E. coli Bacteria TMDLs for the Wild Rice River and Tributaries in Ransom and Sargent Counties, North Dakota

Wild Rice River (photo by Matt Olson)

Tributary to the Wild Rice River

Crooked Creek

Shortfoot Creek

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FINAL
July 2024

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CONTENTS

List of Figures

List of Tables

Abbreviations

BMP	Best Management Practice
CAFO/AFO	Confined Animal Feeding Operation/Animal Feeding Operation
CFS	Cubic Feet per Second
CFU	Colony Forming Unit
DAR	Drainage Area Ratio
DMR	Discharge Monitoring Report
ECHO	Enforcement and Compliance History Online (U.S. EPA)
EPA	U.S. Environmental Protection Agency
FDC	Flow Duration Curve
HUC	Hydrologic Unit Code
LA	Load Allocation
LDC	Load Duration Curve
mL	Milliliter
MOS	Margin of Safety
MGD	Million Gallons per Day
NASSCDL	National Agricultural Statistical Survey Cropland Data Layer
NDAC	North Dakota Administrative Code
NRCS	Natural Resource Conservation Service
NDDEQ	North Dakota Department of Environmental Quality
NDPDES	North Dakota Pollutant Discharge Elimination System
NDAWN	North Dakota Agriculture Weather Network
POTW	Publicly Owned Treatment Works
SCD	Soil Conservation District
TMDL	Total Maximum Daily Load
USGS	U.S. Geological Survey
WLA	Wasteload Allocation

Introduction

This document is a tool for local watershed planners and water quality permit writers to address high levels of *Escherichia coli (E. coli)* bacteria in the Wild Rice River and tributaries in order to improve water quality for recreation use. Total Maximum Daily Loads (TMDLs) are required for water bodies not meeting water quality standards (also known as 'impaired waters' or '303(d) waters'). A TMDL is the amount of a pollutant a water body can handle and still meet the state water quality standard. Simply put, TMDLs are a target to achieve water quality. This report develops TMDLs for five water bodies that are not supporting recreation use due to high levels of *E. coli*.

1.0 WATER QUALITY STANDARDS

TMDL targets are based on water quality standards. Standards include: 1) beneficial uses, 2) water quality criteria (narrative and numeric), and 3) antidegradation policies. The North Dakota Department of Environmental Quality (NDDEQ) has set narrative and numeric water quality criterion to protect beneficial uses of all surface waters in the State. Complete water quality standards for the State of North Dakota are found at deq.nd.gov (search "Water Quality Standards").

1.1 Beneficial Use

Rivers and streams are grouped into classes (I, IA, II, III) to protect and manage similar beneficial uses. A beneficial use is a water quality goal such as making sure a water body is suitable for drinking water or recreation. Class II streams are assigned uses of aquatic life, municipal and domestic drinking water (with treatment), agriculture and industry, and recreation. Class III stream uses include aquatic life, agriculture and industry, and recreation.

The Wild Rice River and tributaries consists of class II and III streams that are not supporting recreation beneficial use. One water body (Tributary to the Wild Rice River, unnamed but locally known as Bulldog or Muskrat Creek) is also considered not supporting aquatic life use. This document focuses on recreation use impairments, based on the amount of *E. coli* found in water bodies, and does not address aquatic life use because it is not associated with *E. coli*.

1.2 Water Quality Criteria

1.2.1 Narrative Criteria

Narrative criteria are descriptions of water quality conditions and goals, such as:

"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" (NDDEQ, 2019b).

A complete list of narrative standards is found in North Dakota Administrative Code (NDAC) 33.1-16-02.1-08(s).

1.2.2 Numeric Criteria

Numeric criteria are limits or ranges for the measured amount of a pollutant in a water body needed to support beneficial use(s). The amount of *E. coli* in a water body determines if it is supporting recreation use. Numeric criteria for *E. coli* apply to all rivers and streams during the recreation season, May 1 to September 30. There are two numeric criteria for *E. coli*:

1. The monthly geometric mean of samples must be less than or equal to 126 CFU/100mL.
2. No more than 10 percent of samples in a month can be greater than 409 CFU/100mL.

E. coli is measured as colony forming units (CFU) in one-hundred milliliters (mL) of water.

Together the two numeric criteria determine if the beneficial use, recreation, is supported:

- **Fully supporting**: 1 & 2 are met.
- **Fully supporting, but threatened**: 1 is met, 2 is not met.
- **Not supporting**: 1 is not met, 2 may or may not be met.

The Water Quality Assessment Methodology for North Dakota's Surface Waters lists a minimum *E. coli* sample size for recreation use assessment. In the current 2018 methodology, assessment is based on a minimum of five monthly *E. coli* samples to calculate geometric mean (criteria 1 above), and a minimum of 10 monthly samples to calculate percent exceeding the maximum (criteria 2 above). If needed, samples for the same month from more than one year can be grouped together to compare a larger number of samples. To be fully supporting, the water body must be fully supporting for all five months of the recreation season.

North Dakota has consistently applied a minimum of five monthly samples for *both* conditions of geometric mean and percent exceeding in all approved *E. coli* TMDLs to-date. To maintain consistency, this document develops TMDLs based on a minimum of five monthly *E. coli* samples for both geometric mean and percent exceeding. A minimum of five samples, instead of 10, is not expected to change recreation use assessments for any of the included water bodies. The assessment methodology is under review and will be clarified in the 2026 Integrated Report (IR).

All five TMDL water bodies in this document are not supporting numeric criteria for recreation.

1.3 Antidegradation

North Dakota's antidegradation policy protects healthy waters (NDAC 33.1-16-02.1 App IV). If the health of a water body is better than the water quality standard, the policy helps prevent loss of water quality. Antidegradation rules apply to regulated point sources and do not apply to nonpoint sources.

TMDLs in this document were developed to meet all applicable water quality criteria for *E. coli*. As a result the TMDL calculations support recreation beneficial use and the antidegradation policy.

1.4 Other Water Quality Standards

Water quality standards for downstream waters, and waters shared with other states or tribes, should be considered when developing TMDLs. Several of the TMDL water bodies are in watersheds shared with the state of South Dakota and the Sisseton-Wahpeton Oyate of the Lake Traverse Reservation.

The South Dakota Department of Agriculture and Natural Resources has water quality standards for South Dakota waters. Water bodies that drain from South Dakota into the TMDL watershed area in North Dakota are not assigned recreation use and so do not have additional *E. coli* water quality criteria to include in the TMDLs.

At the time of this report the Sisseton-Wahpeton Oyate of the Lake Traverse reservation do not have a water quality standards program approved by the U.S. Environmental Protection Agency (EPA). As a result, water bodies that drain from the Lake Traverse Reservation into the TMDL watershed area in North Dakota do not have additional *E. coli* water quality criteria to include in the TMDLs. EPA efforts to establish federal baseline water quality standards for all reservation waters are ongoing.

Water bodies under the jurisdiction of North Dakota that are downstream of the TMDL water bodies are subject to the same water quality standards for recreation use and so do not have additional *E. coli* water quality criteria to include in the TMDLs.

1.5 Water Quality Target

The TMDL water quality target represents the parameter and value used to support the water quality standards. Targets can be based on numeric criteria when available (such as *E. coli*) or, when no numeric criteria are available, they may need to be developed from narrative criteria.

The TMDLs in this document were based on numeric water quality criteria for *E. coli*. **Section 1.2.2** lists two numeric criteria for *E. coli* (geometric mean and percent exceeding). To ensure both criteria were supported, the more conservative monthly geometric mean *E. coli* criterion (126 CFU/100 mL) was used as the TMDL target.

2.0 LOCATION

The water quality standards introduced in **Section 1** were used to develop TMDLs for five impaired water bodies located in southeastern North Dakota. **Table 1** and **Figures 1-2** outline their location in Sargent and Ransom counties of southeastern North Dakota.

Table 1. Location description of TMDL water bodies.

Counties	Sargent (majority), Ransom
8-digit Hydrologic Unit Code (HUC)	09020105 (Western Wild Rice subbasin)
Main Stream	Wild Rice River (class II)
Major Basin	Red River

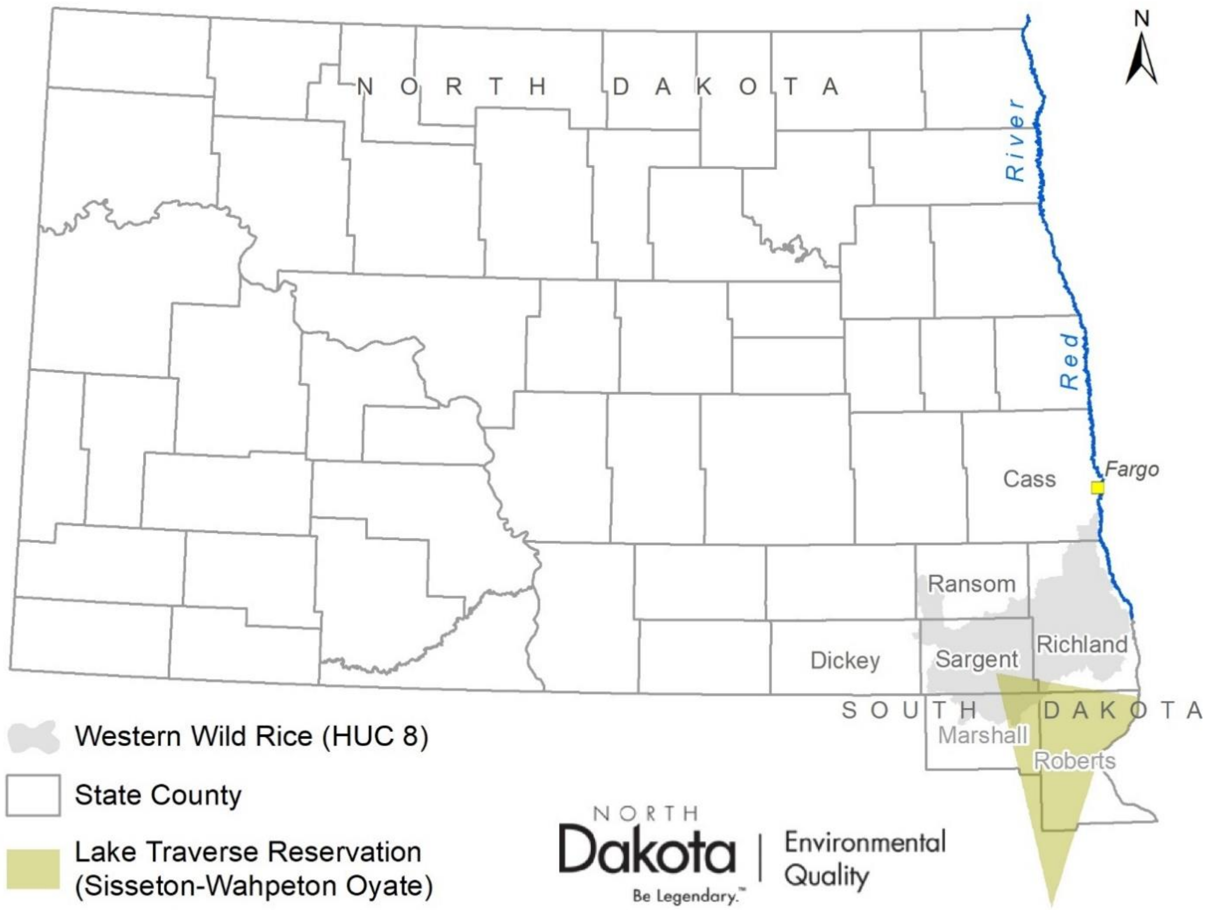


Figure 1. Location of Western Wild Rice subbasin. (Source: ND GIS HUB Accessed February 1, 2022)

