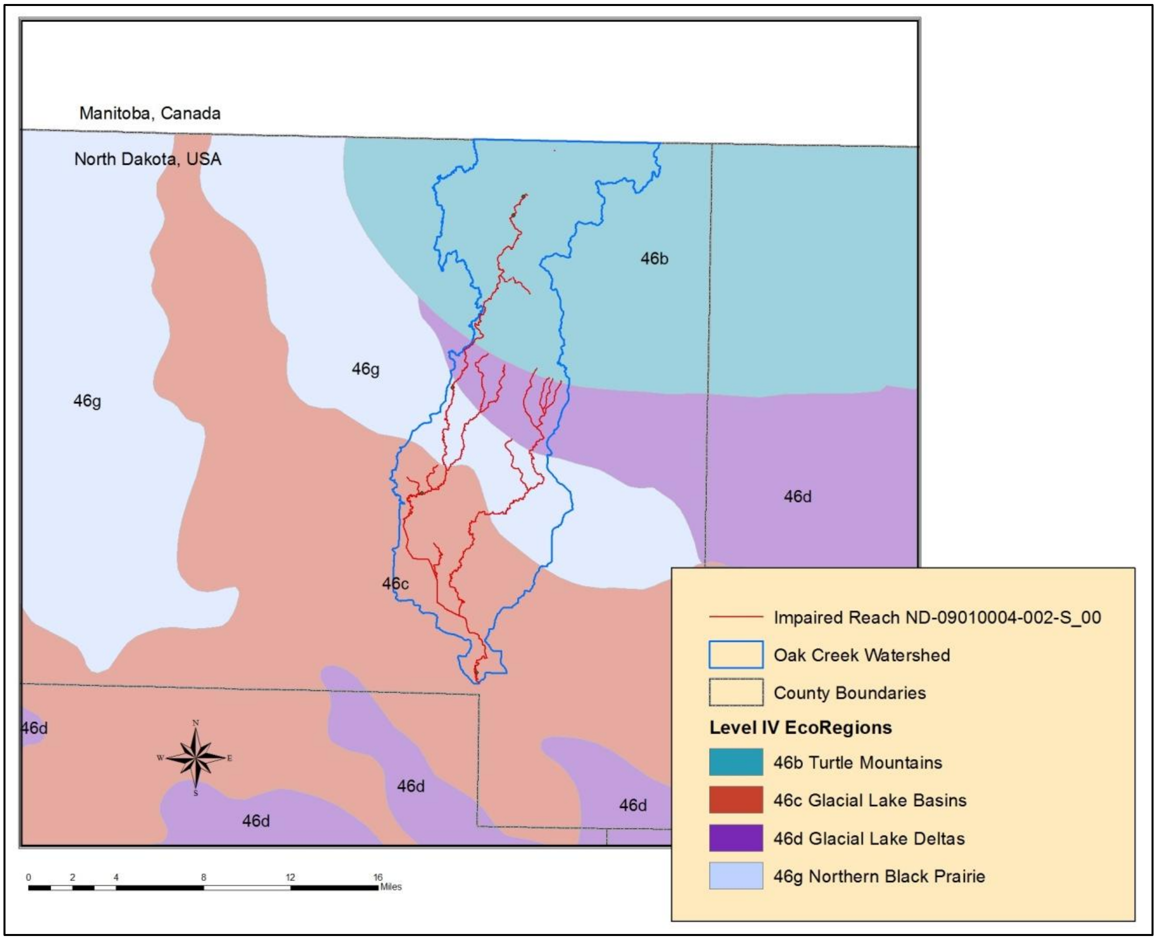

Figure 3. Level IV Ecoregions of Oak Creek Watershed.

1.3 Land Use/Land Cover

Land use data from the North Dakota Agricultural Statistics Service (NDASS, 2005) indicates that the watershed is primarily agricultural (80.2 percent), consisting of crop production and livestock grazing (Figure 4). Approximately 44 percent of the agricultural land is actively cultivated, tilled mainly for small grains and soybeans, and a variety of other crops (Tables 3 and 4). Approximately 36 percent of the watershed is pasture/range/haylands, two percent is low density urban development, while water and woods make up more than 17 percent of the watershed.

There are no confined animal feeding operations (CAFOs) within the contributing drainage, but there are three permitted animal feeding operations (AFOs), one medium and two small, which are zero discharge operations. The number of non-permitted animal feeding operations is unknown, but thought to be significant as a high proportion of the watershed is in pasture and range land use. While all CAFOs must obtain a permit, only those AFOs that have the potential to impact water quality are required to obtain a permit. For more details on operations requiring a permit, please refer to North Dakota State Century Code, Chapter 33-16-03.1-05.

Table 3. Major Land Use Categories in the Section 303(d) Listed Oak Creek Watershed (based on 2005 NDASS data).

Major Category	Acres	Percent of Watershed
Agriculture/Cultivated	39,519.1	44.5 %
Pasture/Range/Hay	31,704.1	35.7 %
Urban/Barren/Fallow	2,131.4	2.4 %
Water	8,880.7	10.0 %
Woods	6,571.7	7.4 %

Table 4. Land Use Types in the Section 303(d) Listed Oak Creek Watershed (based on 2005 NDASS data).

Land Use Type	Acres	Percent of Watershed
Wheat/Small Grains	24,155.5	27.2 %
Soybeans	11,633.7	13.1 %
Canola	2,042.6	2.3 %
Sunflowers	888.1	1.0 %
Flax	444.0	0.5 %
Beans/Peas	177.6	0.2 %
Mustard	177.6	0.2 %
Fallow	710.5	0.8 %
Pasture/Range	29,217.5	32.9 %
Hay/Alfalfa	2,486.6	2.8 %
Water	8,880.7	10.0 %
Woods	6,571.7	7.4 %
Urban	1,420.9	1.6 %
TOTAL	**88,807.0**	**100.0**

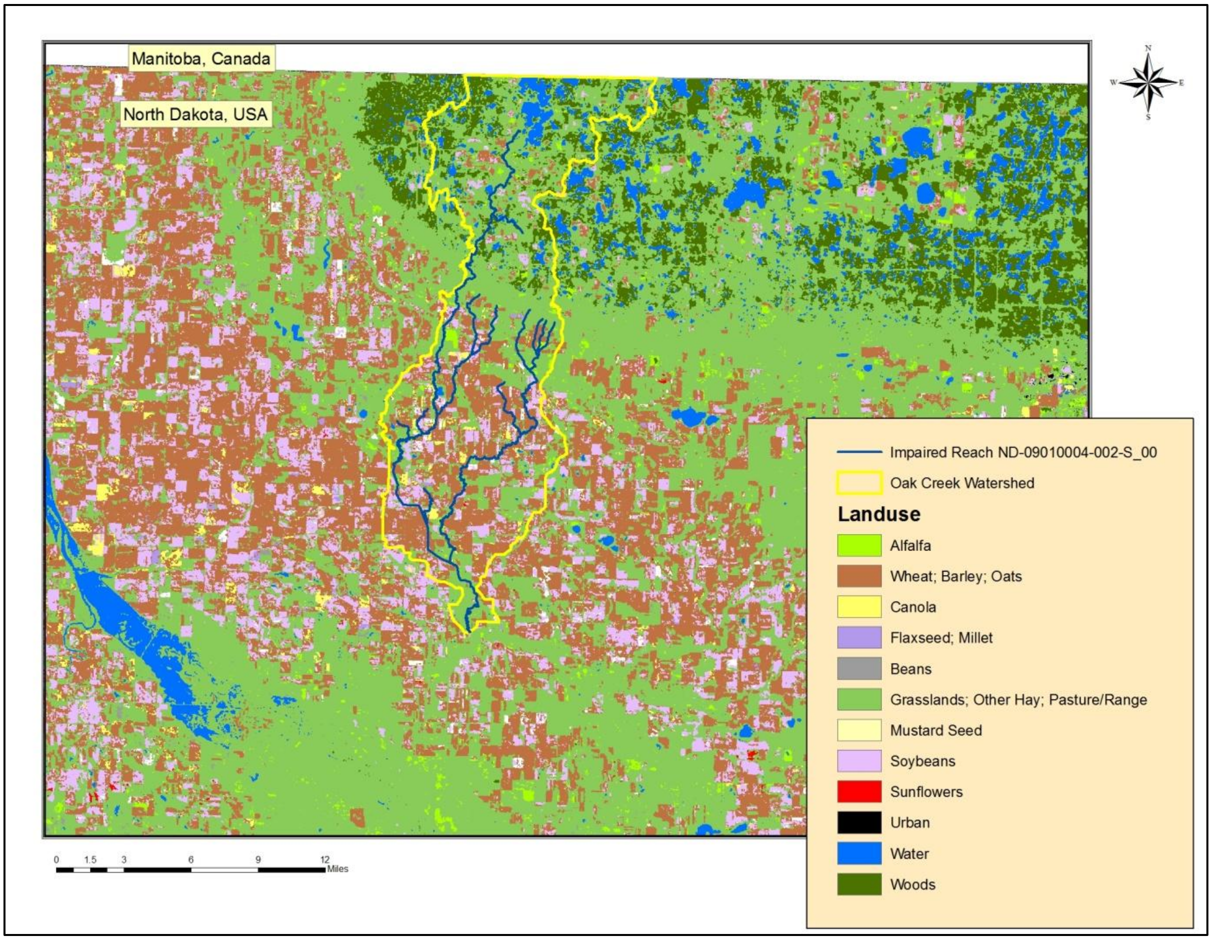

Figure 4. Land Use Map for Oak Creek Watershed (NDASS, 2005).

1.4 Climate and Precipitation

North Dakota's climate is characterized by large temperature variation across all time scales, light to moderate irregular precipitation, plentiful sunshine, low humidity, and nearly continuous wind. Its location at the geographic center of North America results in a strong continental climate, which is exacerbated by the mountains to the west. There are no barriers to the north or south so a combination of cold, dry air masses originating in the far north and warm humid air masses originating in the tropical regions regularly overflow the state. Movement of these air masses and their associated fronts causes near continuous wind and often results in large day to day temperature fluctuations in all seasons. The average last freeze in spring occurs in late May. In the fall, the first 32 degree or lower temperature occurs between September 10th and 25th. However, freezing temperatures have occurred as late as mid-June and as early as mid-August.

About 75 percent of the annual precipitation falls during the period of April to September, with 50 to 60 percent occurring between April and July (Figures 5 and 6). Most of the summer rainfall is produced during thunderstorms, which occur on an average of 25 to 35 days per year. On the average, rains occur once every three or four days during the summer. Winter snowpack, although persistent from December through March, only averages around 15 inches (Enz, 2003). Figure 5 shows average monthly precipitation data from the Bottineau, ND station (320941) close to the headwaters of the reach and Figure 6 shows average monthly precipitation data from the Willow City, ND station (329445) which is within two miles of the downstream end of the reach. While these two graphs show that over time, monthly averages at the two stations remain consistent, there can be great differences in total precipitation from year to year at any one site (Figure 7).

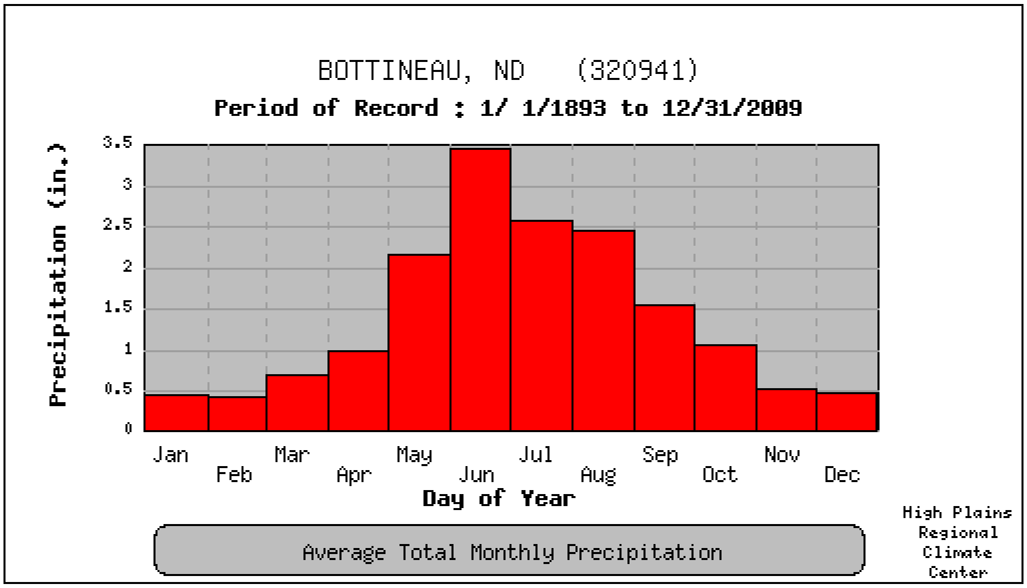

Figure 5. Average Total Monthly Precipitation Data for the High Plains Regional Climate Center Station at Bottineau, North Dakota (320941) from 1893 – 2009.

