E. coli Bacteria TMDL for the Wild Rice River in Richland County, North Dakota

Final: August 2018

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1.0 INTRODUCTION AND DESCRIPTION OF THE WATERSHED

The Wild Rice River watershed is a 1.4 million acre watershed located in Cass, Dickey, Ransom, Richland and Sargent Counties in southeastern North Dakota and Marshall and Roberts Counties in northeastern South Dakota (Figure 1). For the purposes of this TMDL, the impaired watershed segment is located in Richland County and comprises approximately 64,469 acres. The Wild Rice River impaired segment watershed lies within the Lake Agassiz Plain (48) Ecoregion.

Table 1. General Characteristics of the Wild Rice River Watershed.

Legal Name	Wild Rice River
Stream Classification	Class II
Major Drainage Basin	Red River
8-Digit Hydrologic Unit	09020105
Counties	Richland County
Level III Ecoregion	Lake Agassiz Plain (48)
Watershed Area (acres)	64,469

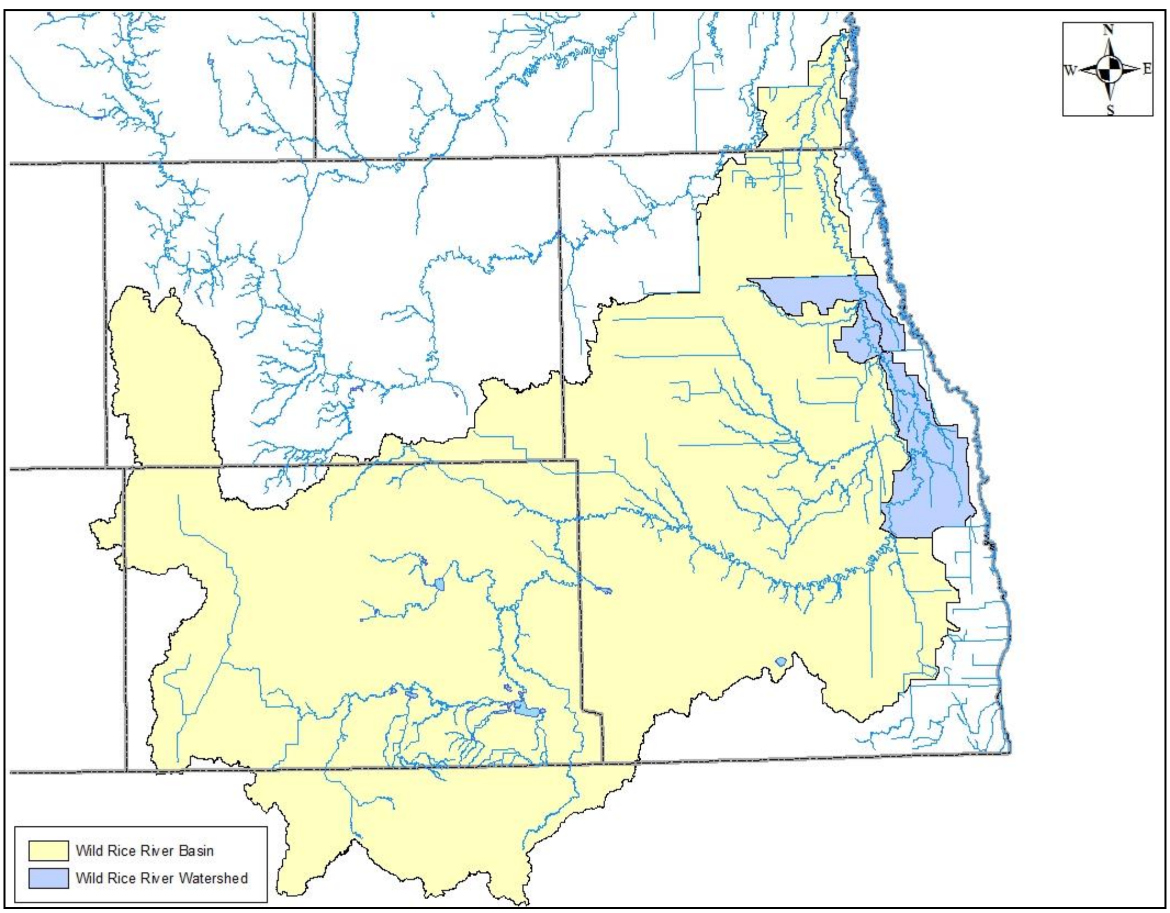

Figure 1. Wild Rice River Basin and TMDL Listed Segment Watershed in North Dakota.

1.1 Clean Water Act Section 303(d) Listing Information

Based on the 2016 Section 303 (d) List of Impaired Waters Needing TMDLs (NDDoH, 2017), the North Dakota Department of Health has identified a 47.49-mile segment (ND-09020105-003-S_00) of the Wild Rice River from its confluence with a tributary about 3.6 miles northeast of Great Bend, ND downstream to its confluence with the Colfax Watershed as fully supporting but threatened for recreational use due to E. coli bacteria (Table 2 and Figure 2).

In 2011, the NDDoH revised the state water quality standard for bacteria from a fecal coliform bacteria standard to an E. coli bacteria standard for protection of recreational uses. Segment ND-09020105-003-S_00 was originally listed for a recreational use impairment due to fecal coliform bacteria and in 2009 a fecal coliform TMDL was approved by EPA Region 8. Following the completion of the fecal coliform TMDL, the NDDoH began collecting E. coli data and in 2014 listed the waterbody for a recreational use impairment due to E. coli bacteria. The purpose of this TMDL is to address the E. coli bacteria impairment. As a result, and due to the water quality standards change and newly gathered data, segment ND-09020105-003-S_00 will be delisted for fecal coliform bacteria impairment and this E. coli bacteria TMDL will supersede the previous fecal coliform bacteria TMDL.

Table 2. Wild Rice River Section 303(d) Listing Information for Assessment Unit ND-09020105-003-S_00 (NDDoH, 2017).

Assessment Unit ID	ND-09020105-003-S_00
Waterbody Description	Wild Rice River from its confluence with a tributary about 3.6 miles northeast of Great Bend, ND downstream to its confluence with the Colfax Watershed.
Size	47.49 miles
Designated Use	Recreation
Use Support	Fully Supporting but Threatened
Impairment	E. coli Bacteria
TMDL Priority	High

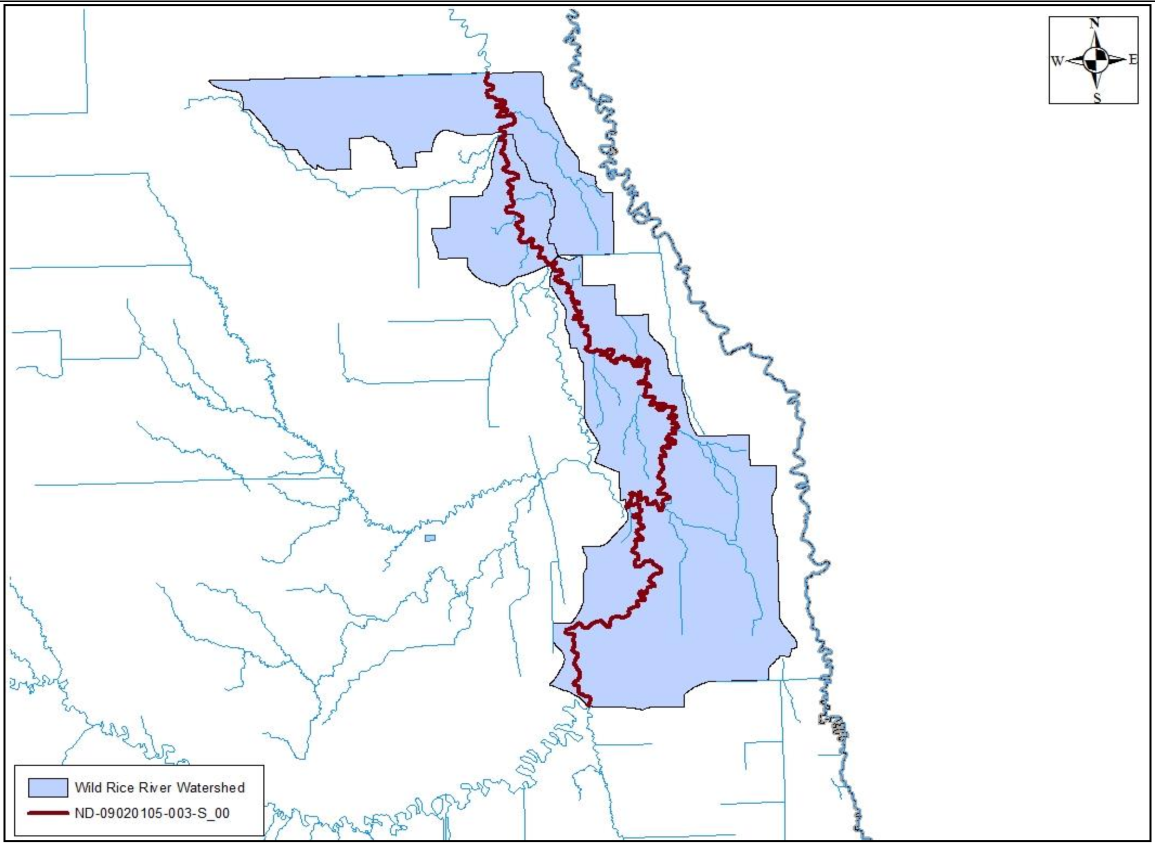

Figure 2. Wild Rice River TMDL Listed Segment.