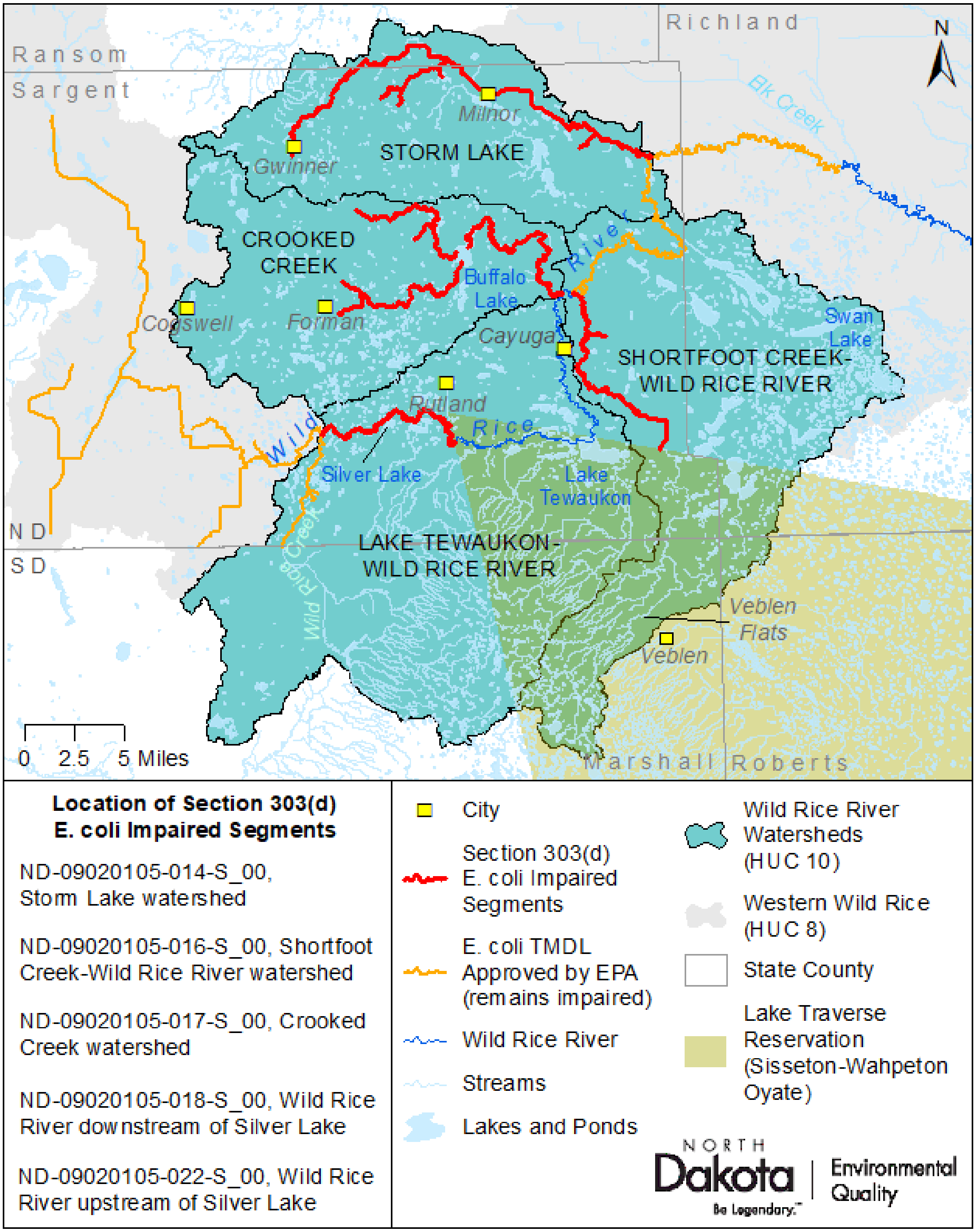


Figure 2. Location of TMDL water bodies. (Source: ND GIS HUB. Accessed January 31, 2022)

3.0 WATER BODY DESCRIPTIONS

As shown in **Section 2**, all five TMDL water bodies are located within the same drainage area (Western Wild Rice subbasin). This area contains waters under other state (South Dakota) and federal (U.S. Environmental Protection Agency for the Lake Traverse Reservation) oversight. The TMDLs in this document were developed for sections of the Wild Rice River and its tributaries and only apply to North Dakota waters. Descriptions of each TMDL water body are detailed in **Table 2**.

Table 2. TMDL water bodies as they will appear in the 2024 North Dakota Integrated Report Section 303(d) Impaired Waters List.

Designated Use	Recreation
Use Assessment	Not Supporting
Impairment	*E. coli*
TMDL Priority Ranking	High

Name	ID	Size (miles)	Class	Description
Crooked Creek Watershed	ND-09020105-017-S_00	40.70	III	Crooked Creek watershed to its confluence with Wild Rice River (ND-09020105-015-S_00).
Shortfoot Creek Watershed	ND-09020105-016-S_00	18.34	III	Shortfoot Creek from its confluence with the Wild Rice River upstream to tribal boundary, including all tributaries.
Tributary to the Wild Rice River*	ND-09020105-014-S_00	38.69	III	Unnamed tributary to the Wild Rice River (ND-09020105-012-S_00) located near Milnor, ND in NE Sargent County.
Wild Rice River	ND-09020105-022-S_00	6.17	II	Wild Rice River from its confluence with Wild Rice Creek downstream to its confluence with the Silver Lake Diversion.
Wild Rice River	ND-09020105-018-S_00	8.92	II	Wild Rice River from its confluence with the Silver Lake Diversion downstream to the reservation boundary.

*Additional impairment for: combination benthic/fishes bioassessments, not supporting fish and other aquatic biota use.

Some sections of the Wild Rice River and tributaries have already received TMDLs addressing high levels of bacteria. **Table 3** lists bacteria TMDLs for water bodies in and near the watershed that have been approved by the EPA. Approved TMDLs are found at deq.nd.gov (search “Completed TMDLs”).

Table 3. Approved bacteria TMDLs in the Wild Rice River and tributaries TMDL area.

Name	ID	Description	Parameter Addressed	Year Approved
Wild Rice River	ND-09020105-012-S_00	Wild Rice River from its confluence with Shortfoot Creek downstream to its confluence with Elk Creek.	*E. coli*	2018
Wild Rice River	ND-09020105-019-S_00	Wild Rice River upstream from its confluence with Wild Rice Creek, including all tributaries.	*E. coli*	2011
Wild Rice Creek	ND-09020105-020-S_00	Wild Rice Creek from its confluence with the Wild Rice River upstream to the ND-SD border, including all tributaries.	*E. coli*	2011
Shortfoot Creek Watershed	ND-09020105-016-S_00	Shortfoot Creek from its confluence with the Wild Rice River upstream to tribal boundary, including all tributaries.	Fecal coliform*	2010

*North Dakota water quality standards have been revised to use *E. coli* bacteria instead of fecal coliform for assessing recreation use; the *E. coli* TMDL developed in this document will replace the approved 2010 fecal coliform TMDL

4.0 WATERSHED CHARACTERISTICS

The following tables and figures describe characteristics of the TMDL watershed area. Watershed characteristics help identify potential pollutant sources and inform strategies to address them.

4.1 Ecoregions

Ecological regions (ecoregions) are based on geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology. Understanding how regions are similar in these ways and how they differ is important when interpreting water quality data and developing water quality plans.

The overall area of the TMDL water bodies is flat to gently rolling with many temporary and seasonal wetlands. **Figure 3** and **Table 4** describe ecoregions in the drainage area.

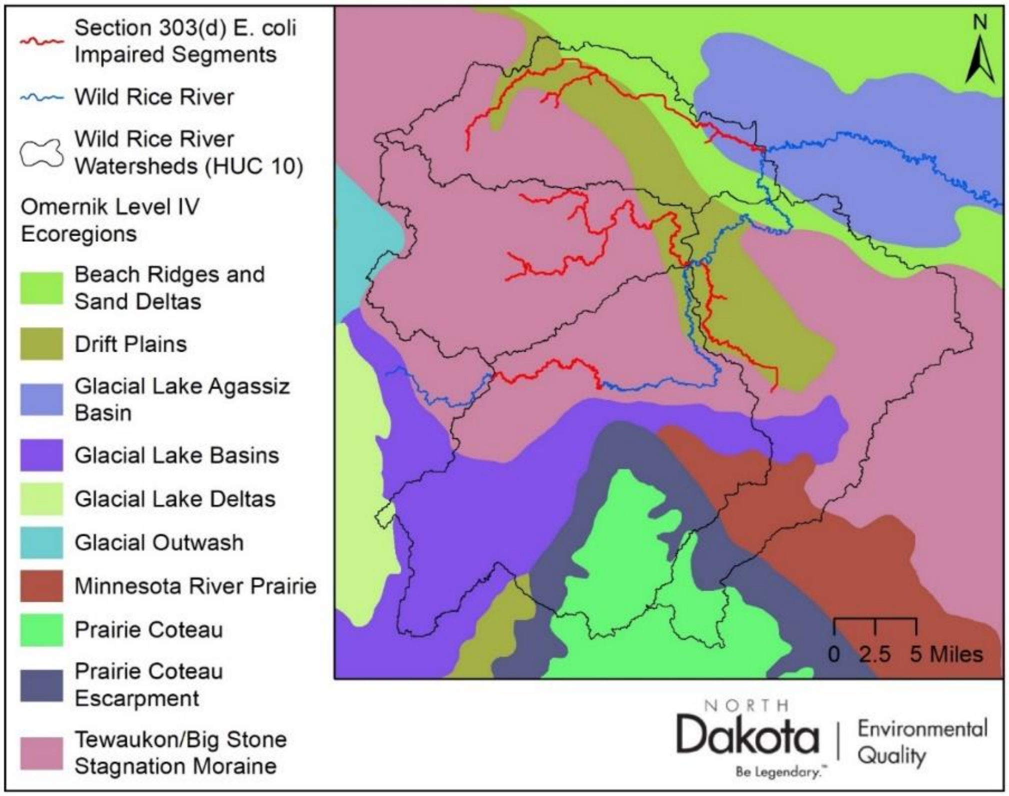


Figure 3. Omernik Level 4 ecoregions in the TMDL area. (Source: ND GIS HUB. Accessed February 2, 2022)

Table 4. Omernik Level 4 ecoregions in the TMDL area.

Level 4 Ecoregion	Description
Beach Ridges and Sand Deltas	Variable relief with high erosion risk in sand dune areas
Drift Plains	Level with many temporary and seasonal wetlands (often drained or tilled)
Glacial Lake Agassiz Basin	Extremely flat, large floodplains, high water tables, silt and clay soils
Glacial Lake Basins	Smooth terrain with deep soils
Glacial Lake Deltas	Sand and fine gravel sediments, thin vegetation cover with high risk for wind erosion
Glacial Outwash	Smooth terrain with highly permeable soils
Minnesota River Prairie	Level with wetlands
Prairie Coteau	Closely spaced semipermanent and seasonal wetlands, no drainage pattern, higher precipitation than ecoregions to the west
Prairie Coteau Escarpment	Distinct change in elevation with enough precipitation for forest growth in riparian areas
Tewaukon/Big Stone Stagnation Moraine	Many semipermanent wetlands

4.2 Elevation

The TMDL drainage area ranges from 2,080 feet above sea level (ft asl) on the Prairie Coteau to 1,053 ft asl at the watershed outlet. The Wild Rice River drops in elevation roughly 194 ft over the entire drainage area. (**Figure 4**)