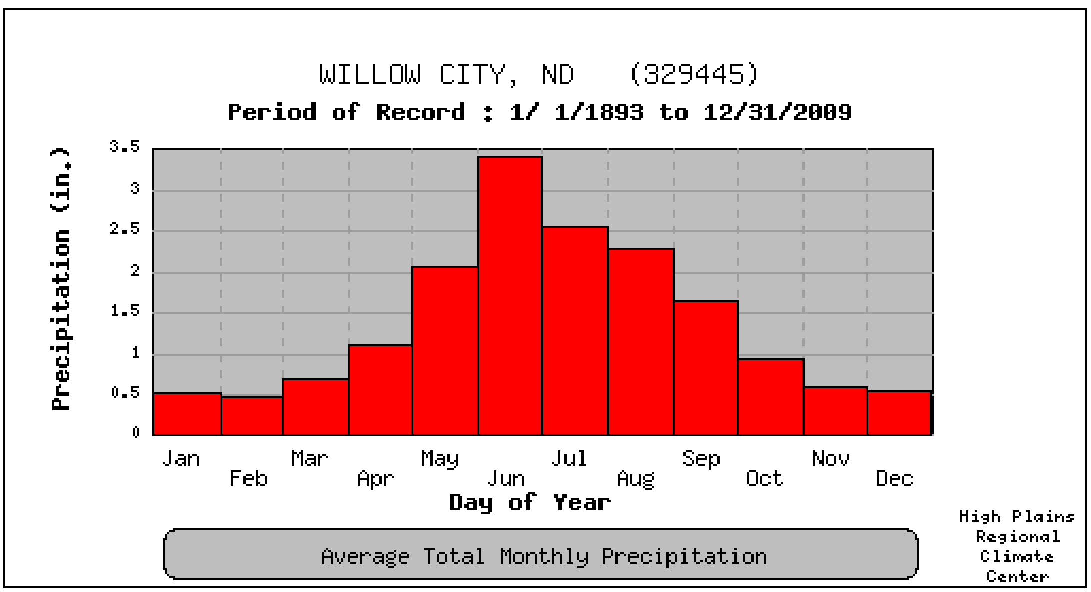

Figure 6. Average Total Monthly Precipitation Data for the High Plains Regional Climate Center Station at Willow City, North Dakota (329445) from 1893 – 2009.

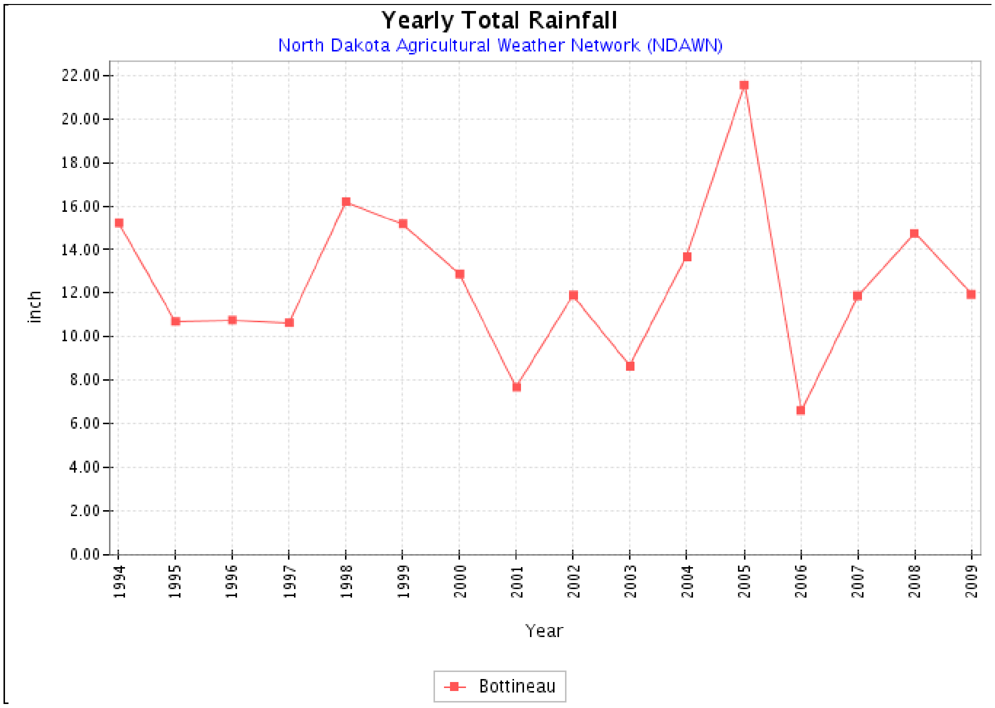

Figure 7. Total Annual Rainfall at the Bottineau, ND NDAWN Weather Station (NDAWN, 2010).

During the years sampling was conducted in the Oak Creek watershed, total annual precipitation was 21.57 inches in 2005 and 6.61 inches in 2006 (Figures 7 and 8). Average annual temperatures and wind in 2005 were 40 F and 9.3 mph, while in 2006 they were 41 F and 8.9 mph respectively (NDAWN, 2010).

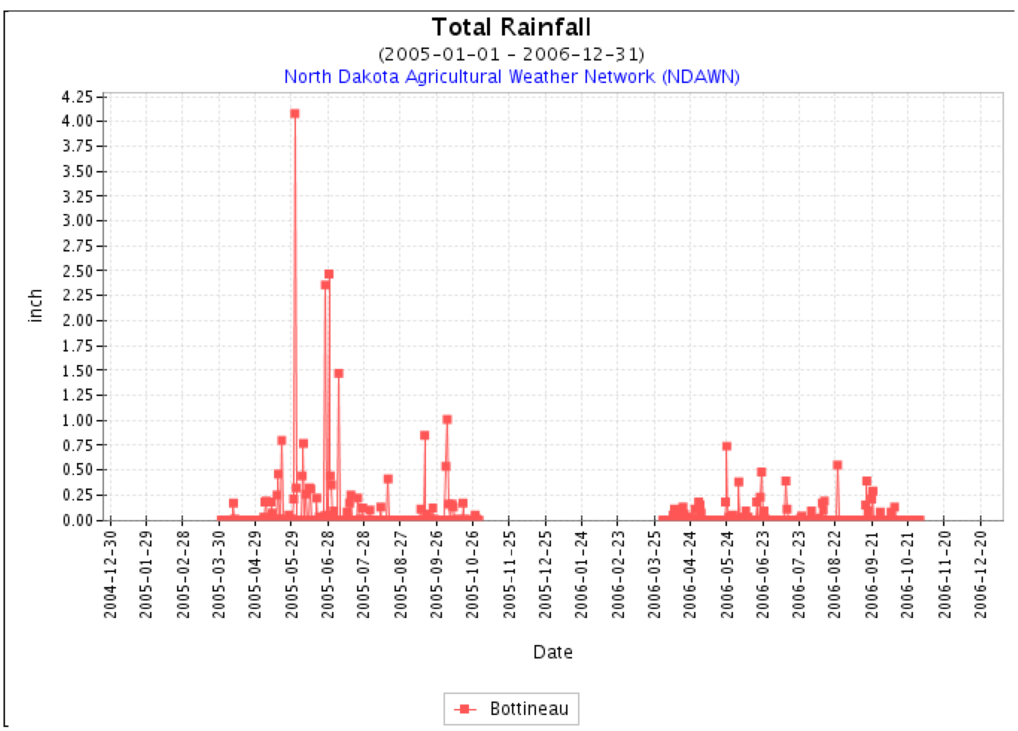

Figure 8. Daily Rainfall Amounts at the Bottineau, ND NDAWN Weather Station, 2005-2006.

1.5 Available Data

Water quality data was collected at five sites along Oak Creek in 2005 and 2006 (Figure 9). Samples were collected in 2005 from April until the middle of September. It was determined that since there was extensive flooding in 2005, the data collected may not represent a typical year so additional data were collected in 2006. Unfortunately, 2006 was an extremely dry year and flows ceased in the creek by the middle of August. A nearby USGS Gauging Station (05123400) supplied data that was used to calculate flow for the load duration curves using the Drainage-Area Ratio Method described later in this document. Some stage and discharge measurements were also taken at each of the five water quality sampling sites.

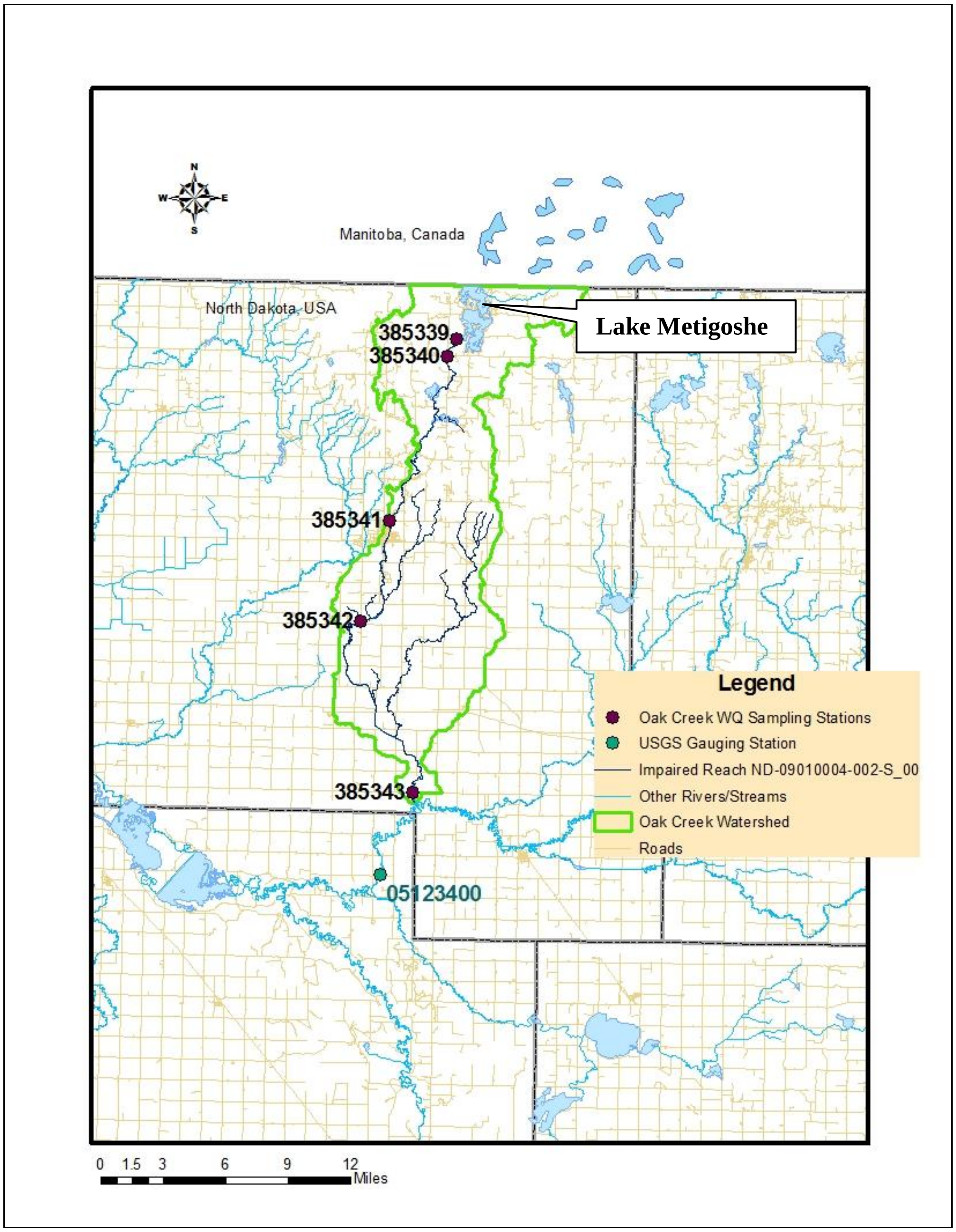

Figure 9. Sampling Site Locations on Oak Creek

1.5.1 Fecal Coliform Bacteria Data

The five water quality sampling sites along Oak Creek were monitored for fecal coliform bacteria. While the state of North Dakota has an E. coli bacteria standard (see Section 2.2), no E. coli data are available for Oak Creek in North Dakota. The recreation season in North Dakota is May 1 to September 30 (NDDoH, 2006).