1.2 Topography

The watershed for the Section 303(d) listed segment highlighted in this TMDL lies within the Level IV Glacial Lake Agassiz Plain (48a) and Sand Deltas and Beach Ridges (48b) ecoregions (Figure 3).

The Glacial Lake Agassiz Plain ecoregion (48a) is comprised of thick beds of glacial drift overlain by silt and clay lacustrine deposits from glacial Lake Agassiz. The topography of this ecoregion is extremely flat, with sparse lakes and pothole wetlands. Tallgrass prairie was the dominant habitat prior to European settlement and has now been replaced with intensive agriculture. Agricultural production in the southern region consists of corn, soybeans, wheat, and sugar beets.

The Sand Deltas and Beach Ridges (48b) ecoregion disrupts the flat topography of the Red River Valley. The beach ridges are parallel lines of sand and gravel that were formed by wave action of the contrasting shoreline levels of Lake Agassiz. The deltas consist of lenses of fine to coarse sand and are blown into dunes (USGS, 2006).

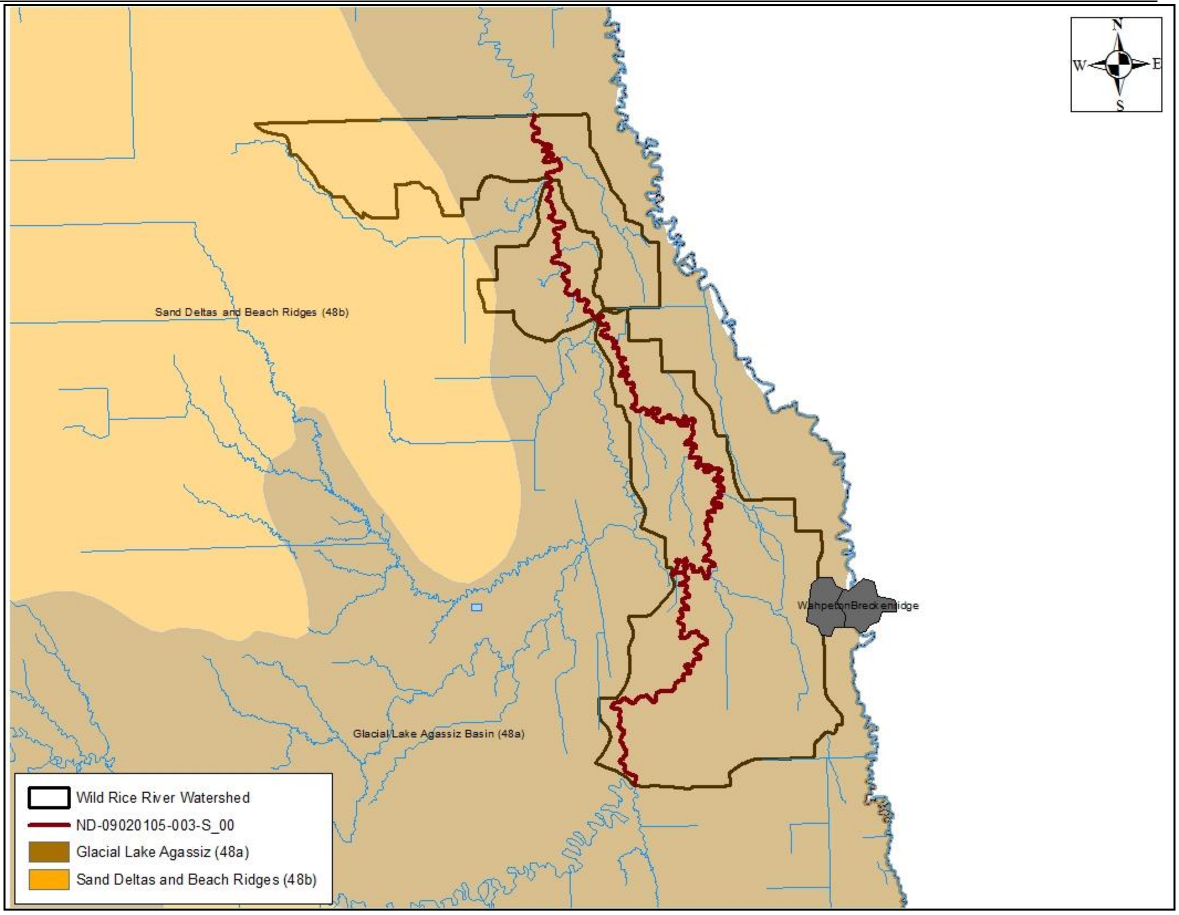

Figure 3. Level IV Ecoregion in the Wild Rice River TMDL Listed Segment Watershed.

1.3 Land Use

The dominant land use in the Wild Rice River TMDL listed segment watershed is row crop agriculture. According to the 2015 National Agricultural Statistical Service (NASS) land survey data, approximately 84 percent of the land is cropland, 6 percent is developed space, and 8 percent is in wetlands, riparian woodlands, native grassland, alfalfa and reseeded tame grass. The majority of the crops grown consist of soybeans, corn, spring wheat and sugarbeets (Figure 4). Unpermitted animal feeding operations and "hobby farms" are also present in the Wild Rice River watershed, but their number and location are unknown.

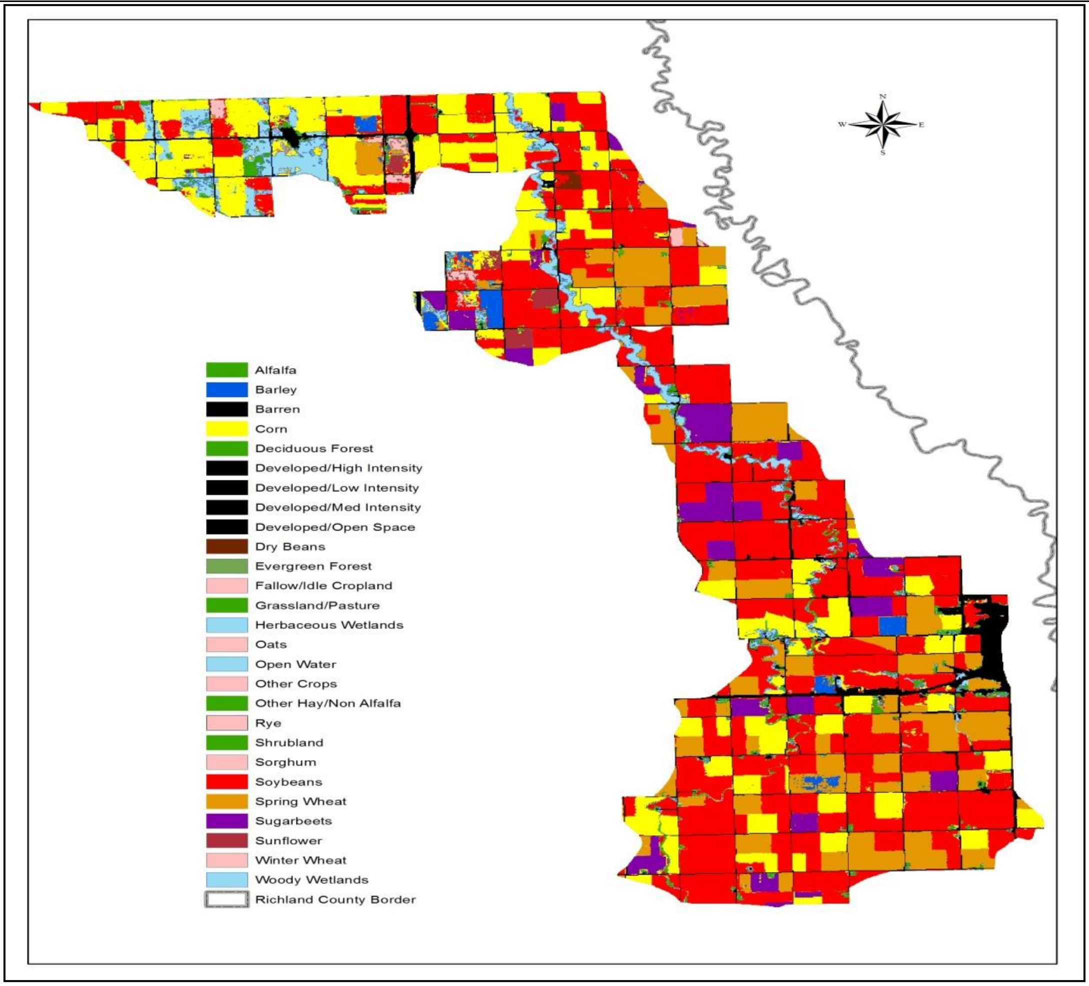

Figure 4. Landuse in the Wild Rice River TMDL Listed Segment Watershed (NASS, 2015).