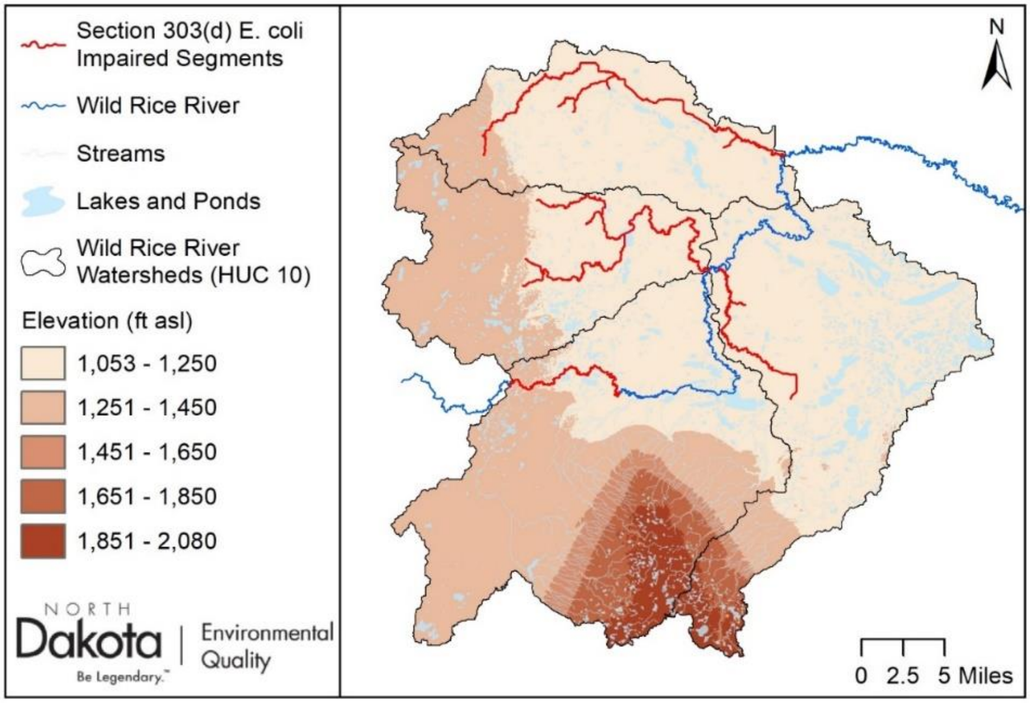


Figure 4. Elevation of the TMDL area. (Source: ND GIS HUB. Accessed March 30, 2022)

4.3 Climate

Rainfall totals were collected from the North Dakota Agricultural Weather Network (NDAWN) station in Mooreton, ND (30 miles east of Milnor, ND). Mooreton is the closest station with weather data from the same period of time water quality data was collected.

On average, the area receives 18 inches of rain annually. Average monthly rainfall totals for sampling periods and long-term monthly totals are shown in **Figure 5**. Average monthly air temperature typically ranged from the high 50's to low 70's (°F) between May and September.

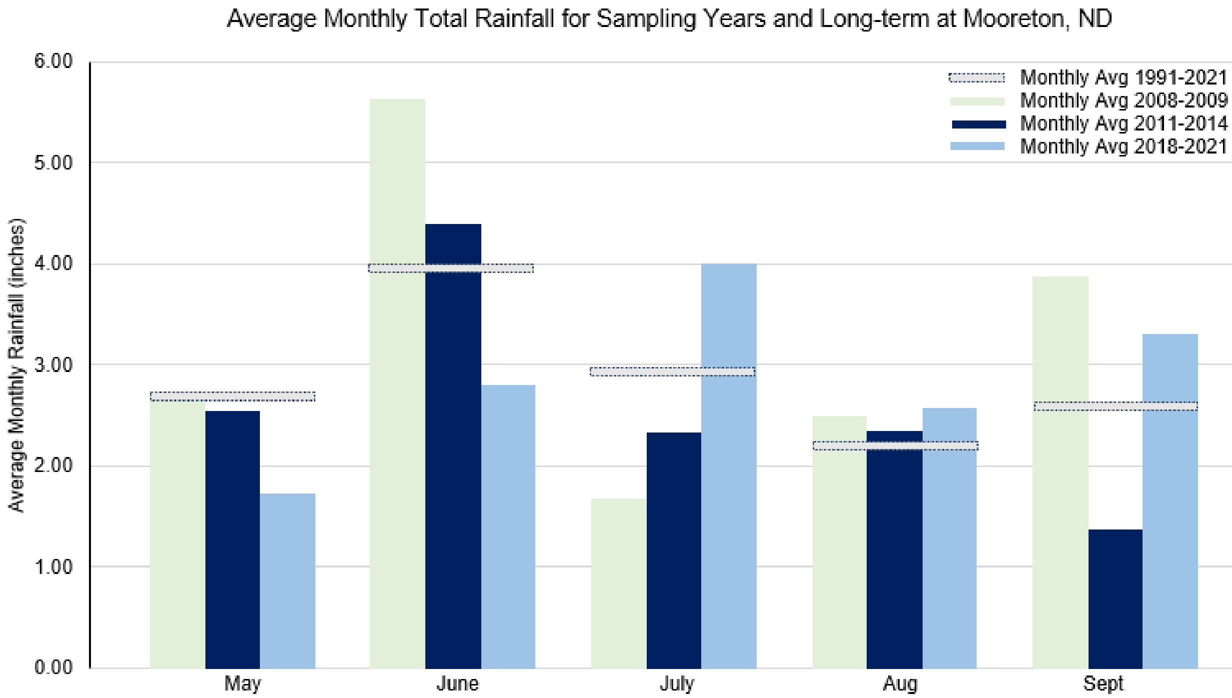


Figure 5. Monthly average rainfall totals from Mooreton NDAWN weather station.

4.4 Land Owners

The TMDL watershed area is mostly privately owned but includes areas managed by other state agencies and federal agencies (**Figure 6**).

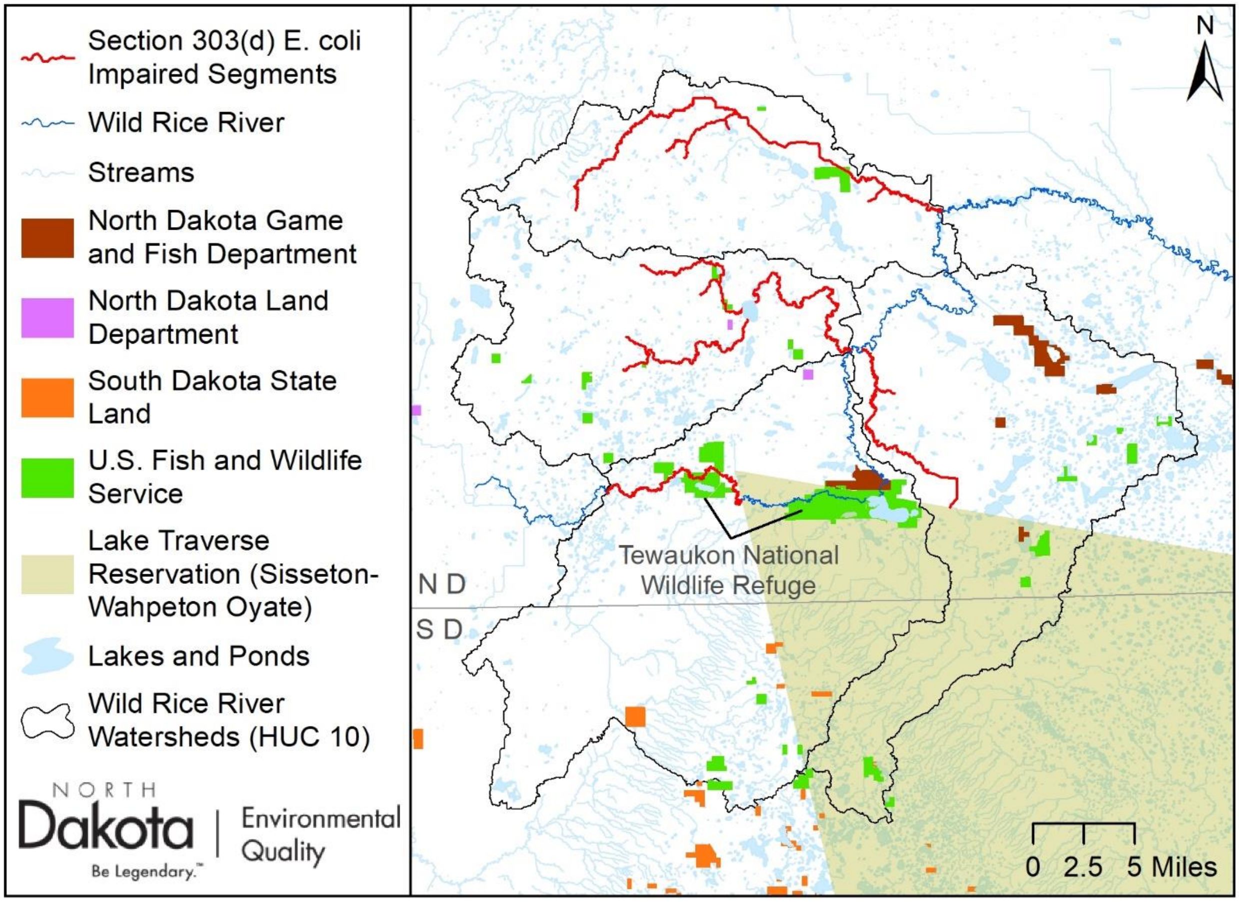


Figure 6. Land ownership in the TMDL area. (Source: ND GIS HUB. Accessed February 7, 2022)

4.5 Land Use

The U.S. Department of Agriculture's (USDA) National Agricultural Statistical Survey Cropland Data Layer (NASSCDL) estimates crop acres from satellite images taken during the growing season. Images have a ground resolution of 30 meters (USDA 2020).

Figure 7 shows land use in the TMDL area for 2020. Categories are listed in order of area, from largest (Soybeans) to smallest (Other Crops).