Tables 5 - 9 provide data summaries for each site (385339, 385340, 385341, 385342, and 385343). The data were pooled across years (2005 and 2006) and the geometric mean concentration of fecal coliform bacteria and the percent of samples over 400 CFU/100mL were calculated for each month during the recreational period of May 1 through September 30. For values returned as below detection limit, half of the value of the detection limit (5 CFU/100mL) was used in calculations. For values returned as too numerous to count, a value of 1,500 CFU/100mL was used in calculations. Due to flow and personnel limitations, fewer than the five-sample preferred minimum were collected in the months of July through September. A summary of all of the fecal coliform data are provided in Appendix A.

For all of the sites, the month of June saw the greatest number of fecal coliform bacteria samples with elevated concentrations, with site 385343 (downstream-most site) being the most impaired site of the five. Since the entire reach of Oak Creek is listed as impaired (NDDoH, 2010), and since the downstream-most site seems to be the most impaired of the sites sampled, this is the data that will be used to develop the load duration curve for the TMDL. If an implementation plan is initiated, data from the other stream sites, along with any new data collected, can be used to guide implementation of BMPs throughout the watershed.

Table 5. Summary of Fecal Coliform Bacteria Data (CFU/100 mL) for Site 385339, (2005-2006).

Month	N	Min.	Max.	Geomean	% Over 400 (CFU/100mL)	% ND[1] (of total)	Beneficial Use Support
MAY	9	ND	80	7.35	0.0	77.8	Fully Supporting
JUN	4	ND	1400	20.45	25.0	75.0	Fully Supporting, but Threatened
JUL	2	ND	ND	5.00	0.0	100.0	Fully Supporting
AUG	3	ND	10	7.94	0.0	33.3	Fully Supporting
SEP	1	ND	ND	ID[2]	0.0	100.0	Fully Supporting

[1]ND = Non-Detect (below lab detection limits), [2]ID = Insufficient Data

Table 6. Summary of Fecal Coliform Bacteria Data (CFU/100mL) for Site 385340, (2005-2006).

Month	N	Min	Max	Geomean	% Over 400 (CFU/100mL)	% ND[1] (of total)	Beneficial Use Support
MAY	14	ND	330	15.61	0.0	42.9	Fully Supporting
JUN	6	ND	TNTC[2]	78.30	33.3	33.3	Fully Supporting, but Threatened
JUL	2	30	40	34.64	0.0	0.00	Fully Supporting
AUG	3	ND	60	24.66	0.0	33.3	Fully Supporting
SEP	1	ND	ND	ID[3]	0.0	100.0	Fully Supporting

[1]ND = Non-Detect (below lab detection limits), [2]TNTC = Too Numerous To Count, [3]ID = Insufficient Data

Table 7. Summary of Fecal Coliform Bacteria Data (CFU/100mL) for Site 385341, (2005-2006).

Month	N	Min	Max	Geomean	% Over 400 (CFU/100mL)	% ND[1] (of total)	Beneficial Use Support
MAY	16	ND	100	16.87	0.0	18.8	Fully Supporting
JUN	8	10	1400	115.01	37.5	0.0	Fully Supporting, but Threatened
JUL	2	10	30	17.32	0.0	0.0	Fully Supporting
AUG	3	ND	70	19.13	0.0	33.3	Fully Supporting
SEP	1	20	20	ID[2]	0.0	100.0	Fully Supporting

[1]ND = Non-Detect (below lab detection limits), [2]ID = Insufficient Data

Table 8. Summary of Fecal Coliform Bacteria Data (CFU/100mL) for Site 385342, (2005-2006).

Month	N	Min	Max	Geomean	% Over 400 (CFU/100mL)	% ND[1] (of total)	Beneficial Use Support
MAY	16	ND	260	15.61	0.0	25.0	Fully Supporting
JUN	8	ND	TNTC[2]	78.30	37.5	12.5	Fully Supporting, but Threatened
JUL	2	10	80	34.64	0.0	0.0	Fully Supporting
AUG	3	30	180	24.66	0.0	0.0	Fully Supporting
SEP	1	20	20	ID[3]	0.0	0.0	Fully Supporting

[1]ND = Non-Detect (below lab detection limits), [2]TNTC = Too Numerous To Count, [3]ID = Insufficient Data

Table 9. Summary of Fecal Coliform Bacteria Data (CFU/100mL) for Site 385343, (2005-2006).

Month	N	Min	Max	Geomean	% Over 400 (CFU/100mL)	% ND[1] (of total)	Beneficial Use Support
MAY	16	ND	TNTC[2]	87.30	18.75	6.25	Fully Supporting, but Threatened
JUN	8	60	TNTC[2]	222.09	12.5	0.00	Not Supporting
JUL	2	20	200	63.25	0.0	0.00	Fully Supporting
AUG	3	10	300	31.07	0.0	0.00	Fully Supporting
SEP	1	ND	ND	ID[3]	0.0	100.00	Fully Supporting

[1]ND = Non-Detect (below lab detection limits), [2]TNTC = Too Numerous To Count, [3]ID = Insufficient Data

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

1.5.2 Hydraulic Discharges

A daily discharge record was constructed for Oak Creek site 385343 using the Drainage-Area Ratio Method (Ries et al., 2000) and the historical discharge measurements (1987–2009) collected by the USGS at gauging station 05123400 located in the Willow Creek watershed. (Figure 8). Site 385343 on Oak Creek is located within the Willow Creek watershed, so an appropriate portion of the flow at the USGS site was used in calculations as further described in Section 5.1. The flow duration curve based on the synthesized flow record for site 385343 can be found in Appendix B.

2.0 WATER QUALITY STANDARDS

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

2.1 Narrative Water Quality Standards

The North Dakota Department of Health has set narrative water quality standards that apply to all surface waters in the State. The narrative general water quality standards are listed below (NDDoH, 2006).

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

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

    1. Cause a public health hazard or injury to environmental resources;

    2. Impair existing or reasonable beneficial uses of the receiving waters; or

    3. Directly or indirectly cause concentrations of pollutants to exceed applicable standards of the receiving waters.

In addition to the narrative standards, the NDDoH has set a biological goal for all surface waters in the State. The goal states that "the biological condition of surface waters shall be similar to that of sites or waterbodies determined by the department to be regional reference sites" (NDDoH, 2006).

2.2 Numeric Water Quality Standards

Oak Creek is a Class III stream which carries the following definition (NDDoH, 2006):

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

Numeric criteria have been developed for Class III streams for both fecal coliform bacteria and E. coli bacteria (Table 10). Both bacteria standards apply only during the recreation season of May 1 to September 30.

Table 10. North Dakota Fecal Coliform and E. coli Bacteria Standards for Class III Streams.

Parameter	Water Quality Standard	
	Geometric Mean[1]	Maximum[2]
Fecal Coliform Bacteria	200 CFU/100 mL	400 CFU/100 mL
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 effort. TMDL targets must be based on state water quality standards, but can also include site specific values when no numeric criteria are specified in the standard. The following TMDL target for Oak Creek is based on the North Dakota water quality standard for fecal coliform bacteria. If the target is met, the recreation beneficial use will be fully supported.

3.1 Fecal Coliform Bacteria Target

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

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

4.0 SIGNIFICANT SOURCES

4.1 Point Sources

Within Oak Creek watershed there are two wastewater treatment systems permitted through the North Dakota Pollutant Discharge Elimination System (NDPDES) Program. One in Bottineau, ND and one further upstream near the headwaters at Lake Metigoshe managed by the Lake Metigoshe Recreational District. Each system is allowed to discharge on an “as needed” basis, which averages about twice per year (Appendix C). No fecal coliform or E. coli monitoring is required in either of the NDPDES permits, so no bacteria data is available. Wasteload allocations are given to these facilities as described later in Section 5.5. Dwellings in this watershed also utilized individual septic waste systems.

There are no confined animal feeding operations (CAFOs) in Oak Creek watershed. There are three permitted AFOs in the watershed, one medium (less than 1000 cattle) and two small (less than 300 cattle). However, they are zero discharge facilities and are not deemed a significant source for this report.

4.2 Nonpoint Sources

The TMDL listed segment on Oak Creek is experiencing fecal coliform bacteria pollution from nonpoint sources in the watershed. Livestock production is a significant agricultural practice in the watershed. Primary nonpoint sources for fecal coliform bacteria in Oak Creek watershed are as follows:

- Runoff of manure from cropland and pasture if there is knowledge of manure being applied;
- Runoff of manure from unpermitted animal feeding areas;
- Direct deposit of manure into Oak Creek by livestock

Wildlife may also contribute to the fecal coliform bacteria found in the water quality samples, but most likely in a lower concentration. Wildlife are nomadic with fewer numbers 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 the fecal coliform bacteria in the water quality samples. Failures can occur for several reasons, although the most common reason is improper maintenance (e.g. age, inadequate pumping). Other reasons for failure include improper installation, location, and choice of system. Harmful household chemicals can also cause failure by killing the bacteria that digest the waste. While the number of systems that are not functioning properly is unknown, it is estimated that 28 percent of the systems in North Dakota are failing.

5.0 TECHNICAL ANALYSIS

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

The loading capacity or TMDL is the amount of pollutant (e.g. fecal coliform bacteria) a waterbody can receive and still meet and maintain water quality standards and beneficial uses. The following technical analysis addresses the fecal coliform bacteria load allocation and the load allocation reductions necessary to achieve the water quality standards target of 200 CFU/100 mL plus a margin of safety.

5.1 Mean Daily Stream Flow

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

Flows for the watershed 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 stream flow at the ungauged site is hydrologically similar (same per unit area) to the stream gauging station used as an index. Land use was also compared for the two watersheds to determine similarities (Table 11). Drainage area and land use for the ungauged site (385343) as well as land use for the index site (05123400) was determined through GIS using digital elevation models (DEMs) and the 2005 NDASS land use database. Streamflow data and drainage area for the index station (05123400) was obtained from the USGS Water Science Center website. The index station (05123400) streamflow data was then divided by the drainage area to determine streamflows per unit area at the index station. Those values are then multiplied by the drainage area for the ungauged site to obtain estimated flow statistics for the ungauged site.

Table 11. Land Use Comparison for Willow Creek and Oak Creek Watersheds.

Index Station			**Ungauged Site**	
Willow Creek Watershed			**Oak Creek Watershed**	
Acres	**Watershed Percentage**	**Land use Name**	**Watershed Percentage**	**Acres**
264,294.4	35.6%	Wheat/Small Grains	27.2%	24,155.5
64,588.8	8.7%	Soybeans	13.1%	11,633.7
9,057.3	1.22%	Canola	2.3%	2,042.6
14,773.8	1.99%	Sunflowers	1.0%	888.1
6,830.1	0.92%	Flax	0.5%	444.0
6,533.1	0.88%	Beans/Peas	0.2%	177.6
222.7	0.03%	Mustard	0.2%	177.6
18,411.5	2.48%	Corn	0%	0
3,712.0	0.50%	Fallow	0.8%	710.5
227,916.8	30.70%	Pasture/Range	32.9%	29,217.5
18,560.0	2.5%	Hay/Alfalfa	2.8%	2,486.6
60,802.6	8.19%	Water	10.0%	8,880.7
37,788.5	5.09%	Woods	7.4%	6,571.7
8,908.4	1.20%	Urban/Developed	1.6%	1,420.9
742,400		**Total Acres**		**88,807**

5.2 Flow Duration Curve Analysis

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

(USEPA, 2007).