1.4 Climate and Precipitation

Figures 5 and 6 show the monthly precipitation and temperature for the period 2002-2016 for the North Dakota Agriculture Weather Network (NDAWN) site located near Wapheton, ND which is located near the Wild Rice River watershed. Richland County has a subhumid climate characterized by warm summers with frequent hot days and occasional cool days. Average temperatures range from 12º F in winter to 60º F in summer. Precipitation occurs primarily during the warm period and is normally heavy in later spring and early summer. Total annual precipitation is about 20 inches.

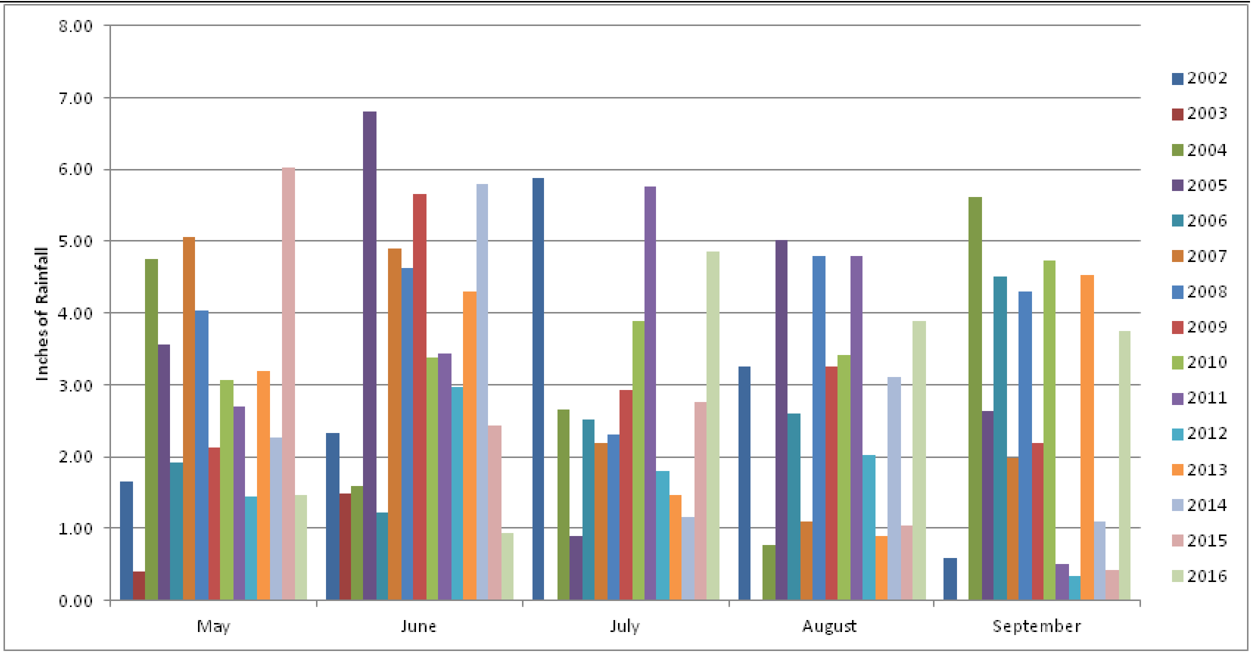

Figure 5. Monthly Precipitation at Wapheton, North Dakota from 2002-2016 (NDAWN, 2016).

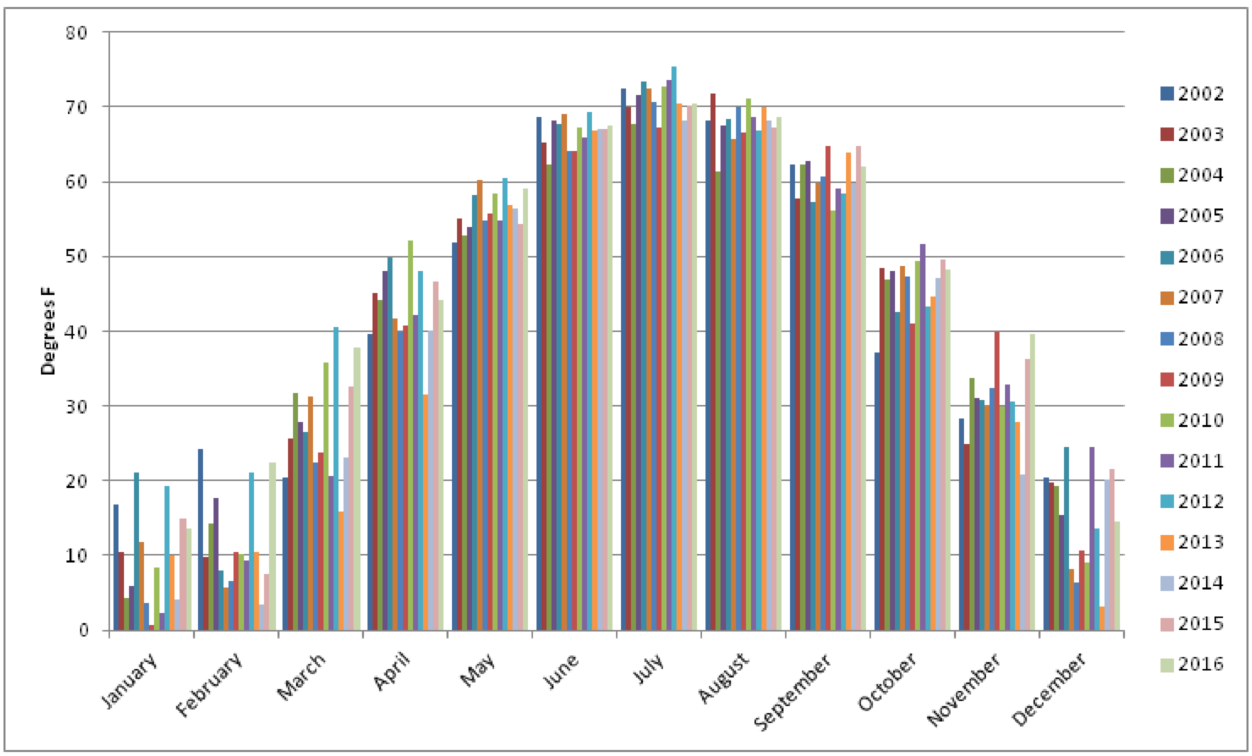

Figure 6. Monthly Air Temperature at Wapheton, North Dakota from 2002-2016 (NDAWN, 2016).

1.5 Available Data

1.5.1 E. coli Bacteria Data

E. coli bacteria samples were collected at one location within the TMDL listed reach (Figure 7). The monitoring site 380031 is located 3.2 miles northwest of

Abercrombie, ND. Site 380031 is a NDDoH Watershed Management Program Ambient Water Quality Monitoring Network station that is monitored monthly during the recreational season (May 1 to September 30) 2001 to 2016.

Table 3 provides a summary of E. coli geometric mean concentrations, the percentage of samples exceeding 409 CFU/100mL for each month and the recreational use assessment by month. The geometric mean E. coli bacteria concentration and the percent of samples over 409 CFU/100ml was calculated for each month (May-September) using those samples collected during each month in 2001 to 2016.

Table 3. Summary of E. coli Bacteria Data for Site 380031 Data Collected in 2001-2016.