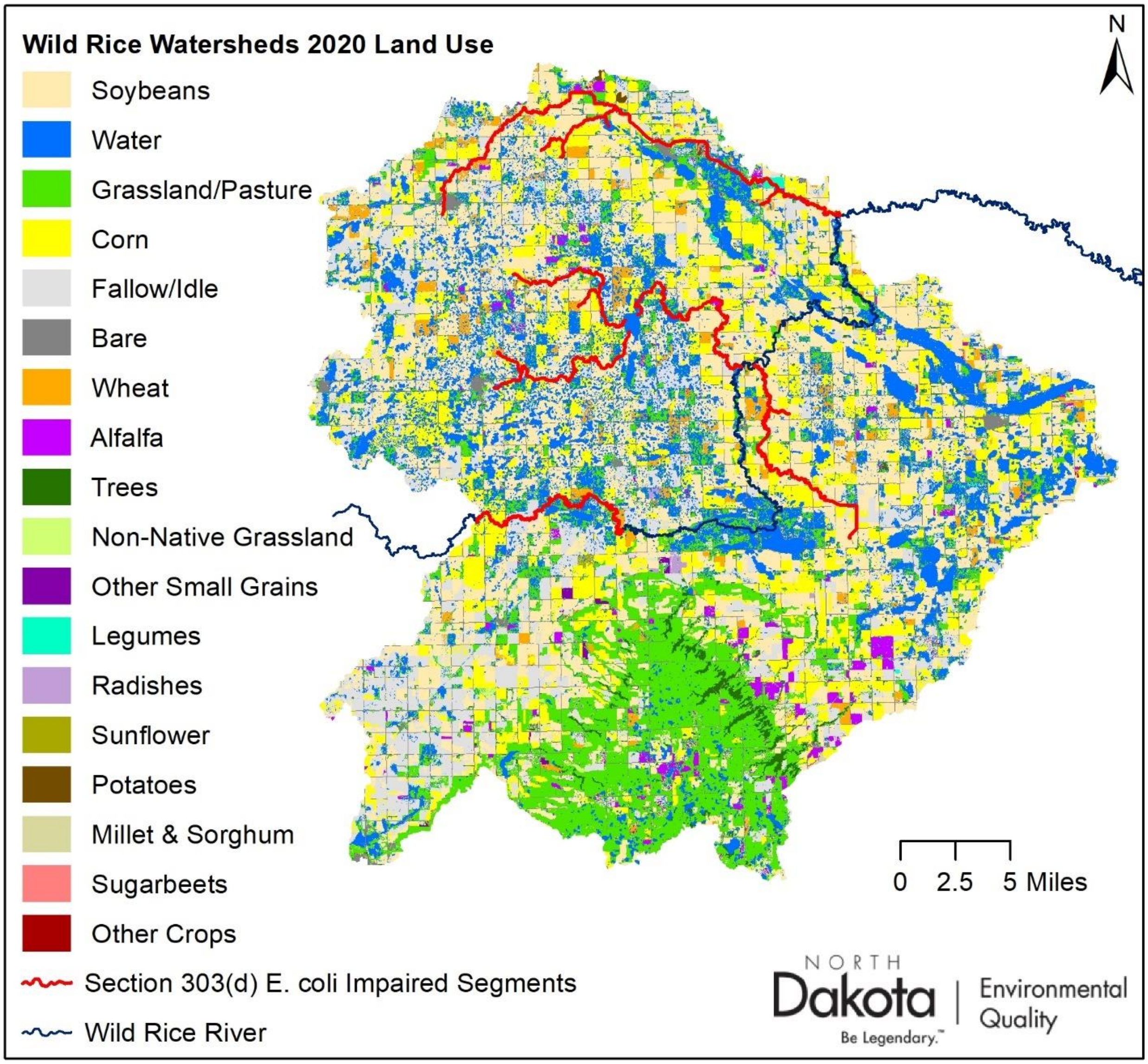
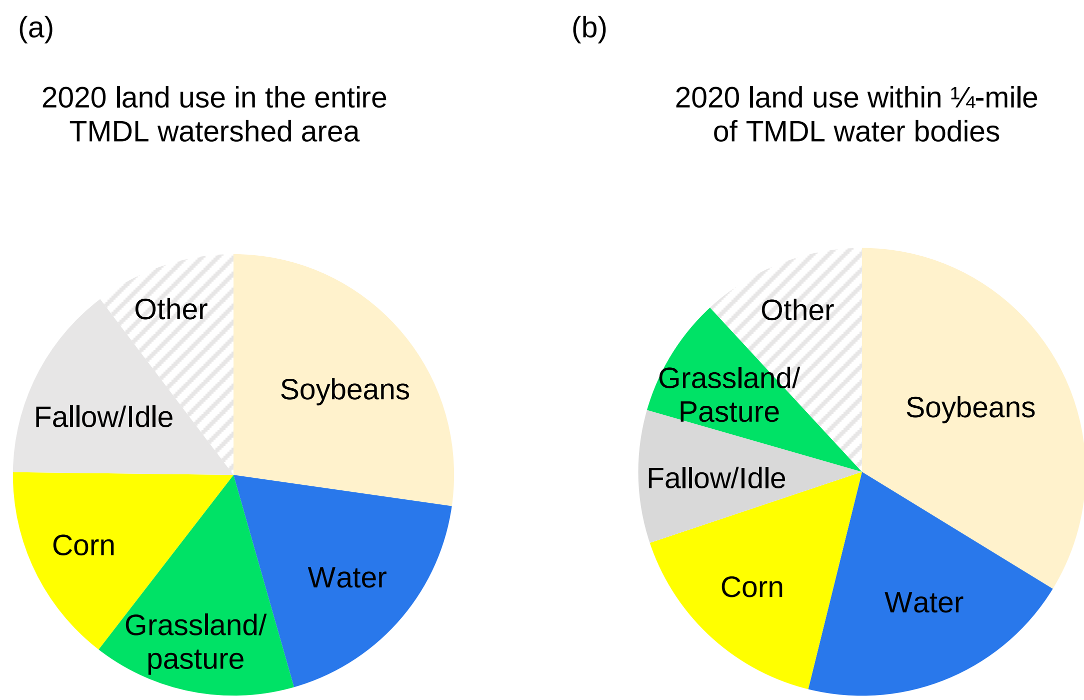


Figure 7. Land use in the TMDL area. (Source: National Agricultural Statistical Survey 2020 Cropland Data Layer. Accessed February 2, 2022)

In 2020, nearly half of the TMDL watershed area was used for crops (mainly soybeans and corn). The second largest area was open water and wetlands, and third largest was rangeland. Almost none of the watershed area was trees and shrubs. Areas closest to the TMDL water bodies (areas within a quarter-mile of each stream section) were similar to the overall watershed area (**Figure 8**).



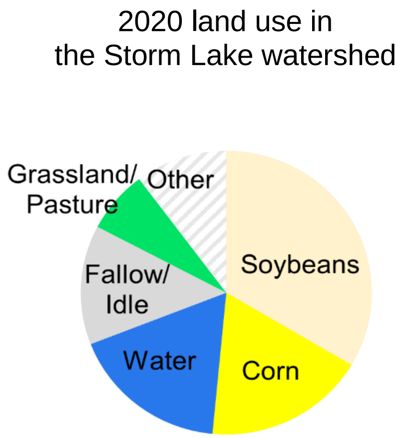
(c)

Land Use Type	Entire TMDL watershed area	Area within ¼-mile of TMDL water bodies
Crops (all)	46 %	56 %
Water or wetlands	18 %	20 %
Grassland or pasture	15 %	9 %
Fallow or idle	14 %	10 %
Bare or developed	3 %	4 %
Trees or shrubs	1 %	1 %

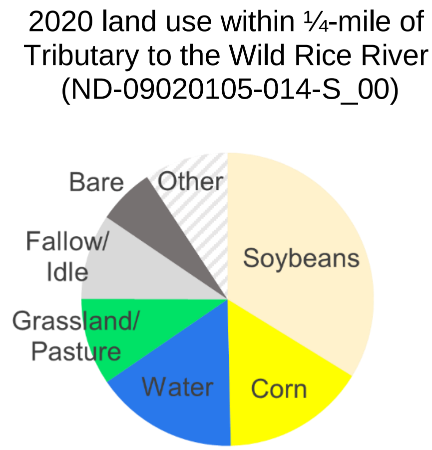
Figure 8. Breakdown of land use in the TMDL area.
(a) Major types of land use in the TMDL watershed area, (b) major types of land use within ¼-mile of TMDL water bodies, and (c) land use percentages. Based on 2020 NASSCDL.

Land use for individual TMDL watershed and water body areas are shown in **Figures 9-12**.

(a)



(b)

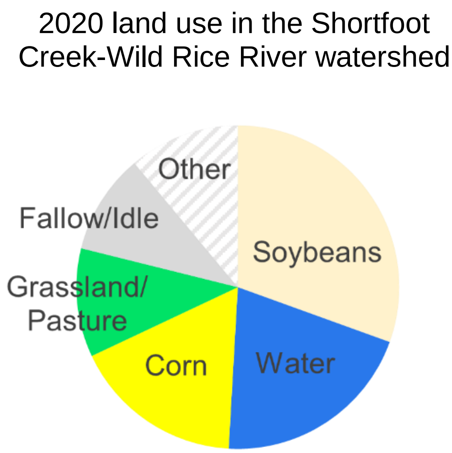


(c)

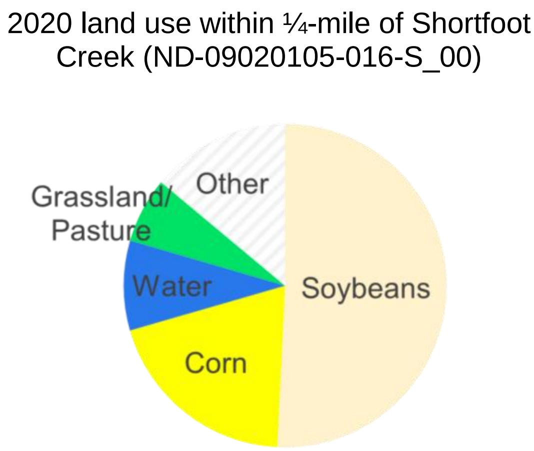
Land Use Type	Storm Lake watershed area	Area within ¼-mile of ND-09020105-014-S_00
Crops (all)	56 %	58 %
Water or wetlands	18 %	16 %
Fallow or idle	14 %	9 %
Grassland or pasture	7 %	10 %
Bare or developed	4 %	6 %
Trees or shrubs	1 %	1 %

Figure 9. Breakdown of land use in the Storm Lake watershed.
(a) Major types of land use in the Storm Lake watershed, (b) major types of land use within ¼-mile of Tributary to the Wild Rice River (ND-09020105-014-S_00), and (c) land use percentages. Based on 2020 NASSCDL.

(a)



(b)

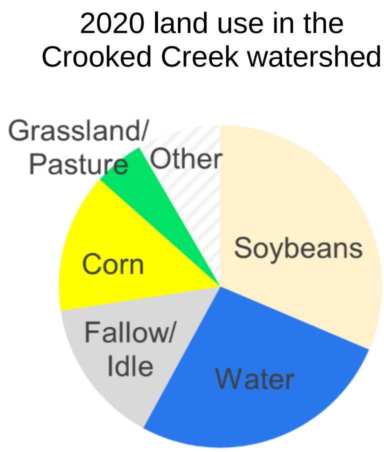


(c)

Land Use Type	Shortfoot Creek-Wild Rice River watershed	Area within ¼-mile of Shortfoot Creek (ND-09020105-016-S_00)
Crops (all)	53 %	75 %
Water or wetlands	20 %	9 %
Grassland or pasture	12 %	7 %
Fallow or idle	10 %	5 %
Bare or developed	3 %	3 %
Trees and shrubs	2 %	1 %

Figure 10. Breakdown of land use in the Shortfoot Creek-Wild Rice River watershed.
(a) Major types of land use in the Shortfoot Creek-Wild Rice River watershed, (b) major types of land use within ¼-mile of Shortfoot Creek (ND-09020105-016-S_00), and (c) land use percentages. Based on 2020 NASSCDL.

(a)



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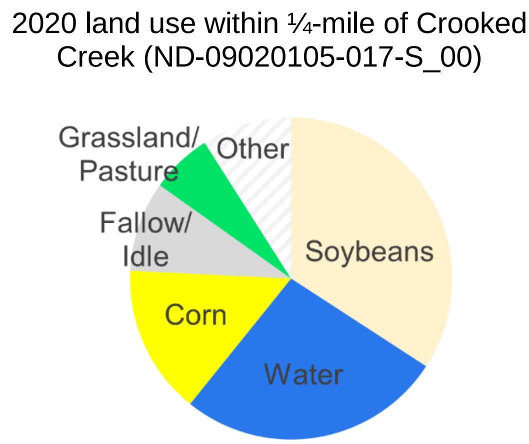
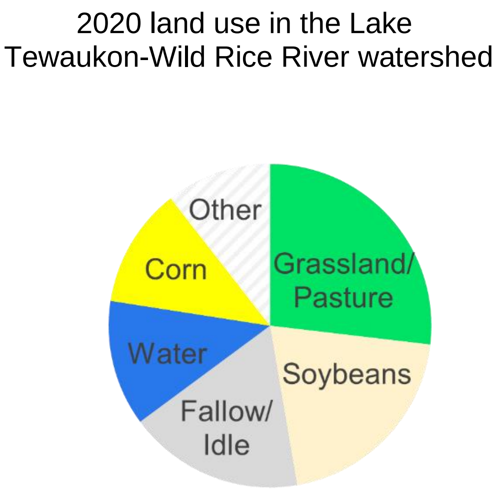


(c)

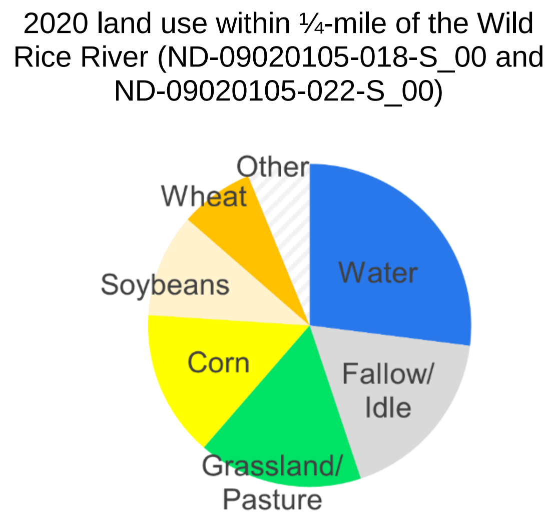
Land Use Type	Percent (%) of Crooked Creek watershed	Percent (%) of area within ¼-mile of ND-09020105-017-S_00
Crops	50 %	54 %
Water or wetlands	27 %	27 %
Fallow or idle	15 %	9 %
Grassland or pasture	5 %	6 %
Bare or developed	3 %	3 %
Trees or shrubs	< 1 %	< 1 %

Figure 11. Breakdown of land use in the Crooked Creek watershed.
(a) Major types of land use in the Crooked Creek watershed, (b) major types of land use within ¼-mile of Crooked Creek (ND-09020105-017-S_00), and (c) land use percentages. Based on the 2020 NASSCDL.