A basic flow duration curve runs from high to low (0 to 100 percent) along the x-axis with the corresponding flow value on the y-axis (Figure 10). 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 10, a flow duration interval of thirty-three (33) percent, associated with a stream flow of 1.1 cfs, implies that 33 percent of all observed mean daily discharge values equal or exceed 1.1 cfs.

Once the flow duration curve is developed for the stream site, flow duration intervals can be defined which can be used as a general indicator of hydrologic condition (i.e., wet vs. dry conditions and to what degree). These intervals (or zones) provide additional insight about conditions and patterns associated with the impairment (fecal coliform bacteria in this case) (USEPA, 2007). As depicted in Figure 10, the flow duration curve for site 385343, representing TMDL segment ND-09010004-002-S_00, was divided into four zones, one representing high flows (0-6 percent) or flow which are equal to or greater than 35.9 cfs, another for moist conditions(6-24 percent), one for dry conditions (24-33 percent), and one for low flows (33-49 percent) Based on the flow duration curve analysis, no flow (or zero flow) was met or exceeded 49 – 100 percent of the time.

These flow intervals were defined by examining the range of flows for the site for the period of record and then by looking for natural breaks in the flow record based on the flow duration curve plot (Figure 10). A secondary factor in determining the flow intervals used in the analysis is the number of fecal coliform observations available for each flow interval.

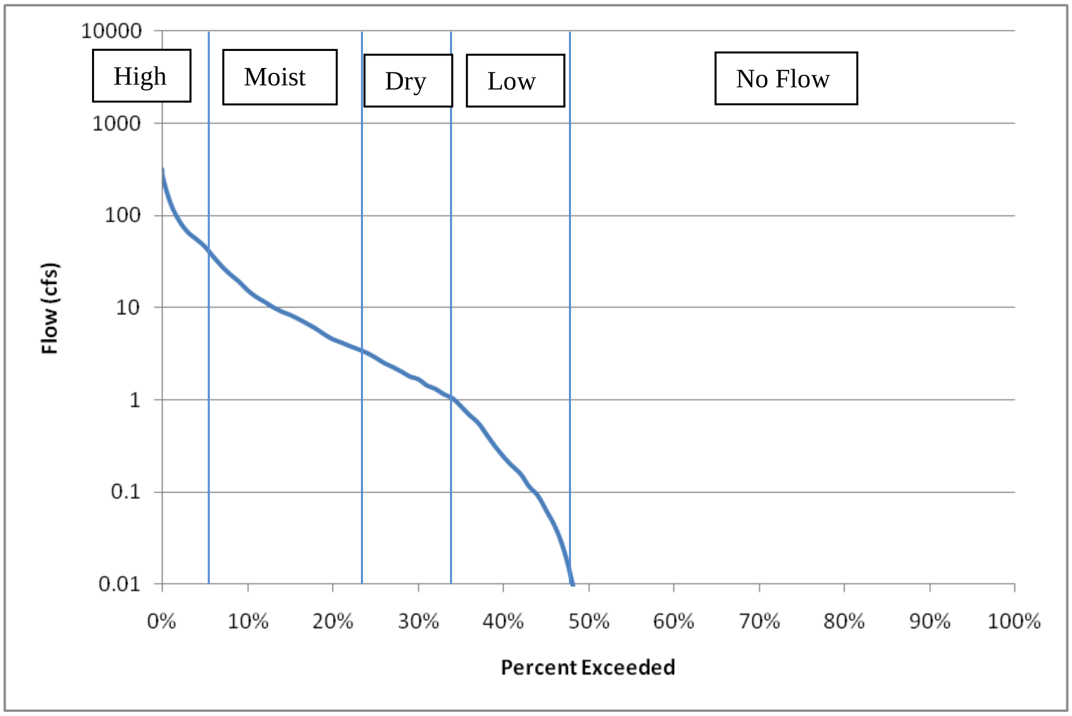

Figure 10. Flow Duration Curve for Oak Creek Site 385343, Located at the Outlet to Willow Creek, in North Dakota.

5.3 Load Duration Curve Analysis

An important factor in determining NPS pollution loads is variability in stream flows and loads associated with high and low flow. To better correlate the relationship between the pollutant of concern and hydrology of the 303(d) listed segment, a load duration curve was developed for Oak Creek. The load duration curve was derived using the 200 CFU/100mL State water quality standard and the flows generated as described in Sections 5.1 and 5.2.

Observed in-stream fecal coliform bacteria concentrations from monitoring site 385343, representing the entire TMDL segment ND-09010004-002-S_00 (Appendix A) were converted to pollutant loads by multiplying fecal coliform bacteria concentrations by the flow and a conversion factor. These loads are plotted against the percent exceeded of the flow on the day of sample collection (Figure 11). Points plotted above the 200 CFU/100 mL target curve exceed the water quality target. Points plotted below the curve are meeting the water quality target of 200 CFU/100 mL.

For each flow interval or zone, a regression relationship was developed between the samples which occur above the TMDL target (200 CFU/100 mL) curve and the corresponding percent exceeded flow. The load duration curve for site 385343, representing impaired reach ND-09010004-002-S_00, depicting the regression relationship for each flow interval is provided in Figure 11.

The regression line for high flow, moist condition, dry condition, and low flows were then used with the midpoint of the percent exceeded flow for that interval to calculate the existing total fecal coliform bacteria load for that flow interval. For example, in Figure 11, the regression relationship between observed fecal coliform bacteria loading and percent exceeded flow for the high flow and moist condition intervals are:

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

Where the midpoint of the high flow interval from 0 to 6 percent is 3.01 percent, the existing fecal coliform load is:

Fecal coliform load (10^7 CFUs/day) = antilog (5.27 + (-9.98*0.0301))
= 94,201 x 10^7 CFUs/day

Where the midpoint of the moist condition flow interval from 6 to 24 percent is 15.01 percent, the existing fecal coliform load is:

Fecal coliform load (10^7 CFUs/day) = antilog (4.90+ (-7.07*0.1501))
= 6,916 x 10^7 CFUs/day

The midpoint for the flow interval is also used to estimate the TMDL target load. In the case of the previous example, the TMDL target load for the midpoints of 3.01 and 15.01 percent exceeded flow derived from the 200 CFU/100 mL TMDL target curves are 32,472 x 10^7 CFUs/day and 4,098 x 10^7 CFUs/day, respectively.

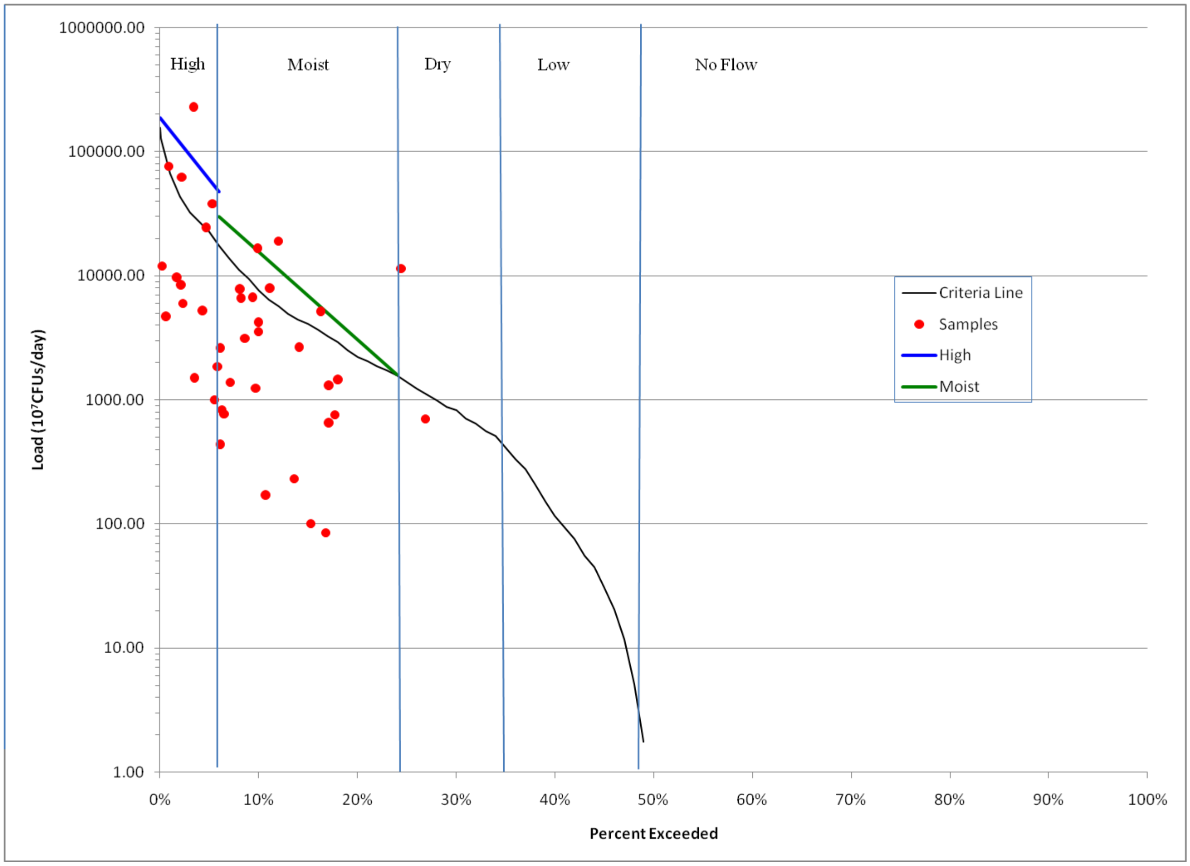

Figure 11. Load Duration Curve for Oak Creek Site 385343 (The curve reflects flows collected from 1987 – 2009)

5.4 Wasteload Allocation Analysis

5.4.1 Bottineau, ND Wastewater Treatment System

According to the NDPEDS permit for Bottineau, ND, a wastewater discharge is allowed on an "as needed" basis. Discharge monitoring reports (DMRs) indicate this wastewater treatment system averages two discharges per year, with up to four times a year during heavy precipitation years. Based on the DMR data, average daily discharge during the recreation season (May 1 – September 30) for the years 2005 to present is 4.13 million gallons per day (MGD) during the intermittent discharge (Appendix C). Typically this is a combined discharge from two cells. Assuming they discharged from each cell separately for 12-14 days rather than the typical 6-7 days, their average daily daily discharge would be reduced to 3.02 MGD (Appendix C).

Since no fecal coliform or E. coli bacteria data are collected as a permit requirement, a fecal coliform concentration of 200 CFUs/100 mL is assumed for the wasteload allocation calculation. Since no fecal coliform or E. coli bacteria data are collected, the system is assigned the water quality standards value of 200 CFU/100mL for this TMDL. This value was chosen both because it is the North Dakota water quality standard, and because those dischargers throughout the state that are required to sample for bacteria are assigned this same value in their permit. While these facilities have a permit limit of 200 CFU/100mL for this TMDL, their discharge is typically much less. The average fecal value for 755 discharges from January 1, 2000 through August 1, 2010 for the general permit covered facilities (NDG12 and NDG22) with fecal coliform monitoring requirements in their permits is 84 CFUs/100 ml. The wasteload allocation for Bottineau, ND was determined by taking an average daily discharge volume of 3.02 MGD multiplied by a fecal coliform concentration of 200 CFUs/100 mL, times appropriate conversion factors.

WLA = 3.02 million gallons/ day * 200 CFUs/100mL
= 3.02 million gallons/day * 3.7854 L/gal*1000mL/L* 200 CFU/100mL

= 2,286.381 x 10^7 CFUs/day

<u>5.4.2 Lake Metigoshe Recreational District Wastewater Treatment System</u>

According to the NDPDES permit for Lake Metigoshe, the District is allowed to discharge on an “as needed” basis. The DMR indicates this wastewater treatment system averages discharges twice per year, with up to four times a year during heavy precipitation years. The last year that the District discharged four times was during the 2005 floods. In 2006 in response to the flooding events and a growing demand placed on the system by new housing construction, the District added two new cells to their system to reduce the needed discharges.