Month	N	Geometric Mean Concentration (CFU/100mL)	Percentage of Samples Exceeding 400 CFU/100mL	Recreational Use Assessment
May	11	25	0%	Fully Supporting
June	10	79	10%	Fully Supporting
July	13	96	15%	Fully Supporting but Threatened
August	12	48	0%	Fully Supporting
September	5	108	20%	Fully Supporting but Threatened

Based on the data collected in 2001 to 2016, geometric mean and percent exceeded calculations determined that during the months of July and September the TMDL listed segment of the Wild Rice River is fully supporting but threatened for recreational beneficial use. While, the months of May, June and August was fully supporting recreational beneficial use (Appendix A).

1.5.2 Hydraulic Discharge

A discharge record was constructed for the listed segment based on mean daily discharge measurements collected at the USGS gauging station (05053000) from 2001 to 2016 (Figure 7). Site 380031 is collocated with the USGS gauge station (05053000).

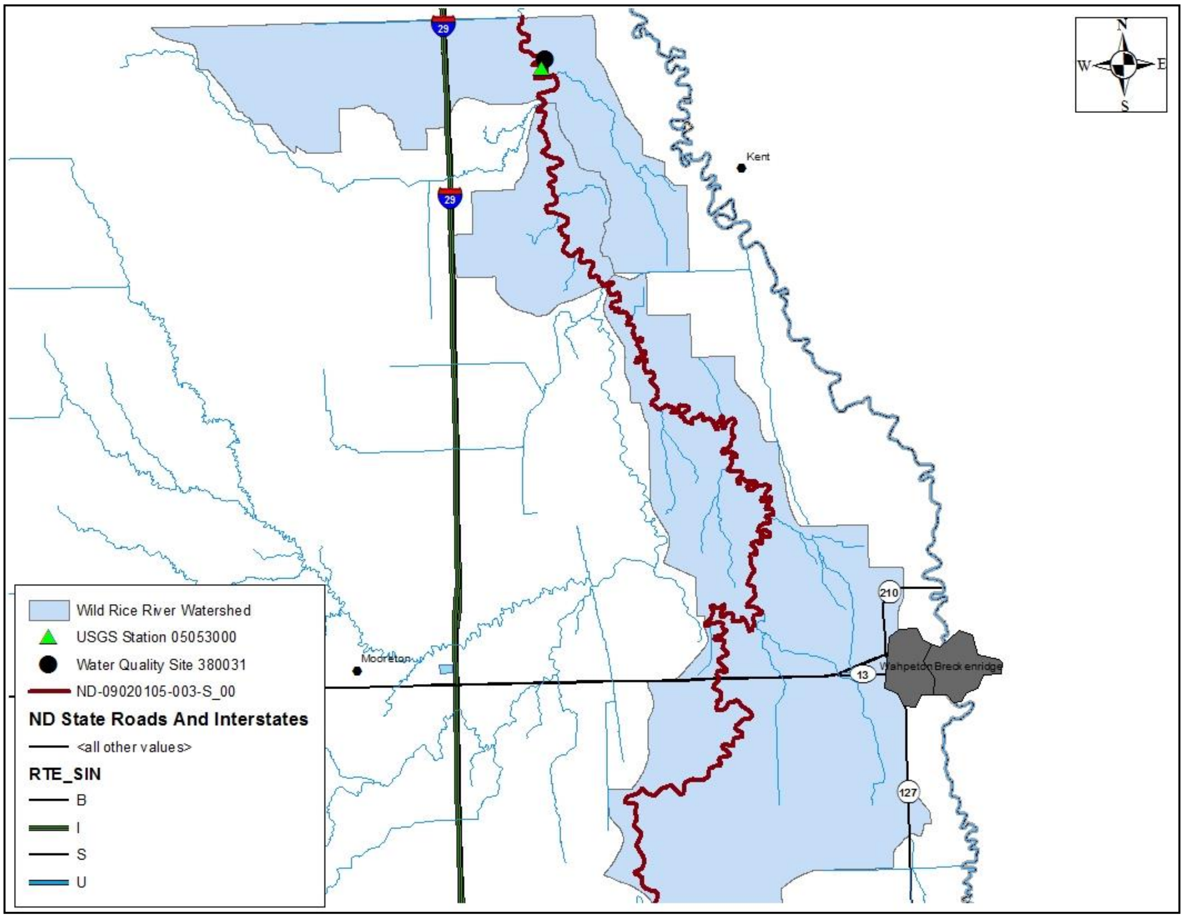

Figure 7. E. coli Bacteria Sample Site (380031) and USGS Gauge Station (05053000) on the TMDL Listed Segment of the Wild Rice River.

2.0 WATER QUALITY STANDARDS

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

2.1 Narrative Water Quality Standards

The NDDoH has set narrative water quality standards that apply to all surface waters in the State. The narrative general water quality standards are listed below (NDDoH, 2014).

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

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

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

In addition to the narrative standards, the NDDoH has set a biological goal for all surface waters in the state. The goal states “the biological condition of surface waters shall be similar to that of sites or waterbodies determined by the department to be regional reference sites” (NDDoH, 2014).

2.2 Numeric Water Quality Standards

The impaired segment of the Wild Rice River is a Class II stream. The NDDoH definition of a Class II stream is shown below (NDDoH, 2014).

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

Table 4 provides a summary of the current numeric E. coli criteria which applies to all streams. The E. coli bacteria standard applies only during the recreation season from May 1 to September 30.

Table 4. North Dakota E. coli Bacteria Water Quality Standards for all Streams.

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

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

3.0 TMDL TARGETS

A TMDL target is the value that is measured to judge the success of the TMDL effort. TMDL target 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 the Wild Rice River is based on the NDDoH water quality standard for E. coli bacteria.

3.1 Wild Rice River Target Reductions in E. coli Bacteria Concentrations

The Wild Rice River segment (ND-09020105-003-S_00) is impaired for recreational use due to E. coli bacteria concentrations exceeding the North Dakota water quality standard. The North Dakota water quality standard for E. coli bacteria is a geometric mean concentration of 126 CFU/100 mL during the recreation season from May 1 to September

30. Thus, the TMDL target for this report is 126 CFU/100 mL. In addition, no more than ten percent of samples collected for E. coli bacteria should exceed 409 CFU/100 mL.

While the standard is intended to be expressed as the 30-day geometric mean, for purposes of these TMDLs, the target is based on an E. coli concentration of 126 CFU/100 mL expressed as a daily average based on individual grab samples. Expressing the target in this way will ensure the TMDL will result in both components of the standard being met and recreational uses are restored.

4.0 SIGNIFICANT SOURCES

4.1 Point Source Pollution Sources

There is no permitted animal feeding operations present within the listed reach of the Wild Rice River watershed. It also should be noted that there is one town located in the watershed it is Colfax, ND but this town is located downstream of the sampling site so it will not be given any waste load allocation in this TMDL. Also, it should be noted that the outer edge of the city of Wapheton, ND is also located in the watershed but will not be given a wasteload allocation because it will be covered in another TMDL and the stormshed does not drain to this watershed.

4.2 Nonpoint Source Pollution Sources

The TMDL listed segment on the Wild Rice River is experiencing E. coli bacteria pollution from non-point sources in the watershed. Livestock production is not the dominant agricultural practice in the watershed, but unpermitted animal feeding operations (AFOs) and "hobby farms" with fewer than 100 animals and livestock grazing and watering in proximity to the Wild Rice River are common along the TMDL listed segment.

The southeast section of North Dakota typically experiences long duration or intense precipitation during the early summer months. These storms can cause overland flooding and rising river levels. Due to the close proximity of these unpermitted AFOs and "hobby farms" to the river, it is likely that this contributes E. coli bacteria to the Wild Rice River. According to aerial imagery a potential AFO is located upstream of monitoring site 380031.

This assessment is also supported by the load duration curve analysis (Section 5.3) which shows all of the exceedences of the E. coli bacteria standard occurring during high, moist and dry condition flows.

Septic system failure might contribute to the E. coli bacteria in the water quality samples. Failures can occur for several reasons, although the most common reason is improper maintenance (e.g. age, inadequate pumping). Other reasons for failure include improper installation, location, and choice of system. Harmful household chemicals can also cause failure by killing the bacteria that digest the waste. Justification for the identification of this source can be found in Section 11.0.

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

5.0 TECHNICAL ANALYSIS

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

The loading capacity or TMDL is the amount of a pollutant (e.g., E. coli bacteria) a waterbody can receive and still meet and maintain water quality standards and beneficial uses.

5.1 Mean Daily Stream Flow

In southeastern 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. Precipitation events of large magnitude, occurring at a faster rate than absorption, contribute to high runoff events. These events are represented by runoff in the high flow regime. The medium flow regime is represented by runoff that contributes to the stream over a longer duration. The low flow regime is characteristic of drought or precipitation events of small magnitude and do not contribute to runoff.