(a)



(b)



(c)

Land Use Type	Lake Tewaukon-Wild Rice River watershed area	Area within ¼-mile of the Wild Rice River (ND-09020105-018-S_00 and ND-09020105-022-S_00)
Crops	37 %	33 %
Grassland or pasture	27 %	18 %
Fallow or idle	18 %	18 %
Water or wetlands	13 %	27 %
Bare or developed	3 %	3 %
Trees or shrubs	2 %	< 1 %

Figure 12. Breakdown of land use in the Lake Tewaukon-Wild Rice River watershed.
(a) Major types of land use in the Lake Tewaukon-Wild Rice River watershed, (b) major types of land use within ¼-mile of the Wild Rice River (ND-09020105-018-S_00 and ND-09020105-022-S_00), and (c) land use percentages. Based on the 2020 NASSCDL.

5.0 WATER QUALITY AND FLOW DATA

Water quality and flow data were collected to assess whether the TMDL water bodies are meeting water quality standards, and to determine reductions needed to meet standards. Water quality samples were collected during the recreation season (May 1-September 30) over multiple years. Flow (discharge) measurements were available on one TMDL water body from a U.S. Geological Survey (USGS) streamgaging station. Flow was estimated for other TMDL water bodies based on the Drainage Area Ratio (DAR) method (Ries et al, 2000). **Figure 13** shows station locations and drainage areas used to develop TMDLs.

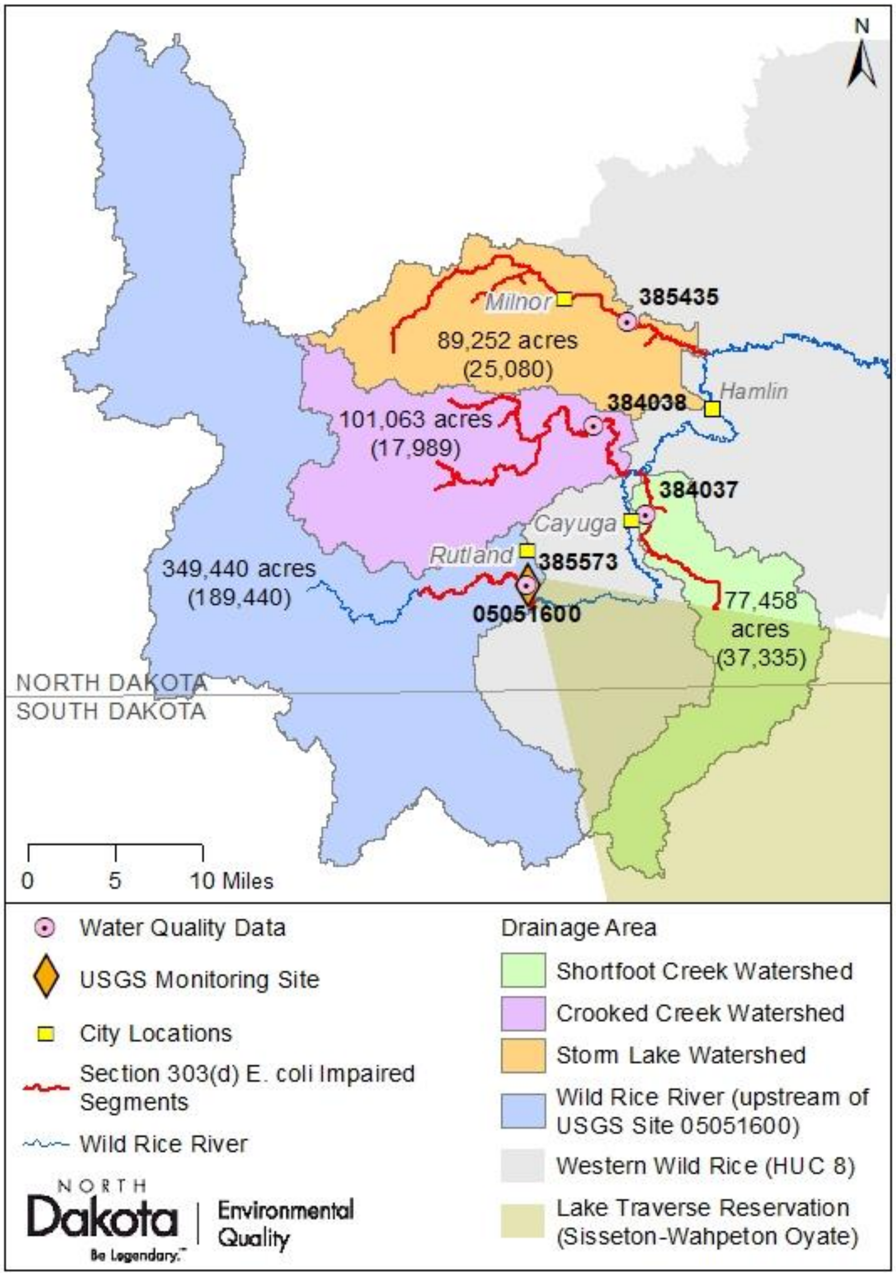


Figure 13. Water quality sites and flow station used to develop TMDLs. Watershed area in acres and contributing drainage areas in acres in parentheses. (Source: ND GIS HUB. Accessed February 2, 2022)

5.1 *E. Coli* Bacteria Data

Samples were collected by the Wild Rice Soil Conservation District (SCD) weekly (as conditions allowed). *E. coli* data from four sites was used to develop TMDLs (Appendix A). Where more than one site was available on the same water body, results from the furthest downstream site were used. Water quality data is also available on the NDDEQ water quality data portal at https://deq.nd.gov.

Samples were tested by the North Dakota Public Health Laboratory in Bismarck, ND. *E. coli* were measured using membrane filtration and dilution (before 2018) or multi-well distribution, also known as Quanti-tray (2018-present). The two methods are considered equivalent measures of bacteria concentration (EPA, 2001); however, each has different measurement ceilings (up to 8,000 CFU/100mL for membrane filtration and dilution; up to 24,000 CFU/100mL for Quanti-tray). To compare consistent data ranges, results from stations were selected from one method, not both. When available, Quanti-tray results (more recent) were used.

Section 1.2.2 (Numeric Criteria) details North Dakota water quality standards for *E. coli*. Sample results from each station were compared to numeric standards to determine if recreation use was being supported. Station location descriptions and recreation use assessments for each TMDL water body are listed in **Tables 5-8**.

Table 5. Site information and assessment for Tributary to the Wild Rice River.

Water Body	Tributary to the Wild Rice River (ND-09020105-014-S_00)			
Site #	385435			
Site Description	3 miles east, 1 mile south of Milnor, ND			
Sampling Years	2008-2009			
E. coli (CFU/100mL)				
Month	# of samples	Geometric mean	Samples > 409	Recreation use assessment
May	2	*Insufficient data*	0 %	*Insufficient Data*
June	10	603	80 %	Not Supporting
July	8	238	12.5 %	Not Supporting
August	8	254	37.5 %	Not Supporting
September	8	262	25 %	Not Supporting

Table 6. Site information and assessment for the Wild Rice River.

Water Bodies	Wild Rice River (two segments) (ND-09020105-018-S_00, ND-09020105-022-S_00)			
Site #	385573 (co-located with USGS station 05051600)			
Site Description	2 miles south of Rutland, ND			
Sampling Years	2011-2014			
E. coli (CFU/100mL)				
Month	# of samples	Geometric mean	Samples > 409	Recreation use assessment
May	27	50	7.4 %	Fully Supporting
June	33	369	39.4 %	Not Supporting
July	29	150	13.8 %	Not Supporting
August	27	134	14.8 %	Not Supporting
September	23	312	39.1 %	Not Supporting

Table 7. Site information and assessment for Shortfoot Creek.

Water Body	Shortfoot Creek (ND-09020105-016-S_00)			
Site #	384037			
Site Description	1 mile east of Cayuga, ND			
Sampling Years	2018-2021			
E. coli (CFU/100mL)				
Month	# of samples	Geometric mean	Samples > 409	Recreation use assessment
May	20	54	5.0 %	Fully Supporting
June	15	163	26.7 %	Not Supporting
July	15	286	33.3 %	Not Supporting
August	14	248	21.4 %	Not Supporting
September	12	468	50.0 %	Not Supporting

Table 8. Site information and assessment for the Crooked Creek watershed.

Water Body	Crooked Creek (ND-09020105-017-S_00)			
Site #	384038			
Site Description	1 mile south, 6.5 miles west of Hamlin, ND			
Sampling Years	2018-2021			
E. coli (CFU/100mL)				
Month	# of samples	Geometric mean	Samples > 409	Recreation use assessment
May	20	29	0 %	Fully Supporting
June	14	92	21 %	Threatened
July	14	196	36 %	Not Supporting
August	13	320	46 %	Not Supporting
September	10	427	60 %	Not Supporting

5.2 Flow Data

Average daily flow was used to calculated TMDLs (total maximum *daily loads*). Flow data were available from one streamgaging station: USGS station 05051600 on the Wild Rice River two miles south of Rutland, ND (co-located with sampling site 385573, see **Figure 13**).

Measured flow data (March-September, 2008-2021) from the USGS station was used to represent the Wild Rice River (ND-09020105-018-S_00 and ND-09020105-022-S_00). Flow for the additional three TMDL water bodies was estimated using the DAR method (Ries et al., 2000). The DAR method estimates unknown flow based on known flow by comparing the areas of similar watersheds. The USGS site is in the same HUC-8 as each TMDL watershed and represents similar ecoregions. Therefore, the drainage areas are considered similar and flow data from the USGS site was used in the DAR to estimate unknown flows.

Drainage areas were determined using the USGS StreamStats tool (**Table 9**). Drainages represent everything upstream, including closed basins. Contributing drainage areas are where runoff flows downstream to the drainage outlet, excluding closed basins. Contributing drainage areas were used to calculate DAR in order to represent typical conditions when isolated basins do not contribute to overall basin discharge. Flow data is available from the USGS National Water Dashboard at https://dashboard.waterdata.usgs.gov/.

Table 9. Drainage areas used to measure or estimate flow for TMDL water bodies.

Drainage name	TMDL water body	Drainage acres	Contributing acres*	Flow method
USGS site 05051600	Wild Rice River (two sections)	349,440	189,440	Measured
Storm Lake watershed	Tributary to the Wild Rice River	89,252	25,080	DAR
Crooked Creek watershed	Crooked Creek	101,063	17,989	DAR
Shortfoot Creek watershed	Shortfoot Creek	77,458	37,335	DAR
*Based on: Drainage Area – (Percent of total drainage area to isolated lakes * Drainage Area)				

5.2.1 Flow Alteration

Water control efforts such as dams and drains have been constructed in the area to mitigate flooding and support land uses such as agriculture, livestock, recreation, and fish and wildlife. Flow controls impact discharge conditions (e.g. reducing peak flows, changing magnitude and duration of flow) and add uncertainty to flow estimates. The North Dakota Department of Water Resources (DWR) maintains water resource data, including dam and drain locations, on their MapServices webpage (https://mapservice.dwr.nd.gov/). DWR data reflects structures the agency has recorded and verified, which may not be a complete list. Efforts are ongoing to verify location and status of structures.