Based on DMR data, average daily discharge during the recreation season (May 1 – September 30) for the years 2005 to present is 1.41 million gallons per day during the intermittent discharge (Appendix C). Since no fecal coliform or E. coli bacteria data are collected for this site either, the system is also assigned the water quality standards value of 200 CFU/100mL for this TMDL.

Wasteload allocation for Lake Metigoshe Recreational District was determined by taking the average discharge and multiplying by the assumed fecal coliform concentration of 200 CFUs/100mL, times appropriate conversion factors.

WLA = 1.41 million gallons/ day * 200 CFUs/100mL

= 1.41 million gallons/day * 3.7854 L/gal*1000mL/L* 200CFUs/100mL

= 1,067.483 x 10^7 CFUs/day

5.5 Loading Sources

The majority of load reductions can generally be allotted to nonpoint sources. However, to account for uncertainty due to periodic discharges from permitted municipal facilities (e.g. Bottineau, ND), wasteload allocations (WLAs) are included for the impaired segment ND-09010004-002-S_00.

The most significant sources of fecal coliform bacteria loading remain nonpoint source pollution originating from livestock. Based on the data available, the general focus of BMPs and load reductions for the listed segment should be on unpermitted animal feeding areas, range/pastureland and riparian areas that are greatly disturbed. Higher priority should be given to the animal feeding areas located in close proximity to Oak 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). TMDLs were developed for two flow regimes (i.e., high flows and moist conditions), as samples indicated there were exceedances of the water quality standard during those flows.

By relating runoff characteristics to each flow regime one can infer +which sources are most likely to contribute to fecal coliform bacteria loading. Animals grazing in the riparian area contribute fecal coliform bacteria by depositing manure where it has an immediate impact on water quality. Due to the close proximity of manure to the stream or by direct deposition in the stream, riparian grazing impacts water quality at high, medium and low flows (Table 12). In contrast, intensive grazing of livestock in the upland and not in the riparian area has a high potential to impact water quality at high flows and medium impact at moderate flows. Exclusion of livestock from the riparian area eliminates the potential of direct manure deposit and therefore is considered to be of high importance at all flows. However, intensive grazing in the upland creates the potential for manure accumulation and availability for runoff at high flows and a high potential for fecal coliform bacteria contamination.

Table 12. Nonpoint Sources of Pollution and Their Potential to Pollute at a Given Flow Regime.

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

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

6.0 MARGIN OF SAFETY AND SEASONALITY

6.1 Margin of Safety

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

To account for the uncertainty associated with known sources and the load reductions necessary to reach the TMDL target of 200 CFU/100 mL, a ten percent explicit margin of safety was used for this TMDL. The MOS was calculated as ten percent of the TMDL. In other words ten percent of the TMDL is set aside from the load allocation as a MOS. The ten percent MOS was derived by taking the difference between the points on the load duration curve using the 200 CFU/100 mL standard and the curve using the 180 CFU/100 mL.

6.2 Seasonality

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

7.0 TMDL

Table 13 provides an outline of the critical elements of Oak Creek fecal coliform bacteria TMDL. The TMDLs are presented in Table 14. This Table provides an estimate of the existing daily load and an estimate of the average daily loads necessary to meet the water quality target (i.e. TMDL load). This TMDL load includes a load allocation from known nonpoint sources and a ten percent margin of safety. It should be noted that the TMDL loads, load allocations, and the MOS are estimated based on available data and reasonable assumptions and are to be used as a guide for implementation. The actual reduction needed to meet the applicable water quality standards may be higher or lower depending on the results of future monitoring

Table 13. TMDL Summary for Oak Creek.

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

The TMDL can be described by the following equation**:**

TMDL = LC = WLA + LA + MOS where:

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

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

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

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

Table 14. Fecal Coliform Bacteria TMDL (10^7 CFUs/day) for Oak Creek (ND-09010004-002-S_00) as Represented by Site 385343.

	Flow Regime			
	High Flow	**Moist Condition**	**Dry Condition**	**Low Flow**
Existing Load	94,201	6,916		
TMDL	32,472	4,098	937[1]	152[1]
WLA (Bottineau)	2,286	2,286	No load reduction necessary	No load reduction necessary
WLA (Metigoshe)	1,067	1,067		
LA	25,872	335		
MOS	3,247	410		

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

8.0 ALLOCATION

There are two permitted municipal facilities, Bottineau and Lake Metigoshe, which discharge to segment ND-09010004-002-S_00, therefore a portion of the TMDL, 2,286 x 10^7 CFU/day and 1,067 x 10^7 CFU/day, respectively have been allocated to these point sources. The remaining load has been allocated to nonpoint sources in the watershed

The nonpoint source load is allocated as a single load because there is not enough detailed source data to allocate the load to individual uses (e.g., animal feeding, septic systems, riparian grazing, upland grazing). To achieve the TMDL targets identified in the report, it will require the wide spread support and voluntary participation of landowners and residents in the immediate watershed as well as those living upstream. The TMDLs described in this report are a plan to improve water quality by implementing best management practices through non-regulatory approaches. “Best management practices” (BMPs) are methods, measures, or practices that are determined to be a reasonable and cost effective means for a land owner to meet nonpoint source pollution control needs,” (USEPA, 2001). This TMDL plan is put forth as a recommendation for what needs to be accomplished for Oak Creek, its tributaries and associated watershed to restore and maintain its recreational uses. Water quality monitoring should continue to assess the effects of the recommendations made in this TMDL. Monitoring may indicate that BMP implementation and/or the loading capacity recommendations should be adjusted.

Nonpoint source pollution is the largest contributor to elevated total fecal coliform bacteria levels in the Oak Creek watershed. The fecal coliform samples and load duration curve analysis of the impaired reach identified the high and moist condition flow regimes for ND-09010004-002-S_00 as the time of fecal coliform exceedences of the 200 CFU/100 mL target. To reduce nonpoint source pollution for the high and moist condition flow regimes, specific BMPs are described in Section 8.1 that will mitigate the effects of total fecal coliform loading to the impaired reach.

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

Table 15. Management Practices and Flow Regimes Affected by the 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 Livestock Management Recommendations

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

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

Water well and tank development - Fencing animals from stream access requires an alternative water source, installing water wells and tanks satisfies this need. Installing water tanks provides a quality water source and keeps animals from wading and defecating in streams. This will reduce the probability of pathogenic infections to livestock and the environment.

Prescribed grazing – This practice provides increased ground cover and ground stability by rotating livestock throughout multiple fields. Grazing with a specified rotation minimizes overgrazing and resulting erosion. The Natural Resources Conservation Service (NRCS) recommends grazing systems to improve and maintain water quality and quantity. Duration, intensity, frequency, and season of grazing can be managed to enhance vegetation cover and litter, resulting in reduced runoff, improved infiltration, increased quantity of soil water for plant growth, and better manure distribution and increased rate of decomposition, (NRCS, 1998).

In a study by Tiedemann et al. (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 16) show that when livestock are managed at a stocking rate of 19 acres per animal unit month with water developments and fencing, bacteria levels were reduced significantly.

Table 16. Bacterial Water Quality Response to Four Grazing Strategies (Tiedemann et al., 1989).

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

Waste management system - Waste management systems can be effective in controlling up to 90 percent of the loading originating from confined animal feeding areas (Table 17). A waste management system is made up of various components designed to control NPS pollution from concentrated animal feeding operations (CAFOs) and animal feeding operations (AFOs). Diverting clean water around the feeding area and containing dirty water from the feeding area in a pond are typical practices of a waste management system. Manure handling and application procedures are also integral to the waste management system. The application of manure is designed to be adaptive to environmental, soil, and plant conditions to minimize the probability of contamination of surface water.

8.2 Other Recommendations

Vegetative filter strip – Vegetated filter strips are used to reduce the amount of sediment, particulate organics, dissolved contaminants, nutrients, and in the case of this TMDL, fecal coliform bacteria to streams. The effectiveness of filter strips and other BMPs in removing fecal coliform bacteria is quite successful. Results from a study by

Pennsylvania State University (1992) as presented by USEPA (1993) (Table 17), suggest that vegetative filter strips are capable of removing up to 55 percent of fecal coliform bacteria loading to rivers and streams. The ability of the filter strip to remove contaminants is dependent on field slope, filter strip slope, erosion rate, amount and particulate size distribution of sediment delivered to the filter strip, density and height of vegetation, and runoff volume associated with erosion producing events (NRCS, 2001).

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

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

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

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

Table 17. Relative Gross Effectiveness of Confined Livestock Control Measures (Pennsylvania State University, 1992).

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

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

9.0 PUBLIC PARTICIPATION

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

- Turtle Mountain County Soil Conservation District;
- Oak Creek Water Resource Board;
- Natural Resource Conservation Service (State Office); and
- US Environmental Protection Agency - Region VIII

In addition to the mailed copies, the TMDL for Oak Creek was posted on the North Dakota Department of Health, Division of Water Quality web site at http://www.ndhealth.gov/WQ/SW/Z2_TMDL/TMDLs_Under_PublicComment/B_Under_Public_Comment.html .

A 30 day public notice soliciting comment and participation was also published in the Bottineau Courant.

As part of its normal review, a public notice review was received from the US EPA Region VIII (Appendix D). No comments were received from any other agency, organization or individual.

10.0 MONITORING

As stated previously, it should be noted that the TMDL loads, wasteload allocations, 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 best management practices(BMPs) and technical assistance that are implemented as a part of any watershed restoration program are successful in reducing fecal coliform bacteria loadings, as well as E. coli 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. These include, but are not limited to fecal coliform bacteria and E. coli bacteria. Once a watershed restoration plan (e.g. Section 319 Non point Source Project Implementation Plan [PIP]) is implemented, monitoring will be conducted in the watershed beginning two years after implementation and extending five years after the implementation project is complete.

In regards to the two point sources, as NDPDES permits are renewed, fecal coliform and /or E. coli bacteria limits will be established in their permits and discharge monitoring will be implemented to ensure both the permit limits and their discharge volumes are consistent with their wasteload allocations and therefore, water quality standards.

11.0 TMDL IMPLEMENTATION STRATEGY

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

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

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

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Appendix A
Fecal Coliform Bacteria Data
For Sites 385339, 385340, 385341, 385342, and 385343
Collected During 2005 and 2006

Fecal Coliform Bacteria Concentrations (CFU/100mL), 2005 – 2006

Site 385339

Date	Time	Value
4/25/05	14:30	ND (5)
5/11/05	11:25	ND (5)
5/16/05	12:00	ND (5)
5/23/05	15:00	10
6/9/05	14:05	ND (5)
6/16/05	12:00	ND (5)
6/20/05	15:20	ND (5)
6/30/05	11:30	1400
7/14/05	14:25	ND (5)
7/21/05	12:45	ND (5)
8/1/05	09:20	10
8/10/05	17:40	ND (5)
8/25/05	12:05	10
9/15/05	14:00	ND (5)
4/17/06	14:45	ND (5)
4/24/06	16:00	10
4/26/06	14:15	ND (5)
5/3/06	14:00	ND (5)
5/8/06	10:15	ND (5)
5/10/06	15:00	ND (5)
5/18/06	11:45	ND (5)
5/22/06	10:15	ND (5)
5/25/06	12:50	80

Site 385340

Date	Time	Value
4/6/05	15:15	ND (5)
4/11/05	14:45	20
4/13/05	13:00	ND (5)
4/18/05	16:05	ND (5)
4/20/05	15:15	ND (5)
4/25/05	14:10	20
4/27/05	15:35	ND (5)
5/2/05	16:00	ND (5)
5/4/05	15:50	ND (5)
5/9/05	15:50	10
5/11/05	11:40	10
5/16/05	12:15	ND (5)
5/18/05	16:35	30
5/23/05	14:30	110
5/25/05	16:25	ND (5)
5/31/05	15:30	30
6/2/05	11:15	320
6/9/05	14:30	ND (5)
6/16/05	12:15	ND (5)
6/20/05	15:50	40
6/30/05	11:50	480
7/14/05	14:45	30
7/21/05	13:40	40
8/1/05	09:40	60
8/10/05	17:50	ND (5)
8/25/05	11:45	50
9/15/05	14:20	ND (5)
4/2/06	13:18	20
4/17/06	15:45	10
4/24/06	16:20	10
4/26/06	14:50	ND (5)
5/8/06	11:00	ND (5)
5/18/06	12:10	10
5/22/06	10:45	ND (5)
5/25/06	13:25	100
5/30/06	12:00	330
6/1/06	15:15	TNTC (1500)