Mean daily flows from 2001 through 2016 were used in the development of the flow duration curve and load duration curve for site 380031. Flows for monitoring station 380031 were obtained from the discharge record at the USGS gauge station (05053000) collocated with station 380031.

5.2 Flow Duration Curve Analysis

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

A basic flow duration curve runs from high to low (0 to 100 percent) along the x-axis with the corresponding flow value on the y-axis (Figure 8). Using this approach, flow duration intervals are expressed as a percentage, with zero corresponding to the highest flows in the record (i.e., flood conditions) and 100 to the lowest flows in the record (i.e., drought and/or freeze over). Therefore, as depicted in Figure 8, a flow duration interval of twenty five (25) percent, associated with a stream flow of 244 cfs, implies that 25 percent of all observed mean daily discharge values equal or exceed 244 cfs.

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

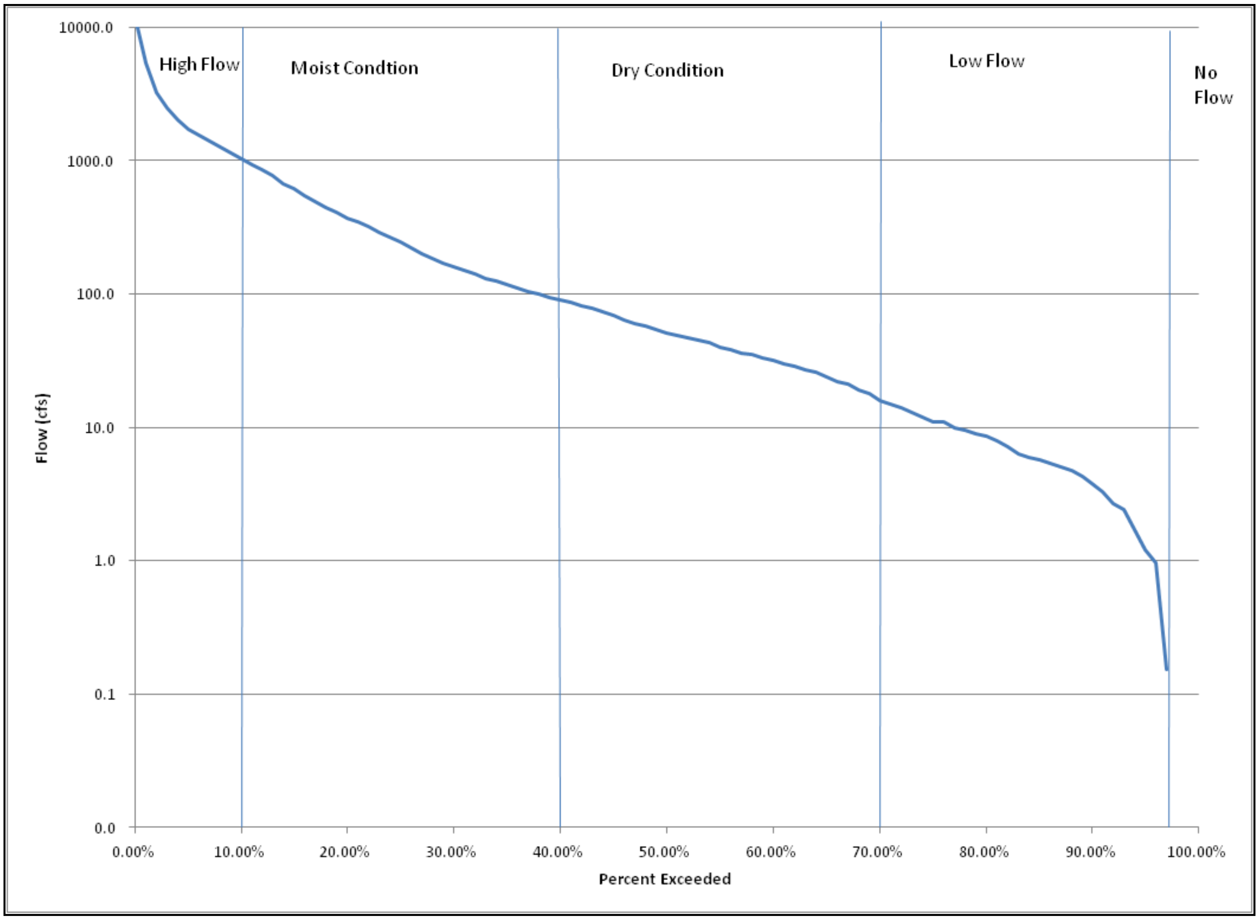

Figure 8. Flow Duration Curve for the Wild Rice River Monitoring Station 380031 at Abercrombie, North Dakota and USGS Station 05053000 near Abercrombie, North Dakota.

5.3 Load Duration Analysis

An important factor in determining Nonpoint Source Pollution (NPS) loads is variability in stream flows and loads associated with high and low flow. To better correlate the relationship between the pollutant of concern and the hydrology of the Section 303(d) TMDL listed segments, a load duration curve was developed for the Wild Rice River TMDL listed segment. The load duration curve for the TMDL listed reach was derived using the E. coli bacteria TMDL target of 126 CFU/100 mL and the flow generated as described in Sections 5.1 and 5.2.

Observed in-stream E. coli bacteria data obtained from monitoring site 380031 in 2001 through 2016 (Appendix A) were converted to a pollutant load by multiplying E. coli bacteria concentrations by the mean daily flow and a conversion factor. These loads are plotted against the percent exceeded of the flow on the day of sample collection (Figure 8). Points plotted above the 126 CFU/100 mL target curve exceed the State water quality target. Points plotted below the curve are meeting the State water quality target of 126 CFU/100 mL.

For each flow interval or zone, a regression relationship was developed between the samples which occur above the TMDL target (126 CFU/100 mL) curve and the corresponding percent exceeded flow. The load duration curve for site 380031 depicting the regression relationship for each flow interval is provided in Figure 8.

The regression lines for the high, moist condition and dry condition for site 380031 were then used with the midpoint of the percent exceeded flow for that interval to calculate the existing E. coli bacteria load for that flow interval. In the example provided in Figure 8, the regression relationship between observed E. coli bacteria loading and percent exceeded flow for the high, moist condition and dry condition intervals is:

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

Where the midpoint of the high flow interval from 0 to 10 percent is 5 percent, the existing E. coli bacteria load is

E. coli bacteria load (10^7 CFUs/day) = antilog (7.84+ (-20.30*0.05))
= 6,694,715 x 10^7 CFUs/day

Where the midpoint of the moist condition interval from 10 to 40 percent is 25 percent, the existing E. coli bacteria load is

E. coli bacteria load (10^7 CFUs/day) = antilog (5.47+ (-0.06*0.25))
= 283,810 x 10^7 CFUs/day

Where the midpoint of the dry condition interval from 40 to 70 percent is 55 percent, the existing E. coli bacteria load is

E. coli bacteria load (10^7 CFUs/day) = antilog (4.90+ (-0.14*0.55))
= 65,563 x 10^7 CFUs/day

The midpoint for the flow intervals is also used to estimate the TMDL target load. In the case of the previous examples, the TMDL target load for the midpoints or 5, 25, and 55 percent exceeded flow derived from the 126 CFU/100 mL TMDL target curves are 526,438 x 10^7 CFUs/day, 75,459 x 10^7 CFUs/day and 12,332 x 10^7 CFUs/day, respectively.