6.0 SOURCES OF *E. COLI*

Water pollution, including *E. coli*, comes from point and nonpoint sources. Point source pollution comes from a specific point, like a pipe or ditch. Nonpoint source pollution comes from more than one point, like runoff from a field. Sources of *E. coli* in the TMDL water bodies include point and nonpoint sources.

6.1 Point Sources

Possible point sources of *E. coli* in the TMDL water bodies are wastewater treatment facilities (also known as publicly owned treatment works or POTWs) permitted by state (ND, SD) and federal (EPA) agencies. Facilities along the Wild Rice River and its tributaries serve small local populations that rarely discharge. All are in areas not expected to increase significantly in population.

Permitted dischargers in the TMDL area were identified using the North Dakota Pollutant Discharge Elimination System (NDPDES) permits program database and EPAs Enforcement and Compliance History Online (ECHO) (https://echo.epa.gov/). NDPDES permitted wastewater systems in the TMDL area are required to sample treated effluent and obtain water quality results before discharging, and once weekly (minimum) during discharge events. Monitoring requirements for the permitted facilities in the TMDL area do not include *E. coli* and so no *E. coli* discharge data are available. Current NDPDES permits for wastewater facilities in the TMDL area are on a 5-year permit cycle expiring September 30, 2024. Individual permits and discharge history are discussed below; information for the permit cycle beginning October 1, 2024 is detailed in **Table 24 (Section 10.1)**.

6.1.1 Storm Lake Watershed Wastewater Treatment Facilities

The NDPDES program permits two wastewater treatment facilities in the Storm Lake watershed, one for the city of Gwinner and one for the city of Milnor (**Figure 14**).

Table 10. Discharge description for Gwinner POTW 2007-2021.

Facility	City of Gwinner POTW
# of lagoon cells	4
# of final discharge points	1
Receiving water body	Tributary to the Wild Rice River (ND-09020105-014-S_00)
Discharge history description	Non-continuous. Typically semiannual; once in the beginning of recreation season and again following recreation season.
Average discharge period	13 days
Average discharge amount	5 million gallons per day

Table 11. Discharge description for Milnor POTW 2007-2021.

Facility	City of Milnor POTW
# of lagoon cells	3
# of final discharge points	1
Receiving water body	Tributary to the Wild Rice River (ND-09020105-014-S_00)
Discharge history description	Non-continuous. Typically semiannual; once in the beginning of recreation season and again following recreation season.
Average discharge period	7 days
Average discharge amount	1 million gallons per day

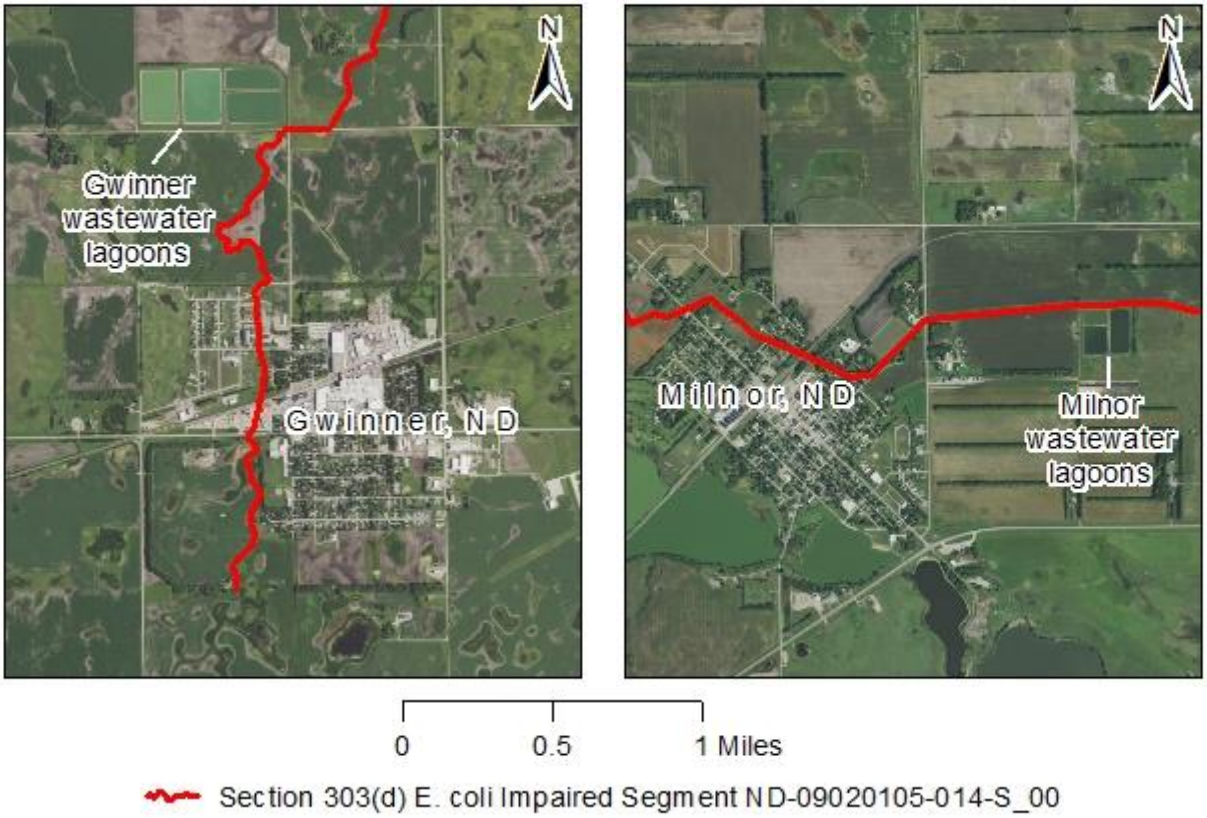


Figure 14. 2020 imagery of wastewater lagoons and TMDL water body in Gwinner (left) and Milnor (right), ND. (Source: ND GIS HUB. Accessed June 14, 2022)

6.1.2 Crooked Creek Watershed Wastewater Treatment Facilities

The NDPDES program permits two wastewater treatment facilities in the Crooked Creek watershed, one for the city of Cogswell and one for the city of Forman (**Figure 15**).

Table 12. Discharge description for Cogswell POTW 2007-2021.

Facility	City of Cogswell POTW
# of cells	3
# of final discharge points	1
Receiving water body	Unnamed slough not directly connected to other surface waters
Discharge history description	No discharge reported
Average discharge period	No discharge reported
Average discharge amount	No discharge reported

Table 13. Discharge description for Forman POTW 2007-2021.

Facility	City of Forman POTW
# of cells	3
# of final discharge points	1
Receiving water body	Crooked Creek (ND-09020105-017-S_00)
Discharge history description	Non-continuous. Typically semiannual; once in the beginning of recreation season and again following recreation season.
Average discharge period	7 days
Average discharge amount	1 million gallons per day

Figure 15. 2020 imagery of wastewater lagoons and TMDL water body in Forman, ND.
(Source: ND GIS HUB. Accessed June 14, 2022)

6.1.3 Shortfoot Creek-Wild Rice River Watershed Wastewater Treatment Facilities

There are three permitted wastewater treatment facilities in the Shortfoot Creek-Wild Rice River watershed, two permitted by NDPDES and one permitted by EPA (within the Lake Traverse Reservation). The NDPDES permits the city of Lidgerwood and the city of Cayuga (**Figure 16**); the EPA permits the Veblen Flats Housing Wastewater Treatment Plant.

Lidgerwood has a three-cell lagoon system with one permitted discharge point to a branch of Swan Lake, which is within a subwatershed that does not contribute to the TMDL water body.

Table 14. Discharge description for Cayuga POTW 2007-2021.

Facility	City of Cayuga POTW
# of cells	3
# of final discharge points	1
Receiving water body	Shortfoot Creek (ND-09020105-016-S_00)
Discharge history description	No discharge reported
Average discharge period	No discharge reported
Average discharge amount	No discharge reported

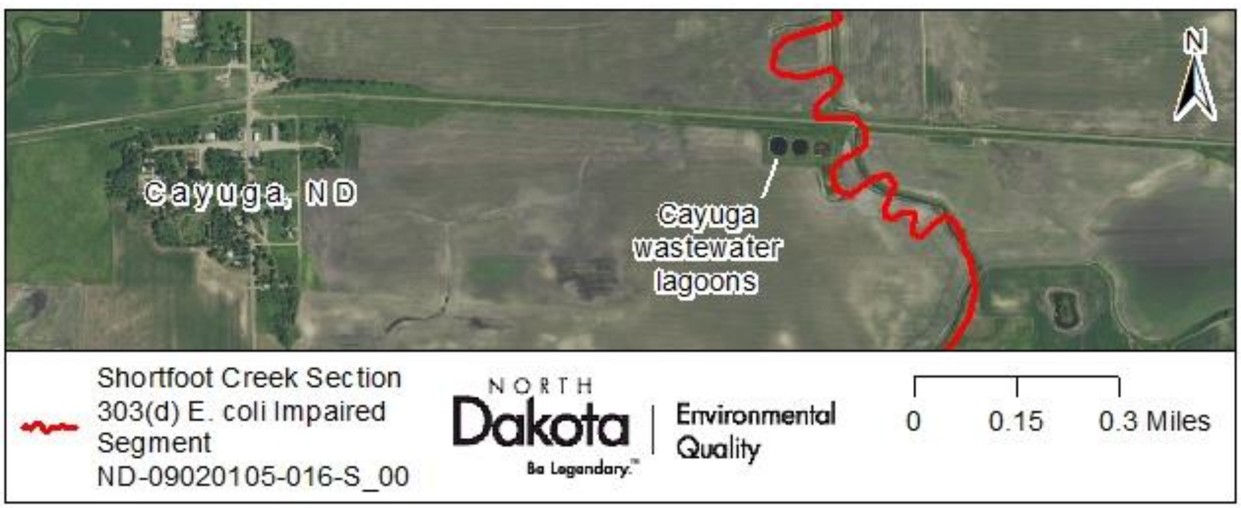


Figure 16. 2020 imagery of wastewater lagoons and TMDL water body in Cayuga, ND. (Source: ND GIS HUB. Accessed June 14, 2022)

The Veblen Flats Housing Wastewater Treatment Plant has a two-cell wastewater lagoon system for the Veblen Flats Housing Community on the Lake Traverse Reservation (Sisseton-Wahpeton Oyate). The POTW, located on Shortfoot Creek upstream of the designated TMDL water body section, has a zero-discharge permit under EPA and has never reported a discharge. The nearby city of Veblen, SD discharges to a watershed not contributing to the TMDL water bodies.

6.1.4 Lake Tewaukon-Wild Rice River Watershed Wastewater Treatment Facilities

The NDPDES program permits one wastewater treatment facility in the Lake Tewaukon-Wild Rice River watershed for the city of Rutland (**Figure 17**).

Table 15. Discharge description for Rutland POTW 2007-2021.