Fecal Coliform Bacteria Concentrations (CFU/100mL), 2005 – 2006

Site 385341

Date	Time	Value
4/7/05	13:40	ND (5)
4/11/05	11:10	ND (5)
4/13/05	11:10	ND (5)
4/18/05	14:00	ND (5)
4/20/05	13:40	ND (5)
4/25/05	10:45	ND (5)
4/27/05	13:53	130
5/2/05	13:50	ND (5)
5/4/05	11:25	ND (5)
5/9/05	14:20	100
5/11/05	13:00	20
5/16/05	10:20	20
5/18/05	15:40	60
5/23/05	11:25	60
5/25/05	14:15	10
5/31/05	12:15	10
6/2/05	11:15	90
6/9/05	12:10	120
6/16/05	10:20	20
6/20/05	13:20	10
6/30/05	14:05	450
7/14/05	11:50	30
7/21/05	15:20	10
8/1/05	11:15	70
8/10/05	16:00	ND (5)
8/25/05	10:00	20
9/15/05	15:30	20
4/2/06	14:28	ND (5)
4/17/06	12:40	10
4/24/06	14:30	ND (5)
4/26/06	10:55	20
5/3/06	11:10	10
5/8/06	15:00	ND (5)
5/10/06	11:30	20
5/18/06	14:10	60
5/22/06	14:30	10
5/25/06	15:00	10
5/30/06	14:30	20
6/1/06	11:30	50
6/22/06	13:40	1400
6/26/06	13:30	450

Site 385342

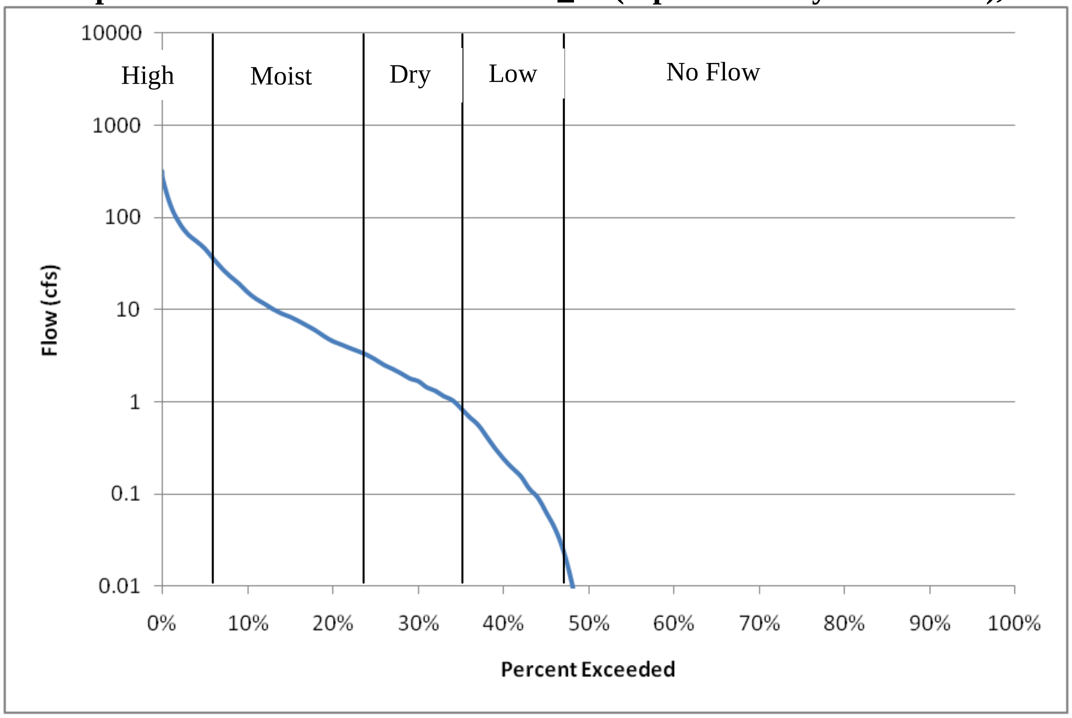
Date	Time	Value
4/7/05	14:50	ND (5)
4/11/05	12:20	ND (5)
4/13/05	12:00	ND (5)
4/18/05	14:15	ND (5)
4/20/05	14:20	ND (5)
4/25/05	11:25	10
4/27/05	14:45	50
5/2/05	14:45	ND (5)
5/4/05	12:20	ND (5)
5/9/05	15:05	20
5/11/05	12:20	60
5/16/05	11:00	ND (5)
5/18/05	14:30	30
5/23/05	12:05	60
5/25/05	15:40	30
5/31/05	13:50	20
6/2/05	11:15	TNTC (1500)
6/9/05	12:55	230
6/16/05	11:00	60
6/20/05	14:00	40
6/30/05	13:30	660
7/14/05	12:45	10
7/21/05	14:45	80
8/1/05	10:35	40
8/10/05	17:15	30
8/25/05	10:50	180
9/15/05	15:00	20
4/2/06	12:20	ND (5)
4/17/06	13:50	ND (5)
4/24/06	15:10	ND (5)
4/26/06	11:35	10
5/3/06	13:15	20
5/8/06	13:00	30
5/10/06	13:00	220
5/18/06	14:50	30
5/22/06	12:15	30
5/25/06	13:35	260
5/30/06	15:30	ND (5)
6/1/06	13:30	ND (5)
6/22/06	14:15	1200
6/26/06	15:30	200

Site 385343

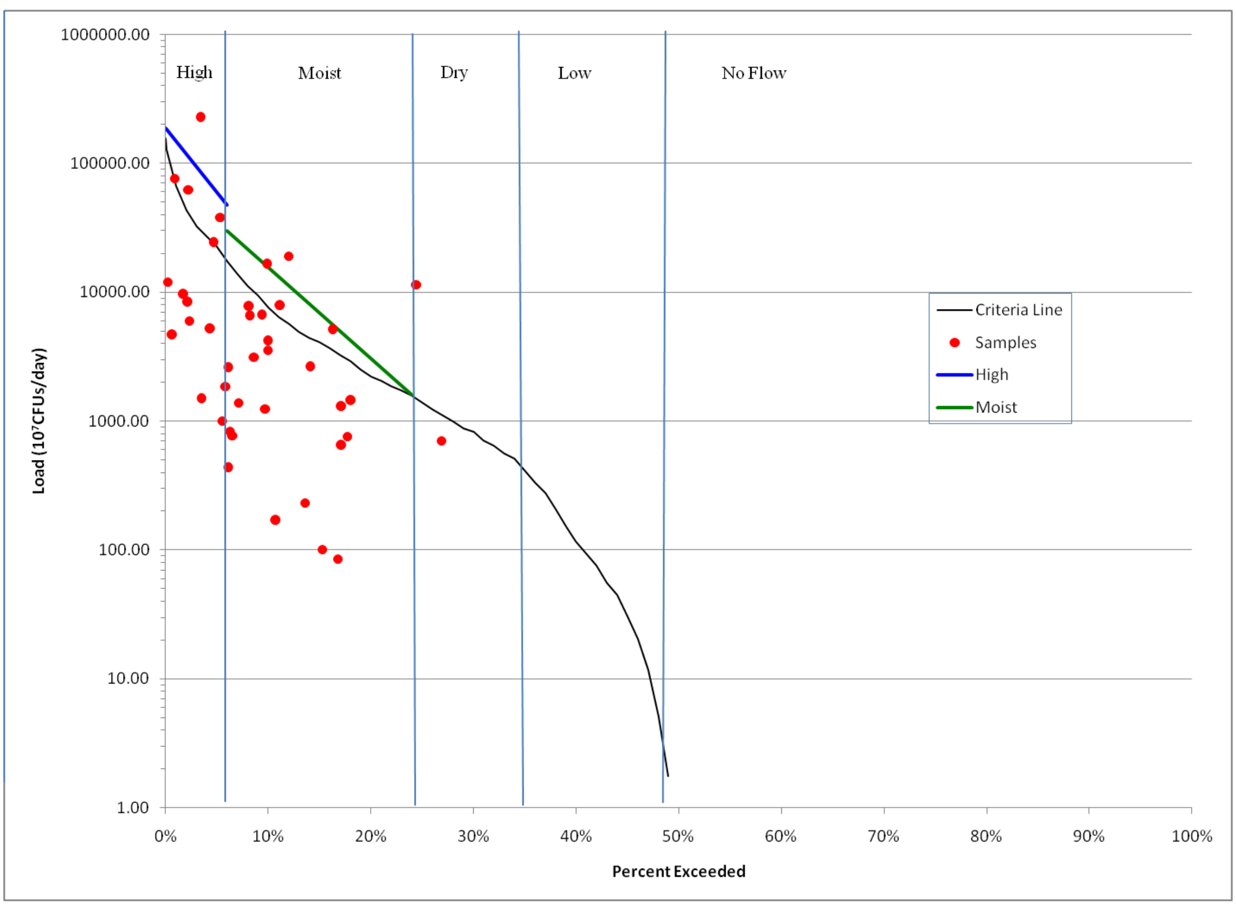
Date	Time	Value
4/6/05	12:00	10
4/11/05	14:20	20
4/13/05	12:30	ND (5)
4/18/05	15:25	10
4/20/05	14:45	20
4/25/05	12:25	30
4/27/05	16:00	ND (5)
5/2/05	15:25	10
5/4/05	15:15	ND (5)
5/9/05	15:30	40
5/11/05	12:00	80
5/16/05	12:40	50
5/18/05	17:15	100
5/23/05	13:50	660
5/25/05	16:00	110
5/31/05	14:40	90
6/2/05	11:15	250
6/9/05	13:20	150
6/16/05	11:30	140
6/20/05	14:50	60
6/30/05	12:25	360
7/14/05	13:45	20
7/21/05	14:10	200
8/1/05	10:10	300
8/10/05	16:45	10
8/25/05	11:20	10
9/15/05	14:45	ND (5)
4/2/06	13:47	10
4/17/06	14:10	40
4/24/06	15:30	40
4/26/06	15:25	30
5/3/06	15:15	TNTC (1500)
5/8/06	12:00	40
5/10/06	14:00	200
5/18/06	13:30	30
5/22/06	11:15	120
5/25/06	14:00	420
5/30/06	13:30	120
6/1/06	14:30	290
6/22/06	14:35	TNTC (1500)
6/26/06	16:00	120

Appendix B
Flow Duration Curve, Load Duration Curve, and TMDL Summary

For Impaired Reach ND-09010004-002-S_00 (represented by site 385343), Oak Creek, ND



Flow Duration Curve



Load Duration Curve

	Load (10^7 CFU/Day)				Load (10^7 CFU/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
High	3.01%	94200.67	32471.88	21.86	2059556.39	709948.90	65.53%
Moist	15.00%	6916.14	4097.83	65.70	454390.52	269227.26	40.75%
			Total	88	2513947	979176	61.05%

Appendix C
Summary of NDPDES Discharge Monitoring Data for Permitted Facilities in the Oak Creek Watershed

Bottineau Waste Water Treatment Plant

([1]Only values during the recreation season of May 1 - Sept 30th were used in calculations)