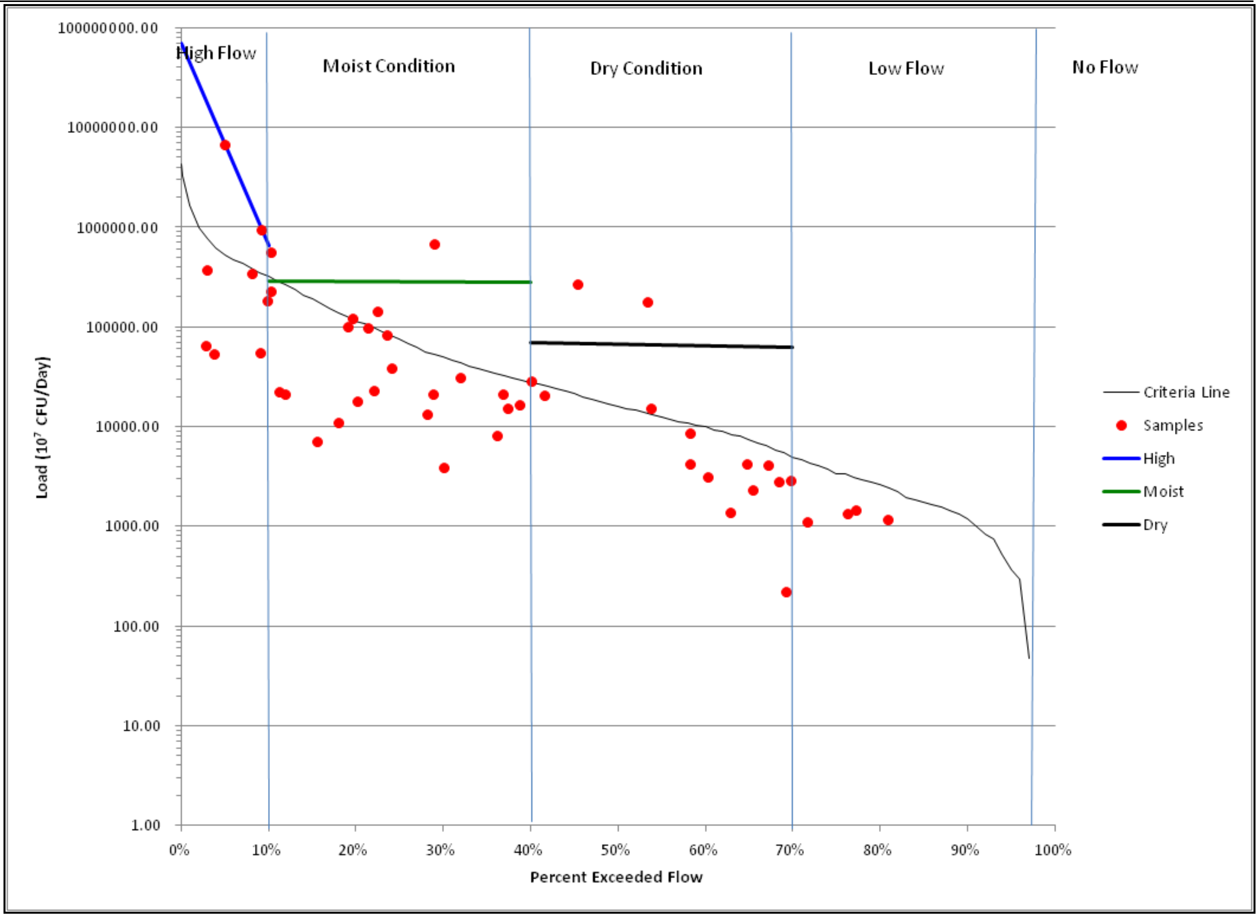

Figure 9. Load Duration Curve for the Wild Rice River Monitoring Station 380031 (the curve reflects flows collected from 2001-2016).

5.4 Loading Sources

The majority of load reductions can generally be allotted to nonpoint sources. The most significant sources of E. coli bacteria loading were defined as nonpoint source pollution originating from livestock. Based on the data available, the general focus of best management practices (BMPs) and load reductions for the listed segments should be on unpermitted animal feeding operations and "hobby farms" in close proximity of the Wild Rice River.

One of the more important concerns regarding nonpoint sources is variability in stream flows. Variable stream flows often cause different source areas and loading mechanisms to dominate (Cleland, 2003). As previously described, three flow regimes (i.e., High, Moist and Dry Conditions Flow) were selected to represent the hydrology of the listed segment when applicable (Figure 9). The three flow regimes were used for site 380031 because samples indicated exceedences of the water quality standard during periods of high, moist and dry condition flows.

By relating runoff characteristics to each flow regime, one can infer which sources are most likely to contribute to E. coli bacteria loading. Animals grazing in the riparian area contribute E. coli bacteria by depositing manure where it has an immediate impact on water quality. Due to the close proximity of manure to the stream or by direct deposition in the stream, riparian grazing impacts water quality at high flow or under moist and dry conditions (Table 5). In contrast, intensive grazing of livestock in the upland and not in the riparian area has a high potential to impact water quality at high flows, and under moist conditions, impact at moderate flows (Table 5). 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 E. coli bacteria contamination.

Table 5. Nonpoint Sources of Pollution and Their Potential to Pollute at a Given Flow Regime.

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

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

6.0 MARGIN OF SAFETY AND SEASONALITY

6.1 Margin of Safety

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

To account for the uncertainty associated with known sources and the load reductions necessary to reach the TMDL target of 126 CFU/100 mL, a ten percent explicit margin of safety was used for these TMDLs. The MOS was calculated as ten percent of the TMDL.

6.2 Seasonality

Section 303(d)(1)(C) of the Clean Water Act and associated regulations require that a TMDL be established with seasonal variations. The TMDLs which are included in this report address seasonality because the flow duration curve for the Wild Rice River segment (ND-090200105-003-S_00) was developed using 2001 to 2016 flow data (15 years). Additionally, the water quality standard is seasonally based on the recreation season from May 1 to September 30 and controls will be designed to reduce E. coli bacteria loads during the seasons covered by the standard.

7.0 TMDL

Table 6 provides an outline of the critical elements of the E. coli bacteria TMDL for the TMDL listed segment. A TMDL for the Wild Rice River (ND-09020105-003-S_00) is summarized in Table 7. The TMDL provides a summary of average daily loads by flow regime necessary to meet the water quality target (i.e., TMDL). The TMDL load includes a load allocation from known nonpoint sources and a 10 percent margin of safety. It should be noted that the TMDL loads, load allocations, and the MOS are estimated based on available data and reasonable assumptions and are to be used as a guide for implementation. The actual reduction needed to meet the applicable water quality standards may be higher or lower depending on the results of future monitoring.

Table 6. TMDL Summary for the Wild Rice River.

Category	Description	Explanation
Beneficial Use Impaired	Recreation	Contact Recreation (i.e. swimming, fishing)
Pollutant	E. coli Bacteria	See Section 2.1
TMDL Target	126 CFU/100 ml	Based on the current state water quality standard for E. coli bacteria. Monitoring will be conducted to determine compliance with the current water quality standard of 126 CFU/100 mL
Significant Sources	Nonpoint	Includes nonpoint sources to the segment (e.g. riparian grazing, unpermitted AFOs).
Margin of Safety (MOS)	Explicit	10 percent

TMDL = LC = WLA + LA + MOS

where

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

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

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

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

Table 7. E. coli Bacteria TMDL (10^7 CFUs/day) for the Wild Rice River Waterbody ND-09020105-003-S_00 as represented by Site 3850031.

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
Existing Load	6,694,715	283,810	65,562	
TMDL	526,438	75,458	12,332	1,942[1]
WLA	0	0	0	No Reduction Necessary
LA	473,794.2	67,912.2	11,098.8	
MOS	52,643.8	7,545.8	1,233.2	

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

8.0 ALLOCATION

Nonpoint source pollution is the sole contributor to elevated E. coli bacteria levels in the Wild Rice River watershed. The E. coli bacteria samples and load duration curve analysis of the impaired reach identified the high, moist and dry condition flow regimes as the time of E. coli bacteria exceedences of the 126 CFU/100 mL target. To reduce NPS pollution for the high, moist and dry condition flow regimes, specific BMPs are described in Section 8.1 that will mitigate the effects of E. coli bacteria loading to the impaired reach.

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

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 E. coli bacteria loading to the Wild Rice River.

8.1 Livestock Management Recommendations

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

<u>Waste management system</u>- Waste management systems can be effective in controlling up to 90 percent of E. coli bacteria loading originating from confined animal feeding areas (Table 8). A waste management system is made up of various components designed to control nonpoint source pollution from concentrated animal feeding operations (CAFOs) and animal feeding operations (AFOs). Diverting clean water from

the feeding area and containing dirty water from the feeding area in a pond are typical practices of a waste management system. Manure handling and application of manure is designed to be adaptive to environmental, soil, and plant conditions to minimize the probability of contamination of surface water.

Table 8. Relative Gross Effectiveness[a] of Confined Livestock Control Measures (Pennsylvania State University, 1992a).

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

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

8.2 Other Recommendations

Septic System – Septic systems provide an economically feasible way of disposing 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 exists when one or more components of the septic system do not work properly and untreated waste or wastewater leaves the system. Wastes may pond in the leach field and ultimately run off directly into nearby streams or percolate into groundwater. Untreated septic system waste is a potential source of nutrients (nitrogen and phosphorus), organic matter, suspended solids, and E. coli bacteria. Land application of septic system sludge, although unlikely, may also be a source of contamination.