Facility	City of Rutland POTW
# of cells	3
# of final discharge points	1
Receiving water body	Intermittent drainage ditch ~2 miles north of the Wild Rice River (ND-09020105-018-S_00)
Discharge history description	Non-continuous. Typically semiannual; during or following recreation season, but has not discharged every year.
Average discharge period	7 days
Average discharge amount	0.23 million gallons per day

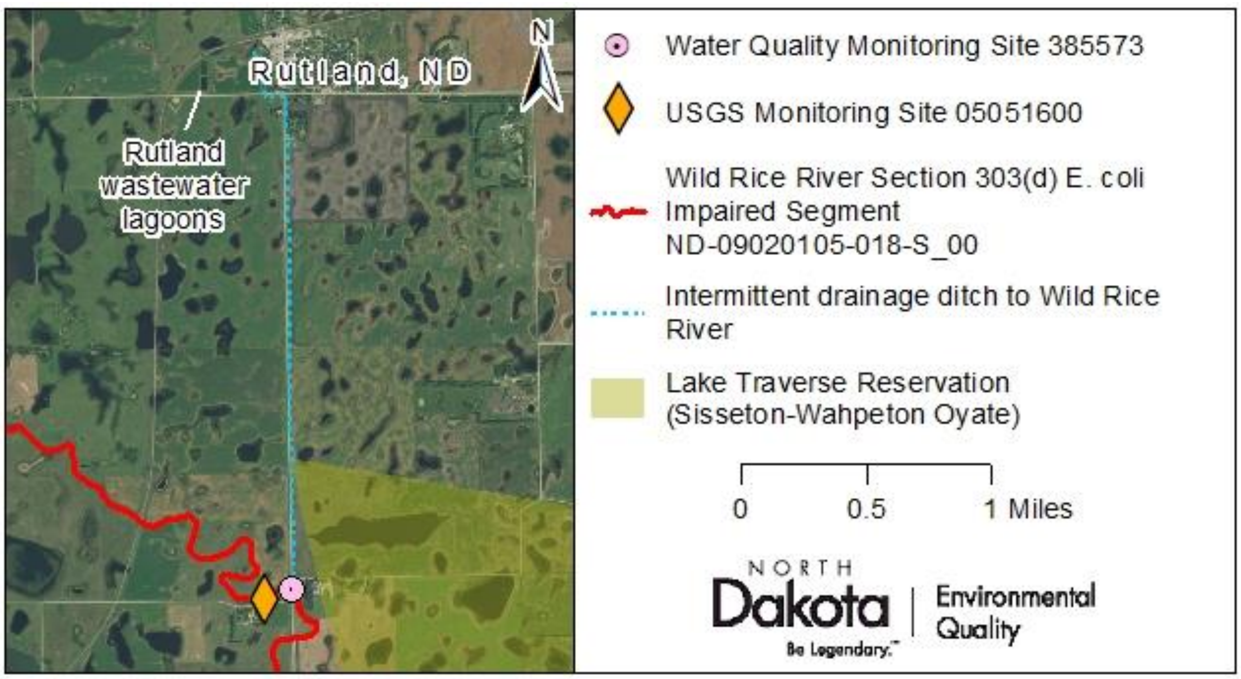


Figure 17. 2020 imagery of wastewater lagoons and TMDL water body in Rutland, ND. (Source: ND GIS HUB. Accessed June 14, 2022)

6.1.5 Other Permittees

Concentrated Animal Feeding Operations/Animal Feeding Operations (CAFO/AFO) in North Dakota are permitted by the NDDEQ, but are prohibited from discharging. Facilities are defined or designated as small, medium, or large CAFO or AFO based on the type and number of animals and site conditions. Nine CAFO/AFOs are permitted by the NDDEQ in the TMDL area, including one large, four medium, and four small facilities. Under North Dakota Administrative Code 33.1-16-03.1-12 permitted CAFO/AFO facilities are prohibited from discharging manure or process wastewater. Facilities are also required to maintain Nutrient Management Plans to ensure manure handling does not impact waters of the state.

Other permitted facilities in the TMDL area do not discharge *E. coli* (for example, industrial stormwater permittees). A complete list of permitted facilities, including discharge data, is included in Appendix B.

6.2 Nonpoint Source Pollution

Possible nonpoint sources of *E. coli* in the TMDL water bodies are runoff from cropland and pasture (including application of manure), livestock in riparian areas, leaking septic systems, and wildlife.

6.2.1 Cropland and Pasture

The 2020 land use assessment of the TMDL area (**Section 4.5**) showed most of the watershed was used as cropland (mostly soybeans and corn) and grassland/pasture. Manure applied to cropland, and manure from livestock grazing in grassland/pasture, can add *E. coli* to water bodies through runoff and direct deposition.

Open water and wetlands covered 20% of the riparian areas along TMDL water bodies. The high density of wetlands provides additional opportunities for *E. coli* to be transported into TMDL water bodies during periods of flooding. Further, almost none (<1%) of the riparian areas along TMDL water bodies were covered by trees or shrubs, which can buffer and help protect streams from *E. coli* in runoff.

6.2.2 Septic Systems

Households and farmsteads with septic systems are located throughout the TMDL area. Failing septic systems or direct discharge sewage systems could be adding *E. coli* to the TMDL water bodies.

6.2.3 Wildlife

The TMDL area is dense with temporary and seasonal wetlands that support wildlife, mitigate flooding, and cycle nutrients. The Tewaukon National Wildlife Refuge on the Wild Rice River attracts hundreds of thousands of birds during spring and fall migrations. Natural background sources of *E. coli* such as wildlife can contribute bacteria by directly depositing waste in water bodies and riparian areas and through runoff.

7.0 EXISTING LOADS AND LOADING CAPACITY

The existing amount of *E. coli* in the TMDL water bodies was measured from stream samples. The target amount of *E. coli* (TMDL or loading capacity) is based on the state water quality standard (**Section 1.5**). The monthly geometric mean *E. coli* standard (126 CFU/100mL) was used to determine a daily target to ensure both standards criteria would be met (geometric mean and percent exceeding). The loading capacity of each water body was developed using Load Duration Curves (LDCs). An LDC shows the water quality target as a loading capacity curve, compared to measured (existing) data.

7.1 Flow Duration Curves

The Flow Duration Curve (FDC) builds the foundation for the LDC. The FDC displays the combined frequency of historic flow data over a period of time. An FDC relates flow (mean daily discharge) to the percent of time mean daily flow values have been met or exceeded. The use of “percent of time exceeded” (duration) provides a uniform scale from 0 to 100 percent, and accounts for the full range of flow for the period of record. On an FDC, low flows are exceeded most of the time and high (flood) flows are rarely exceeded (EPA, 2007).

The FDC runs from high (0%) to low (100%) flow duration along the x-axis and corresponding flow values on the y-axis (**Figure 18**). Zero percent is the highest flows (flood conditions) and one hundred percent is the lowest flow (drought). The curve is broken down into flow zones as a general indicator of conditions and patterns (wet vs dry and to what extent) (EPA, 2007).

Flow Duration Curves for the TMDL water bodies were created using flow data from the USGS streamgaging station and estimated flow data from the DAR method (**Section 5.2**). Although *E. coli* water quality standards only apply during the recreation season (May-Sept), March and April flow data were available and were included in the FDCs to capture variation in spring flow conditions.

In southeastern North Dakota the intensity and length of rain events varies. Rain can be irregular and heavy, or light over a short period. Intense rain that falls faster than the ground can absorb leads to high runoff events. These intense runoff events are represented by the high flow zone. Mid-range and dry zones represent less intense runoff over longer periods. The low flow zone represents drought conditions or light rainfall events not adding runoff to streams.

Flow zones for each curve were defined by natural breaks in the FDC flow record. The following FDCs are based on flow data from one station, using the DAR method, and as a result are ratios of the same curve.

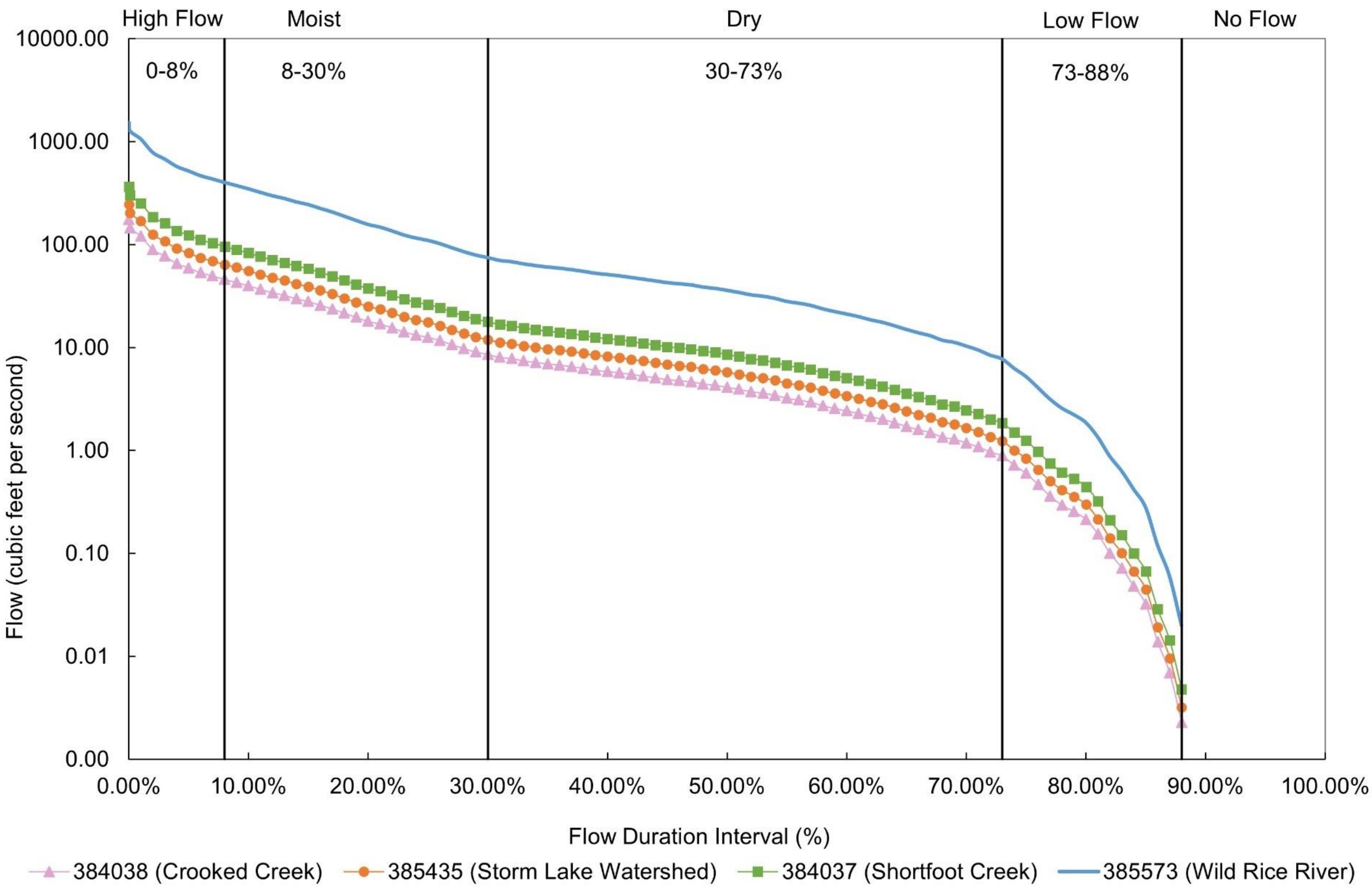


Figure 18. Flow Duration Curves for TMDL water bodies. Flow data collected from USGS streamgaging station 05051600 March-September 2008-2021.

7.2 Load Duration Curves

The LDC, like the FDC, shows flow duration and flow zones on the x-axis. The flow curve is converted to a loading curve by multiplying flow data by the water quality target (*E. coli* criterion, 126 CFU/100mL). The result is a curve that represents the TMDL (loading capacity) for the observed flows. *E. coli* data collected from the TMDL water body were converted to loads and plotted to compare the TMDL (curve) to existing conditions (points). Data points that plot below the TMDL target meet the water quality criterion; points that plot above the curve exceed the criterion. For each flow zone a regression is applied to data points above the TMDL target curve. The midpoint of each regression relationship represents the TMDL for each flow zone.

Regression relationship (where *load* is measured in 10^7 CFU/day):

*E. coli bacteria load = antilog (intercept + (slope * midpoint percent of flow zone))*

Water quality data from site 385573 was used to represent both (connected) TMDL segments of the Wild Rice River (ND-09020105-018-S_00 and ND-09020105-022-S_00) in one LDC (**Figure 19**). As detailed in **Table 5**, site 385435 had only two *E. coli* samples collected in May. As a result, water quality samples in high flow (spring runoff) conditions were not represented by the LDC and flow zones were adjusted to reflect sampling conditions, combining High and Moist Flow zones (**Figure 21**). Similarly, site 384038 had no samples collected during low flow (late summer/fall) conditions. As a result, Dry and Low Flow zones were combined (**Figure 22**).