Permit#	Facility Name	Trt Name	Start	End	Days	Total Discharged	Units	Discharge/ Day[1]
NDG320435	Bottineau City Of	Cell 2	6/29/2005	7/4/2005	6	19.732	MGAL	6.05138462
NDG320435	Bottineau City Of	Cell 3	6/29/2005	7/5/2005	7	19.602	MGAL	
NDG320435	Bottineau City Of	Cell 2	9/29/2005	10/4/2005	6	24.665	MGAL	4.11083333
NDG320435	Bottineau City Of	Cell 3	10/5/2005	10/11/2005	7	22.052	MGAL	
NDG320435	Bottineau City Of	Cell 2	5/9/2006	5/13/2006	5	12.33	MGAL	2.466
NDG320435	Bottineau City Of	Cell 3	5/18/2006	5/24/2006	7	17.15	MGAL	2.45
NDG320435	Bottineau City Of	Cell 2	11/9/2006	11/14/2006	6	14.8	MGAL	
NDG320435	Bottineau City Of	Cell 3	11/9/2006	11/15/2006	7	17.15	MGAL	
NDG320435	Bottineau City Of	Cell 2	6/26/2007	7/2/2007	7	19.732	MGAL	2.81885714
NDG320435	Bottineau City Of	Cell 2	11/2/2007	11/7/2007	6	14.8	MGAL	
NDG320435	Bottineau City Of	Cell 3	11/2/2007	11/8/2007	7	17.15	MGAL	
NDG320435	Bottineau City Of	Cell 2	8/6/2008	8/10/2008	5	17.27	MGAL	6.145
NDG320435	Bottineau City Of	Cell 3	8/6/2008	8/12/2008	7	19.6	MGAL	
NDG320435	Bottineau City Of	Cell 2	11/1/2008	11/7/2008	7	19.732	MGAL	
NDG320435	Bottineau City Of	Cell 2	5/1/2009	5/6/2009	6	14.8	MGAL	2.46666667
NDG320435	Bottineau City Of	Cell 3	6/27/2009	7/2/2009	6	19.6	MGAL	6.55
NDG320435	Bottineau City Of	Cell 2	6/27/2009	7/2/2009	6	19.7	MGAL	
NDG320435	Bottineau City Of	Cell 2	10/26/2009	11/1/2009	7	17.27	MGAL	

Average per day (MGAL): 4.13234272

(discharge from both cells combined on same flow days)

Bottineau Waste Water Treatment Plant

([1]Only values during the recreation season of May 1 - Sept 30th were used in calculations)

Permit#	Facility Name	Trt Name	Start	End	Days	Total Discharged	Units	Discharge/ Day[1]
NDG320435	Bottineau City Of	Cell 2	6/29/2005	7/4/2005	6	19.732	MGAL	3.289
NDG320435	Bottineau City Of	Cell 3	6/29/2005	7/5/2005	7	19.602	MGAL	2.8
NDG320435	Bottineau City Of	Cell 2	9/29/2005	10/4/2005	6	24.665	MGAL	4.11083333
NDG320435	Bottineau City Of	Cell 3	10/5/2005	10/11/2005	7	22.052	MGAL	
NDG320435	Bottineau City Of	Cell 2	5/9/2006	5/13/2006	5	12.33	MGAL	2.466
NDG320435	Bottineau City Of	Cell 3	5/18/2006	5/24/2006	7	17.15	MGAL	2.45
NDG320435	Bottineau City Of	Cell 2	11/9/2006	11/14/2006	6	14.8	MGAL	
NDG320435	Bottineau City Of	Cell 3	11/9/2006	11/15/2006	7	17.15	MGAL	
NDG320435	Bottineau City Of	Cell 2	6/26/2007	7/2/2007	7	19.732	MGAL	2.81885714
NDG320435	Bottineau City Of	Cell 2	11/2/2007	11/7/2007	6	14.8	MGAL	
NDG320435	Bottineau City Of	Cell 3	11/2/2007	11/8/2007	7	17.15	MGAL	
NDG320435	Bottineau City Of	Cell 2	8/6/2008	8/10/2008	5	17.27	MGAL	3.45
NDG320435	Bottineau City Of	Cell 3	8/6/2008	8/12/2008	7	19.6	MGAL	2.8
NDG320435	Bottineau City Of	Cell 2	11/1/2008	11/7/2008	7	19.732	MGAL	
NDG320435	Bottineau City Of	Cell 2	5/1/2009	5/6/2009	6	14.8	MGAL	2.46666667
NDG320435	Bottineau City Of	Cell 3	6/27/2009	7/2/2009	6	19.6	MGAL	3.27
NDG320435	Bottineau City Of	Cell 2	6/27/2009	7/2/2009	6	19.7	MGAL	3.28
NDG320435	Bottineau City Of	Cell 2	10/26/2009	11/1/2009	7	17.27	MGAL	

Average per day (MGAL): 3.02

(discharge from each cell computed seperately)

Lake Metigoshe Recreational District Waste Water Treatment Plant

([1]Only values during the recreation season of May 1 - Sept 30th were used in calculations)

Permit#	Facility Name	Trt Name	Start	End	Days	Total Discharged	Units	Discharge/ Day[1]
NDG325330	Lake Metigoshe Recreation	Cell 3	4/19/2005	4/21/2005	3	3.94	MGAL	
NDG325330	Lake Metigoshe Recreation	Cell 3A (Cell 4)	6/6/2005	6/10/2005	5	5.645	MGAL	1.129
NDG325330	Lake Metigoshe Recreation	Cell 3A (Cell 4)	6/27/2005	6/29/2005	3	4.86	MGAL	1.62
NDG325330	Lake Metigoshe Recreation	Cell 3A (Cell 4)	7/6/2005	7/9/2005	4	6.35	MGAL	1.5875
NDG325330	Lake Metigoshe Recreation	Cell 3A (Cell 4)	8/1/2005	8/4/2005	4	6.74	MGAL	1.685
NDG325330	Lake Metigoshe Recreation	Cell 3	10/4/2005	10/9/2005	6	3.73	MGAL	
NDG325330	Lake Metigoshe Recreation	Cell 3A (Cell 4)	10/4/2005	10/9/2005	6	5.96	MGAL	
NDG325330	Lake Metigoshe Recreation	Cell 3A (Cell 4)	4/18/2006	4/21/2006	4	7.057	MGAL	
NDG325330	Lake Metigoshe Recreation	Cell 3	6/12/2006	6/15/2006	4	4.153	MGAL	1.90075
NDG325330	Lake Metigoshe Recreation	Cell 3A (Cell 4)	6/12/2006	6/15/2006	4	3.45	MGAL	
NDG325330	Lake Metigoshe Recreation	Cell 3A (Cell 4)	10/5/2006	10/10/2006	6	2.82	MGAL	
NDG325330	Lake Metigoshe Recreation	Cell 3A (Cell 4)	11/1/2006	11/3/2006	3	2.5	MGAL	
NDG325330	Lake Metigoshe Recreation	Cell 3A (Cell 4)	5/23/2007	5/25/2007	3	5.02	MGAL	1.6733333
NDG325330	Lake Metigoshe Recreation	Cell 3A (Cell 4)	7/27/2007	8/1/2007	6	6.72	MGAL	1.12
NDG325330	Lake Metigoshe Recreation	Cell 3A (Cell 4)	10/22/2007	10/25/2007	4	2.82	MGAL	
NDG325330	Lake Metigoshe Recreation	Cell 3A (Cell 4)	5/29/2008	6/2/2008	5	4.08	MGAL	0.816
NDG325330	Lake Metigoshe Recreation	Cell 3A (Cell 4)	7/29/2008	8/2/2008	5	6.12	MGAL	1.224
NDG325330	Lake Metigoshe Recreation	Cell 3A (Cell 4)	10/23/2008	10/27/2008	5	3.14	MGAL	
NDG325330	Lake Metigoshe Recreation	Cell 3A (Cell 4)	5/4/2009	5/7/2009	4	7.84	MGAL	1.96
NDG325330	Lake Metigoshe Recreation	Cell 3A (Cell 4)	6/26/2009	7/1/2009	6	6.9	MGAL	1.15
NDG325330	Lake Metigoshe Recreation	Cell 3A (Cell 4)	8/4/2009	8/7/2009	4	4.08	MGAL	1.02

Average per day (MGAL):	1.4071319

(discharge from both cells combined on same flow days)

Appendix D
US EPA Region VIII Public Notice Review and Comments

EPA REGION VIII TMDL REVIEW

TMDL Document Info:

Document Name:	**Fecal Coliform Bacteria TMDL for Oak Creek in Bottineau County, North Dakota**
Submitted by:	**Mike Ell, North Dakota Department of Health**
Date Received:	**September 9, 2010**
Review Date:	**October 1, 2010**
Reviewer:	**Vern Berry, EPA**
Rough Draft / Public Notice / Final?	**Public Notice**
Notes:	

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

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

Approval Notes to Administrator:

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

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

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

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

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

1. Problem Description

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

1.1 TMDL Document Submittal Letter

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

Minimum Submission Requirements.

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

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

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

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

SUMMARY: The public notice draft Oak Creek fecal coliform TMDL was submitted to EPA for review via an email from Mike Ell, NDDoH on September 9, 2010. The email included the draft TMDL document and a request to review and comment on the TMDL document.

COMMENTS: None.

1.2 Identification of the Waterbody, Impairments, and Study Boundaries

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

Minimum Submission Requirements:

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

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

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

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

SUMMARY: The Oak Creek watershed is an 88,807 acre watershed located in Bottineau County, in north central North Dakota. The listed segment of Oak Creek flows from its confluence with Willow Creek, upstream to Lake Metigoshe, including all tributaries (82.4 miles; ND-09010004-002-S_00). It is part of the larger Souris River basin in the Willow sub-basin (HUC 09010004). This segment is listed as impaired for fecal coliform bacteria and is a high priority for TMDL development.

The designated uses for Oak Creek are based on the Class III stream classification in the ND water quality standards (NDCC 33-15-02.1-09).

COMMENTS: None.

1.3 Water Quality Standards

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

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

Minimum Submission Requirements:

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

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

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

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

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

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

SUMMARY: The Oak Creek segment addressed by this TMDL document is impaired based on fecal coliform concentrations impacting the recreational uses. Oak Creek is a Class III stream. 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. Also, the quality of these waters must be maintained to protect secondary contact recreation uses (e.g., wading), fish and aquatic biota, and wildlife uses. Numeric criteria for fecal coliforms and E. coli in North Dakota, Class III streams have been established and are presented in the excerpted Table 10 shown below. Discussion of additional applicable water quality standards for Oak Creek can be found on pages 12 – 13 of the TMDL.

Table 10. North Dakota Fecal Coliform and E. coli Bacteria Standards for Class III Streams.

Parameter	Water Quality Standard	
	Geometric Mean[1]	Maximum[2]
Fecal Coliform Bacteria	200 CFU/100 mL	400 CFU/100 mL
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: None.

2. Water Quality Targets

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

Minimum Submission Requirements:

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

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

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

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

SUMMARY: The water quality target for this TMDL is based on the numeric water quality standards for fecal coliform bacteria based on the recreational beneficial use for Oak Creek. The target for Oak Creek is the fecal coliform standard expressed as the 30-day geometric mean of 200 CFU/100 mL during the recreation season from May 1 to September 30. While the standard is intended to be expressed as the 30-day geometric mean, the target was used to compare to values from single grab samples. This ensures that the reductions necessary to achieve the target will be protective of both the acute (single sample value) and chronic (geometric mean of 5 samples) standard.

North Dakota currently has both a fecal coliform bacteria standard and an E. coli bacteria standard. During the next triennial water quality standards review period, the Department will be eliminating the fecal coliform bacteria standard and will only have the E. coli standard for bacteria. During this transition period to an E. coli only bacteria standard, the fecal coliform bacteria target for this TMDL and the resulting load allocation is believed to be protective of the E. coli standard as well. The department will assess attainment of the E. coli standard through additional monitoring consistent with the state's water quality standards and beneficial use assessment methodology.

COMMENTS: None.

3. Pollutant Source Analysis

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

Minimum Submission Requirements:

- ☒ The TMDL should include an identification of all potentially significant point and nonpoint sources of the pollutant of concern, including the geographical location of the source(s) and the quantity of the loading, e.g., lbs/per day. This information is necessary for EPA to evaluate the WLA, LA and MOS components of the TMDL.
- ☒ The level of detail provided in the source assessment should be commensurate with the nature of the watershed and the nature of the pollutant being studied. Where it is possible to separate natural background from nonpoint sources, the TMDL should include a description of both the natural background loads and the nonpoint source loads.
- ☒ Natural background loads should not be assumed to be the difference between the sum of known and quantified anthropogenic sources and the existing *in situ* loads (e.g. measured in stream) unless it can be demonstrated that all significant anthropogenic sources of the pollutant of concern have been identified, characterized, and properly quantified.
- ☒ The sampling data relied upon to discover, characterize, and quantify the pollutant sources should be included in the document (e.g. a data appendix) along with a description of how the data were analyzed to characterize and quantify the pollutant sources. A discussion of the known deficiencies and/or gaps in the data set and their potential implications should also be included.