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

9.0 PUBLIC PARTICIPATION

To satisfy the public participation requirement of this TMDL, a hard copy of the TMDL for The Wild Rice River and a request for comment was mailed to participating agencies, partners, and to those who request a copy. Those included in the mailing of a hard copy are as follows:

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

In addition to mailing copies of this TMDL for the Wild Rice River to interested parties, the TMDL was posted on the North Dakota Department of Health, Division of Water Quality website at http://www.ndhealth.gov./WQ/SW/Z2 TMDL/TMDLs Under PublicComment/B Under Public Commment.html . A 30-day public notice soliciting comment and participation was published in the following newspapers:

- The Daily News (Wahpeton), representing Richland County
- The Fargo Forum

10.0 MONITORING

As stated previously, it should be noted that the TMDL loads, waste load 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 implementation of BMPs will reduce E. coli bacteria levels necessary to meet water quality standards, water quality monitoring will continue to be conducted through the NDDoH Watershed Management Program State Ambient Water Quality Monitoring Network. 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 E. coli bacteria.

11.0 TMDL IMPLEMENTATION STRATEGY

Currently, the Richland County SCD is the sponsor of the Antelope Creek Watershed and the Riparian Corridor of the Wild Rice River Implementation Project Phase III. The primary goal of the project is working on implementing BMPs to reduce E. coli bacteria concentrations in the impaired segment of Antelope Creek and Wild Rice River. Conservation practices being implemented include Ag waste system, partial manure management systems, cover crop, fencing, grade stabilization structure, grassed waterway, nutrient management, range planting, septic system renovation, streambank protection, trough and tank, well decommissioning. To ensure precision and accuracy of BMP implementation the Richland County SCD is also utilizing the Wild Rice River Watershed Water Quality Decision Support System to define high priority areas in the watershed.

Phase I and II of the Antelope Creek Watershed and the Riparian Corridor of the Wild Rice River Implementation Project has many accomplishments including 136 septic system renovations, a waste management system, 31 wells decommissioned, 12,690 feet of perimeter fencing, 1 partial manure management system, and 301 feet of pipeline. In 2014, the North Dakota Department of Health delisted segment ND-09020105-001-S for E. coli bacteria impairment.

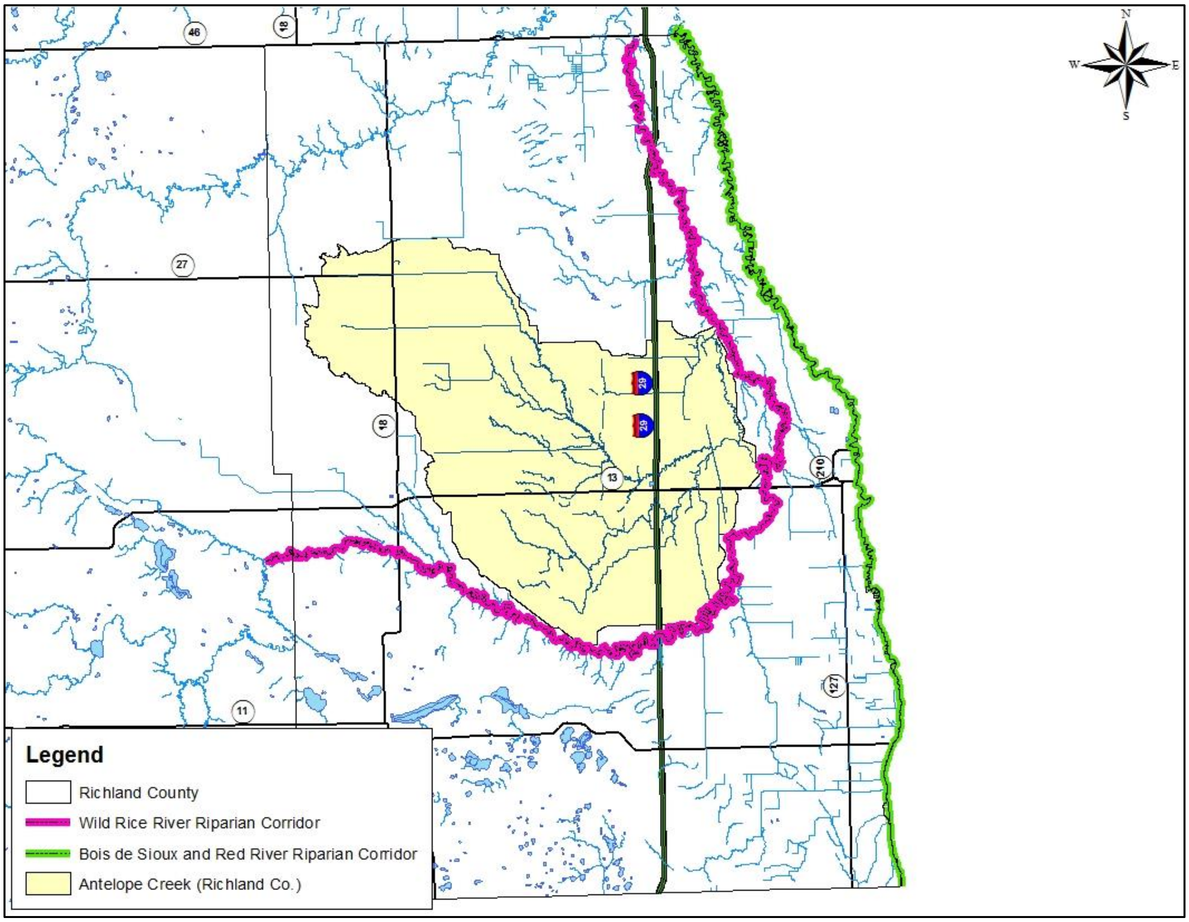

Figure 10. Antelope Creek Watershed and the Riparian Corridor of the Wild Rice River Implementation Project Phase III.

12.0 REFERENCES

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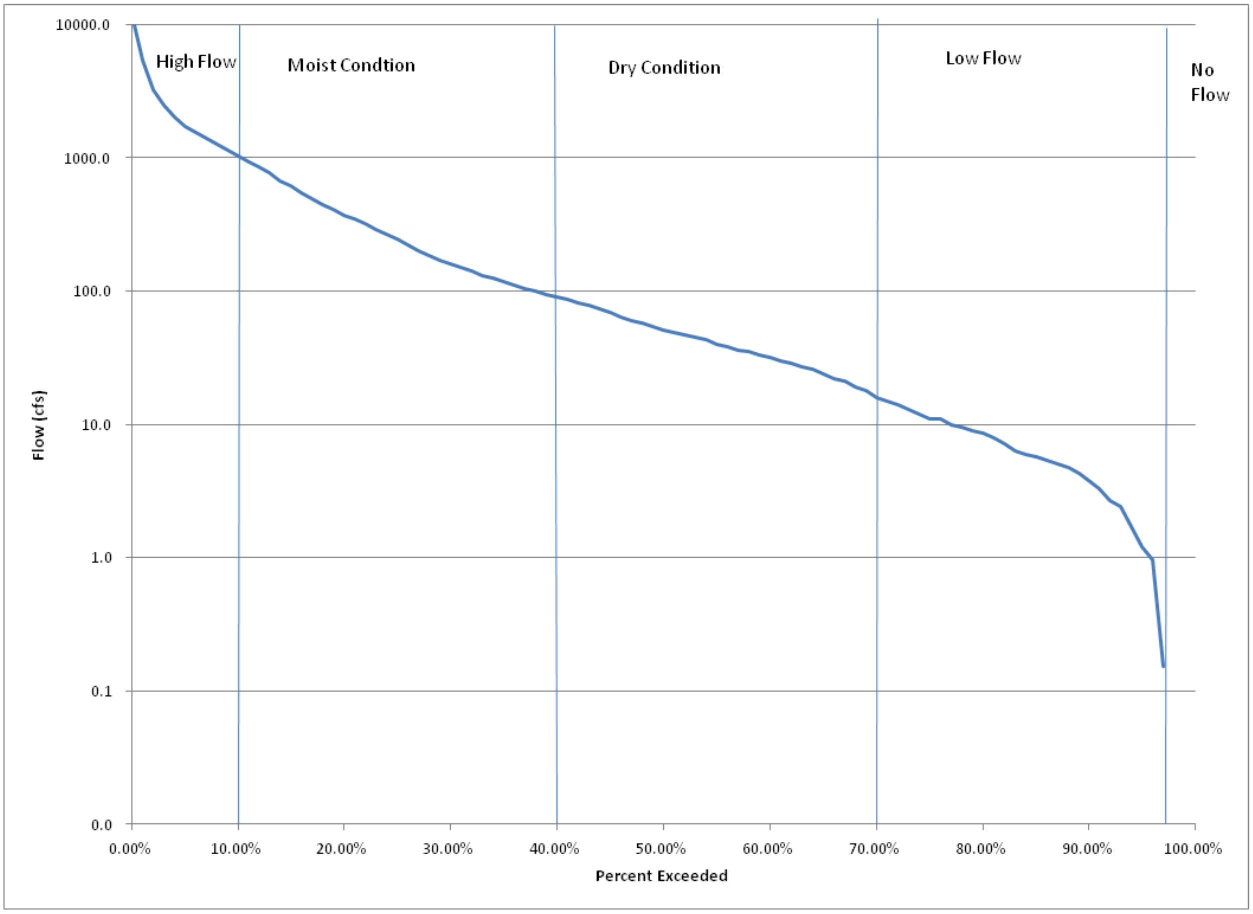
Appendix A
E. coli Bacteria Data Collected for Site 380031 (2001-2016)

	May		June		July		August		September	
	22-May-01	20	03-Jun-03	70	09-Jul-02	1600	13-Aug-02	40	21-Sep-04	140
	29-May-06	10	25-Jun-07	10	07-Jul-03	120	20-Aug-03	70	04-Sep-07	1600
	22-May-07	110	03-Jun-08	30	06-Jul-04	1600	10-Aug-04	70	08-Sep-09	100
	05-May-09	20	17-Jun-09	1600	11-Jul-06	20	24-Aug-05	5	01-Sep-10	130
	02-May-11	10	15-Jun-10	130	30-Jul-07	30	22-Aug-06	30	26-Sep-12	5
	30-May-12	50	07-Jun-11	70	16-Jul-08	100	26-Aug-08	60		
	14-May-13	10	18-Jun-13	10	28-Jul-09	60	30-Aug-11	90		
	29-May-13	30	17-Jun-14	340	19-Jul-11	60	22-Aug-12	60		
	20-May-14	10	17-Jun-15	190	18-Jul-12	5	20-Aug-13	60		
	20-May-15	100	22-Jun-16	50	15-Jul-13	230	26-Aug-14	90		
	24-May-16	40			22-Jul-14	80	24-Aug-15	60		
					21-Jul-15	120	30-Aug-16	50		
					26-Jul-16	80				
Geometric Mean	25		79		96		48		108	
% Exceeded 409 CFU/100 mL	0%		10%		15%		0%		20%	
Recreational Use Assessment	FS		FS		FSbT		FS		FSbT	
Number of Samples	11		10		13		12		5	

Appendix B
Flow Duration Curve for Site 380031

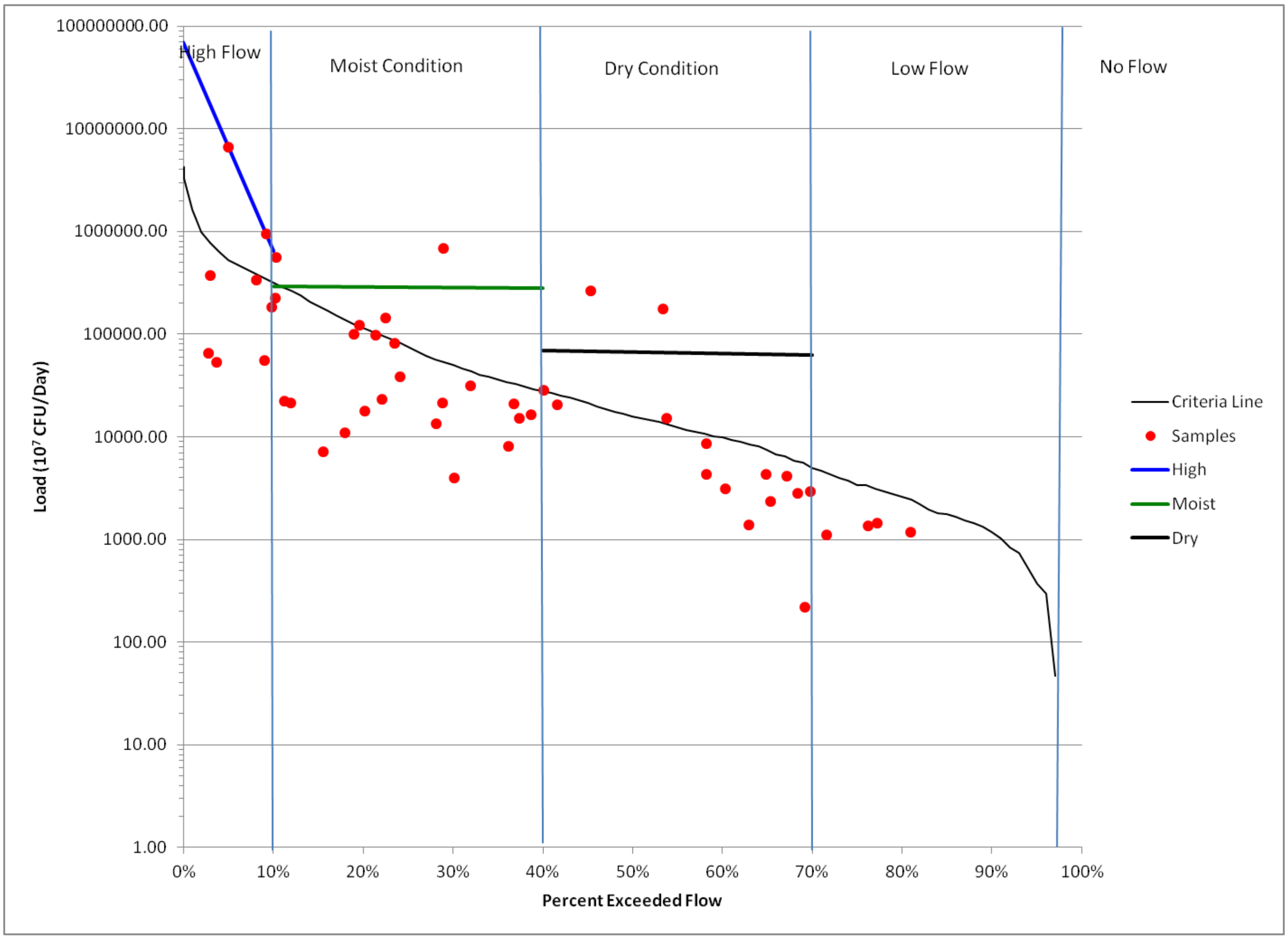
Site 380031 Wild Rice River near Abercrombie, ND



Appendix C
Load Duration Curve, Estimated Loads, TMDL Targets, and Percentage of Reduction Required for Site 380031

380031 Wild Rice River near Abercrombie, ND

	Median Percentile	Load (10^7 CFU/Day) Existing	TMDL	Days	Load (10^7 CFU/Period) Existing	TMDL	Percent Reduction
High	5.00%	6694715.12	526438.04	36.50	244357101.76	19214988.54	92.14%
Moist	25.00%	283810.43	75458.69	109.50	31077242.45	8262726.41	73.41%
Dry	55.00%	65562.96	12332.37	109.50	7179144.44	1350394.51	81.19%
			Total	256	282613489	28828109	89.80%



Appendix D
US EPA Region 8 TMDL Review and Comments

Mike,

Thanks for the opportunity to review the draft TMDLs for the Wild Rice River, Segment 012 (45.68 miles) and Segment 003 (47.49 miles). I don't have any significant comments for these TMDLs, therefore please consider these as informal suggestions for your consideration. If you decide to make revisions, I can send you more formal comments for the record if needed.

For Segment 012 - I do suggest changing the Low Flow allocations in Table 7 since you can't have a negative LA – I can work with Mike Hargiss to make those changes;
For both Segments – I suggest checking the listing references to make sure they are all for the 2016 cycle (i.e., make sure they reference NDDoH, 2017).

As you know, we approved a fecal coliform TMDLs for the same segments on 09/28/2010 and 09/29/2009 respectively. That raises a few policy issues (see below) that we can talk about for future TMDLs.

Appendix E
NDDoH Response to Comments

EPA Comment: For both Segments – I suggest checking the listing references to make sure they are all for the 2016 cycle (i.e., make sure they reference NDDoH, 2017).

NDDoH Response: The listing references for both segments were checked and revised per EPA request.

EPA Comment: As you know, we approved a fecal coliform TMDLs for the same segments on 09/28/2010 and 09/29/2009 respectively. That raises a few policy issues that we can talk about for future TMDLs.

NDDoH Response: The Fecal Coliform TMDL for segment ND-09020105-003-S_00 will be delisted for fecal coliform bacteria and the E. coli TMDL will supersede the previous fecal coliform TMDL. Language has been added to paragraph 2 in Section 1.1 clarifying this decision.