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

SUMMARY: The TMDL document includes the landuse breakdown for the watershed based on the 2005 National Agricultural Statistics Service (NASS) data. In 2005, the dominant land use in the Oak Creek watershed was agriculture consisting of crop production and livestock grazing. Approximately 45 percent of the landuse in the watershed was cropland, 36 percent was pastureland / rangeland, 2 percent was low density urban development and the remaining 17 percent was wetlands, water and woods. The majority of the crops grown consist of wheat and other small grains and soybeans.

Within Oak Creek watershed there are two wastewater treatment systems permitted through the North Dakota Pollutant Discharge Elimination System Program. One in Bottineau, ND and one further upstream near the headwaters at Lake Metigoshe managed by the Lake Metigoshe Recreational District. Each system is allowed to discharge on an "as needed" basis, which averages about twice per year. Wasteload allocations are given to these facilities as described later in the wasteload allocation summary. Dwellings in this watershed also utilized individual septic waste systems. There are no confined animal feeding operations (CAFOs) in Oak Creek watershed. There are three permitted AFOs in the watershed, one medium (less than 1000 cattle) and two small (less than 300 cattle). However, they are zero discharge facilities and are not deemed a significant source for this report. The number of non-permitted animal feeding operations is unknown, but thought to be significant as a high proportion of the watershed is in pasture and range land use.

The listed segment of Oak Creek is experiencing fecal coliform bacteria pollution from non point sources in the watershed. Livestock production is a significant agricultural practice in the watershed. Primary nonpoint sources for fecal coliform bacteria in Oak Creek watershed are as follows:

- Runoff of manure from cropland and pasture if there is knowledge of manure being applied;
- Runoff of manure from unpermitted animal feeding areas;
- Direct deposit of manure into Oak Creek by livestock.

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

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

COMMENTS: None.

4. TMDL Technical Analysis

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

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

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

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

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

Where:

TMDL = Total Pollutant Loading Capacity of the waterbody

LAs = Pollutant Load Allocations

WLAs = Pollutant Wasteload Allocations

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

Minimum Submission Requirements:

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

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

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

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

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

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

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

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

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

SUMMARY: The technical analysis should describe the cause and effect relationship between the identified pollutant sources, the numeric targets, and achievement of water quality standards. It should also include a description of the analytical processes used, results from water quality modeling, assumptions and other pertinent information. The technical analysis for the Oak Creek watershed TMDL describes how the fecal coliform loads were derived in order to meet the applicable water quality standards for the 303(d) impaired stream segment.

The TMDL loads and loading capacities were derived using the load duration curve (LDC) approach. To better correlate the relationship between the pollutant of concern and the hydrology of the Section 303(d) listed waterbody, a LDC was developed for monitoring site 385343. The LDC was derived using the 200 CFU/100 mL TMDL target (i.e., state water quality standard), the daily flow record, and the observed fecal coliform data collected from the site (see Figure 9 of the TMDL document for a map of the monitoring locations) from 2005-2006.

A daily discharge record was constructed for Oak Creek site 385343 using the Drainage-Area Ratio Method and the historical discharge measurements (1987–2009) collected by the USGS at gauging station 05123400 located in the Willow Creek watershed. Site 385343 on Oak Creek is located within the Willow Creek watershed, so an appropriate portion of the flow at the USGS site was used in calculations. The Drainage-Area Ratio Method assumes that the stream flow at the ungauged site is hydrologically similar to the stream gauging station used as an index. Land use was also compared for the two watersheds to determine similarities. The index station (05123400) streamflow data was then divided by the drainage area to determine streamflows per unit area at the index station. Those values are then multiplied by the drainage area for the ungauged site to obtain estimated flow statistics for the ungauged site.

To estimate the required percent reductions in loading needed to achieve the TMDL, a linear regression line through the fecal coliform load data above the TMDL curve in each flow regime was plotted. The required percent reductions needed under the three four regimes were determined using the linear regression line.

The LDC represents flow-variable TMDL targets across the flow regimes shown in the TMDL document. For the Oak Creek segment covered by the TMDL document, the LDC is a dynamic expression of the allowable load for any given daily flow. Loading capacities were derived from this approach for the entire listed segment at each flow regime. Table 14 shows the loading capacity load (i.e., TMDL load) for the listed segment of Oak Creek.

COMMENTS: None.

4.1 Data Set Description

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

Minimum Submission Requirements:

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

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

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

SUMMARY: The Oak Creek TMDL data description and summary are included in the Available Data section, in tables throughout the document and in the data table in Appendix A. Recent water quality monitoring was conducted over the period from 2005-2006 and included 41 fecal coliform samples at station 385343. The data set also includes approximately 22 years of flow record from USGS gauging station 05123400. The flow data, the fecal coliform data and the TMDL target, were used to develop the fecal coliform load duration curve for Oak Creek.

COMMENTS: None.

4.2 Waste Load Allocations (WLA):

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

Minimum Submission Requirements:

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

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

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

SUMMARY: Within Oak Creek watershed there are two wastewater treatment systems permitted through the North Dakota Pollutant Discharge Elimination System (NDPDES) Program. One in Bottineau, ND and one further upstream near the headwaters at Lake Metigoshe managed by the Lake Metigoshe Recreational District.

According to the NDPEDS permit for Bottineau, ND, a wastewater discharge is allowed on an “as needed” basis. Discharge monitoring reports (DMRs) indicate this wastewater treatment system averages two discharges per year, with up to four times a year during heavy precipitation years. Based on the DMR data, average daily discharge during the recreation season (May 1 – September 30) for the years 2005 to present is 4.13 million gallons per day (MGD) during the intermittent discharge. Typically this is a combined discharge from two cells. Assuming they discharged from each cell separately for 12-14 days rather than the typical 6-7 days, their average daily daily discharge would be reduced to 3.02 MGD. Since no fecal coliform or E. coli bacteria data are collected as a permit requirement, a fecal coliform concentration of 200 CFUs/100 mL is assumed for the wasteload allocation calculation. This value was chosen both because it is the North Dakota water quality standard, and because those dischargers throughout the state that are required to sample for bacteria are assigned this same value in their permit. The wasteload allocation for Bottineau, ND was determined by taking an average daily discharge volume of 3.02 MGD multiplied by a fecal coliform concentration of 200 CFUs/100 mL, times appropriate conversion factors.

According to the NDPDES permit for Lake Metigoshe, the District is allowed to discharge on an “as needed” basis. The DMR indicates this wastewater treatment system averages discharges twice per year, with up to four times a year during heavy precipitation years. The last year that the District discharged four times was during the 2005 floods. In 2006 in response to the flooding events and a growing demand placed on the system by new housing construction, the District added two new cells to their system to reduce the needed discharges. Based on DMR data, average daily discharge during the recreation season (May 1 – September 30) for the years 2005 to present is 1.41 million gallons per day during the intermittent discharge. Since no fecal coliform or E. coli bacteria data are collected for this site either, the system is also assigned the water quality standards value of 200 CFU/100mL for this TMDL. Wasteload allocation for Lake Metigoshe Recreational District was determined by taking the average discharge and multiplying by the assumed fecal coliform concentration of 200 CFUs/100mL, times appropriate conversion factors.

The WLAs for both wastewater discharges are expressed as a daily load in the TMDL. However, those loads represent the worst case scenario when both facilities are discharging at the same time. More likely, they will discharge at different times for several days each year. If the loads were expressed for a seasonal or annual time period, the WLAs would make up only a small percentage of the total load of fecal coliform to Oak Creek.

There are three permitted AFOs in the watershed, one medium (less than 1000 cattle) and two small (less than 300 cattle). However, they are zero discharge facilities and are not deemed a significant source for this report.

COMMENTS: None.

4.3 Load Allocations (LA):

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

Minimum Submission Requirements:

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

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

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

SUMMARY: The TMDL document includes the cropland landuse breakdown for the watershed based on the 2005 National Agricultural Statistics Service data. In 2005, the dominant land use in the Oak Creek watershed was agriculture consisting of crop production and livestock grazing. Approximately 45 percent of the landuse in the watershed was cropland, 36 percent was pastureland / rangeland, 2 percent was low density urban development and the remaining 17 percent was wetlands, water and woods.

The load reductions needed for the Oak Creek fecal coliform bacteria TMDL can be generally allotted to nonpoint sources. Livestock production is a significant agricultural practice in the watershed. Primary nonpoint sources for fecal coliform bacteria in Oak Creek watershed are as follows:

- Runoff of manure from cropland and pasture if there is knowledge of manure being applied;
- Runoff of manure from unpermitted animal feeding areas;
- Direct deposit of manure into Oak Creek by livestock.

By relating runoff characteristics to each flow regime one can infer which sources are most likely to contribute to fecal coliform bacteria loading. Animals grazing in the riparian area contribute fecal coliform bacteria by depositing manure where it has an immediate impact on water quality. Due to the close proximity of manure to the stream or by direct deposition in the stream, riparian grazing impacts water quality at high, moist and dry condition, and low flows. In contrast, intensive grazing of livestock in the upland and not in the riparian area has a high potential to impact water quality at high flows and medium impact at moist condition flows. Exclusion of livestock from the riparian area eliminates the potential of direct manure deposit and, therefore, is considered to be of high importance at all flows. However, intensive grazing in the upland creates the potential for manure accumulation and availability for runoff at high flows and a high potential for fecal coliform bacteria contamination.

Source specific data are limited so an aggregate LA is assigned to nonpoint sources with a ranking of important contributors under various flow regimes provided as seen in the following excerpted table.

Table 12. Nonpoint Sources of Pollution and Their Potential to Pollute at a Given Flow Regime.

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

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

COMMENTS: None.

4.4 Margin of Safety (MOS):

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

Minimum Submission Requirements:

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

- ☐ <u>If the MOS is implicit</u>, 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.

- ☒ <u>If the MOS is explicit</u>, 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.

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

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

SUMMARY: The Oak Creek TMDL includes an explicit MOS for the listed segment derived by calculating 10 percent of the loading capacity. The explicit MOS for the Oak Creek segment is included in Table 14.

COMMENTS: None.

4.5 Seasonality and variations in assimilative capacity:

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

Minimum Submission Requirements:

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

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

SUMMARY: By using the load duration curve approach to develop the TMDL allocations, seasonal variability in fecal coliform loads are taken into account. Highest steam flows typically occur during late spring, and the lowest stream flows occur during the winter months. Also, the TMDL is seasonal since the fecal coliform criteria are in effect from May 1 to September 30, therefore the TMDL is only applicable during that period.

COMMENTS: None.

5. Public Participation

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

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

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

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

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

COMMENTS: None.

6. Monitoring Strategy

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

Minimum Submission Requirements:

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

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

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

SUMMARY: Oak Creek will be monitored according to an approved quality assurance project plan. Once a watershed restoration plan is developed and implemented (e.g., a Section 319 Project Implementation Plan), monitoring will be conducted on Oak Creek according to a future Quality Assurance Project Plan, and monitoring will be conducted in the watershed beginning two years after implementation and extending five years after the implementation project is complete.

COMMENTS: None.

7. Restoration Strategy

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

Minimum Submission Requirements:

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

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

SUMMARY: The Allocation section (Section 8.0) of the TMDL document includes a list of BMPs that are recommended to meet the TMDL loads. NDDoH typically works with local conservation districts or other cooperators to develop and implement Watershed Restoration Projects after the TMDL has been developed and approved. Detailed project implementation plans are developed as part of this process if Section 319 money is used.

For the two point sources, as NDPDES permits are renewed, fecal coliform and /or E. coli bacteria limits will be established in their permits and discharge monitoring will be implemented to ensure both the permit limits and their discharge volumes are consistent with their wasteload allocations and therefore, water quality standards. When the permits for the two towns are renewed, it may be necessary to document reasonable assurance demonstrating that the nonpoint source loadings are practicable.

COMMENTS: None.

8. Daily Loading Expression

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

Minimum Submission Requirements:

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

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

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

COMMENTS: None.