Load duration curve data and results are detailed in Appendix C.

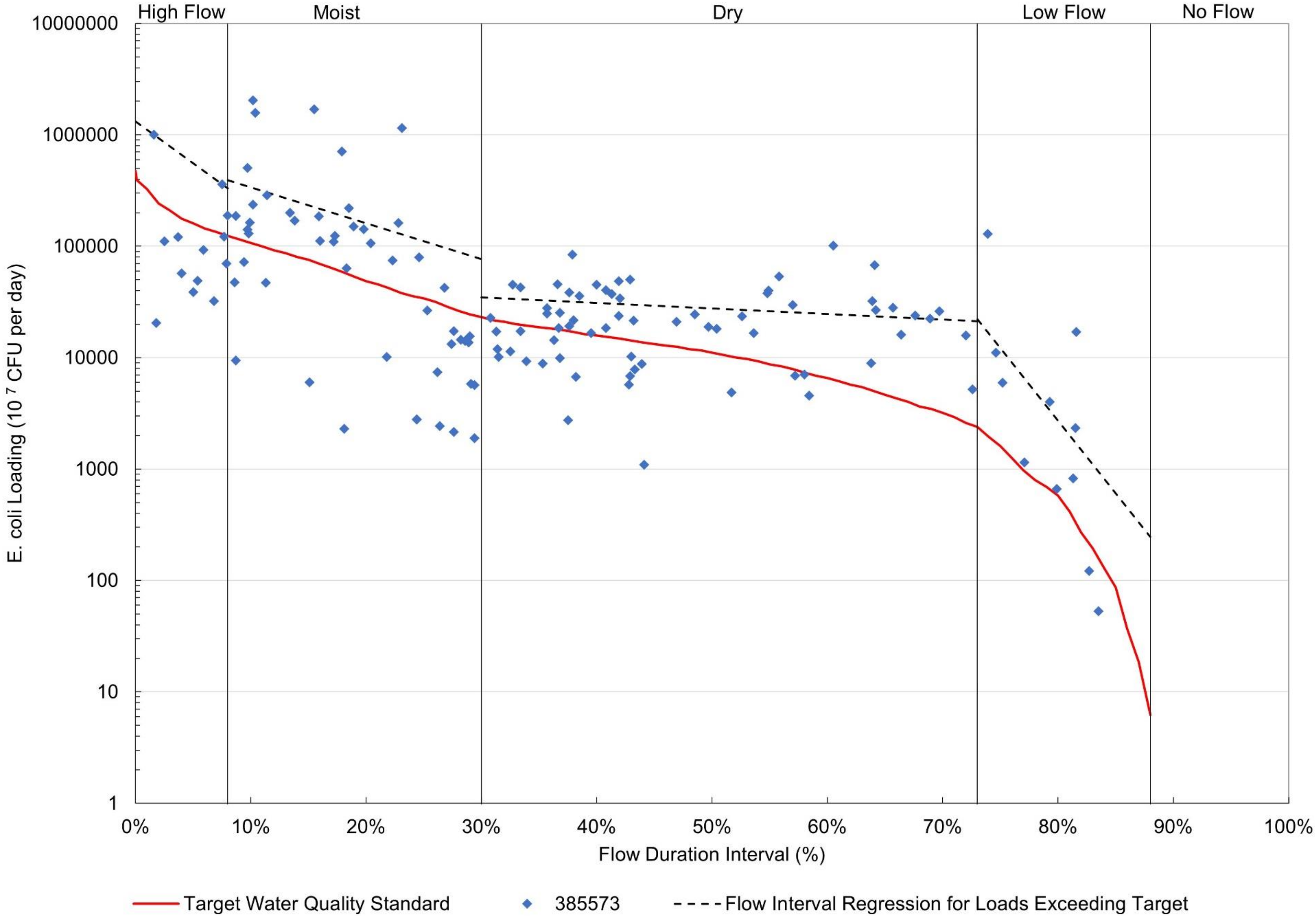


Figure 19. Load Duration Curve and flow zone exceedance regressions for site 385573 on the Wild Rice River (ND-09020105-018-S_00 and ND-09020105-022-S_00).

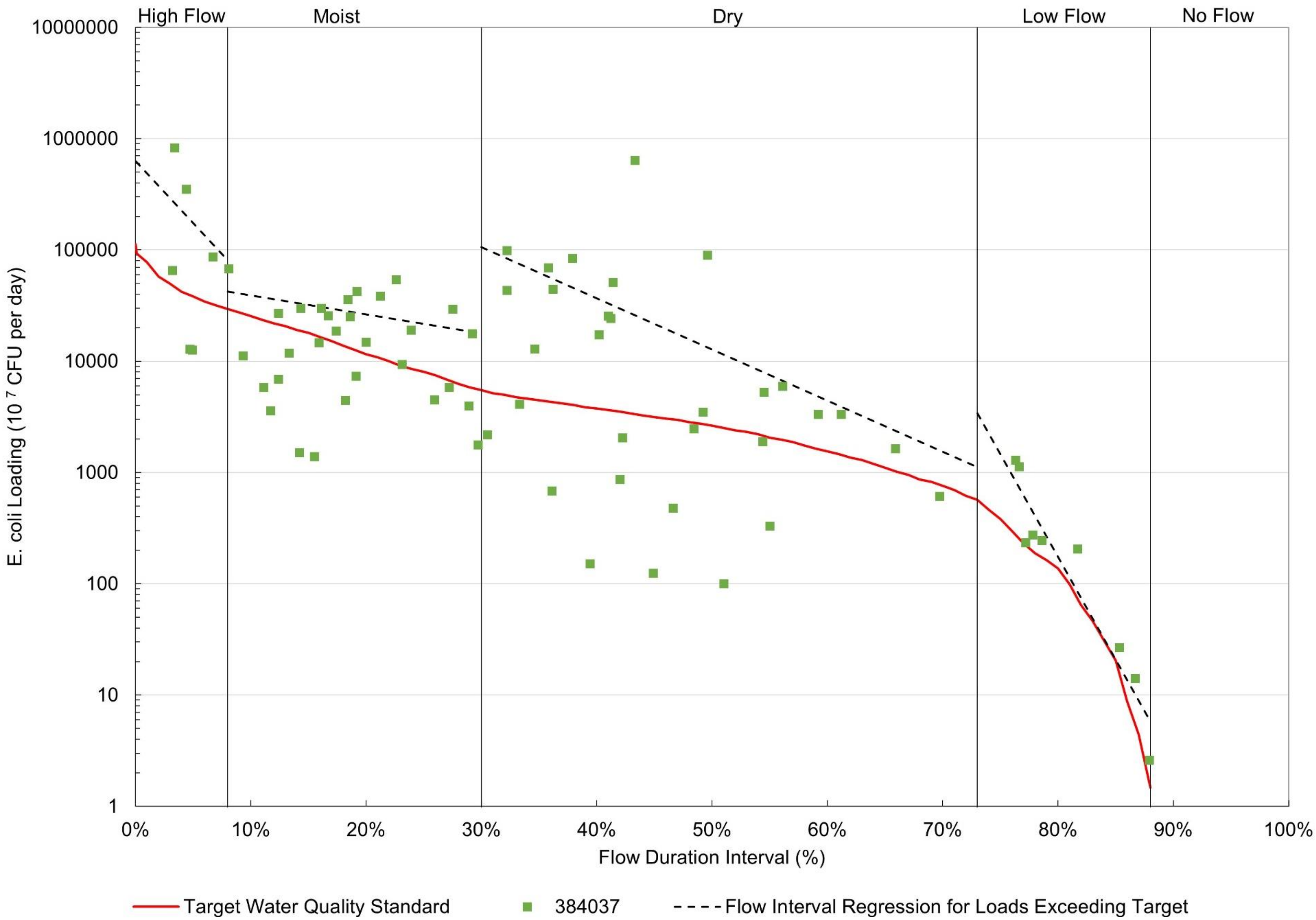


Figure 20. Load Duration Curve and flow zone exceedance regressions for site 384037 on Shortfoot Creek (ND-09020105-016-S_00).

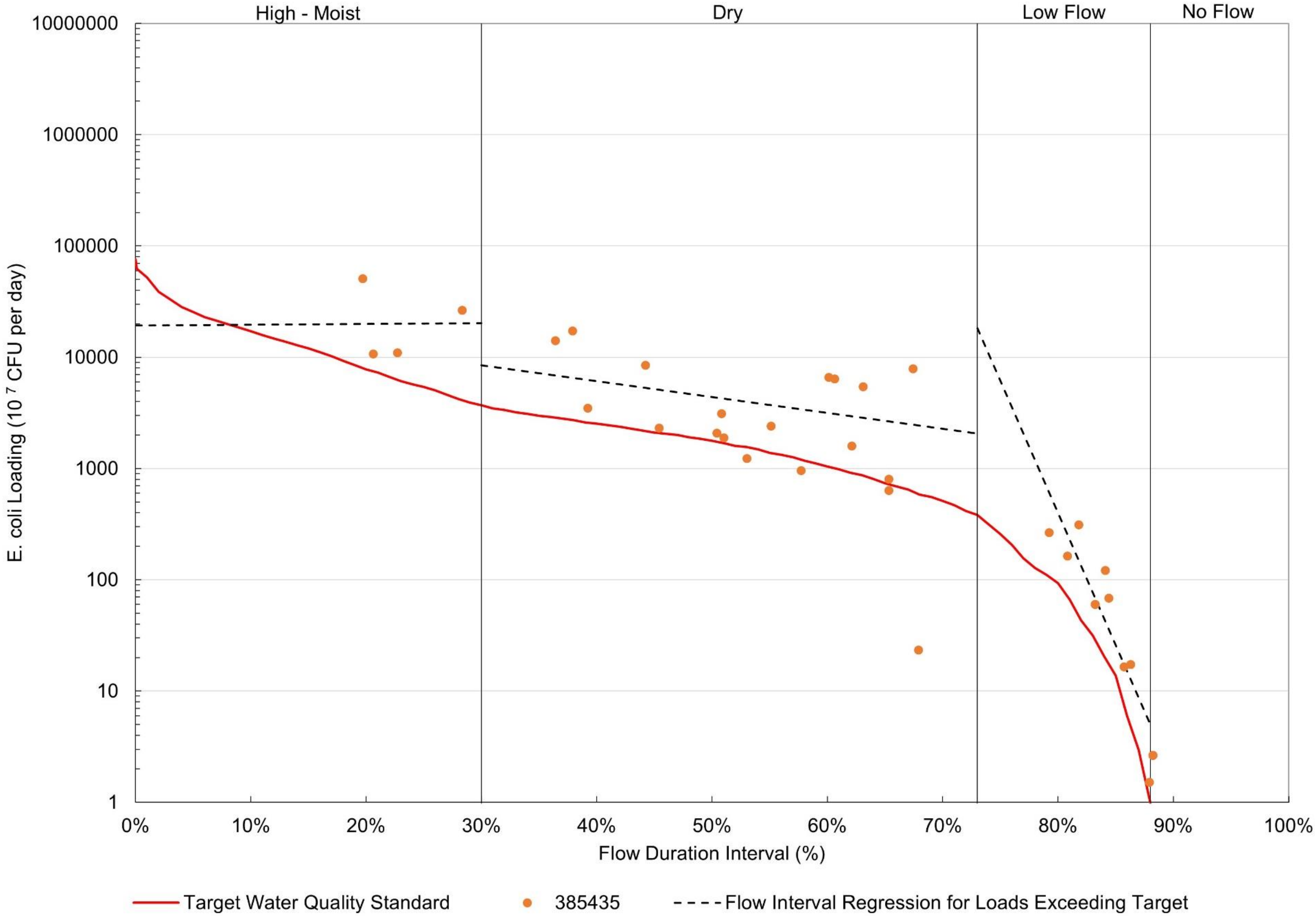


Figure 21. Load Duration Curve and flow zone exceedance regressions for site 385435 on Tributary to the Wild Rice River in the Storm Lake watershed (ND-09020105-014-S_00).

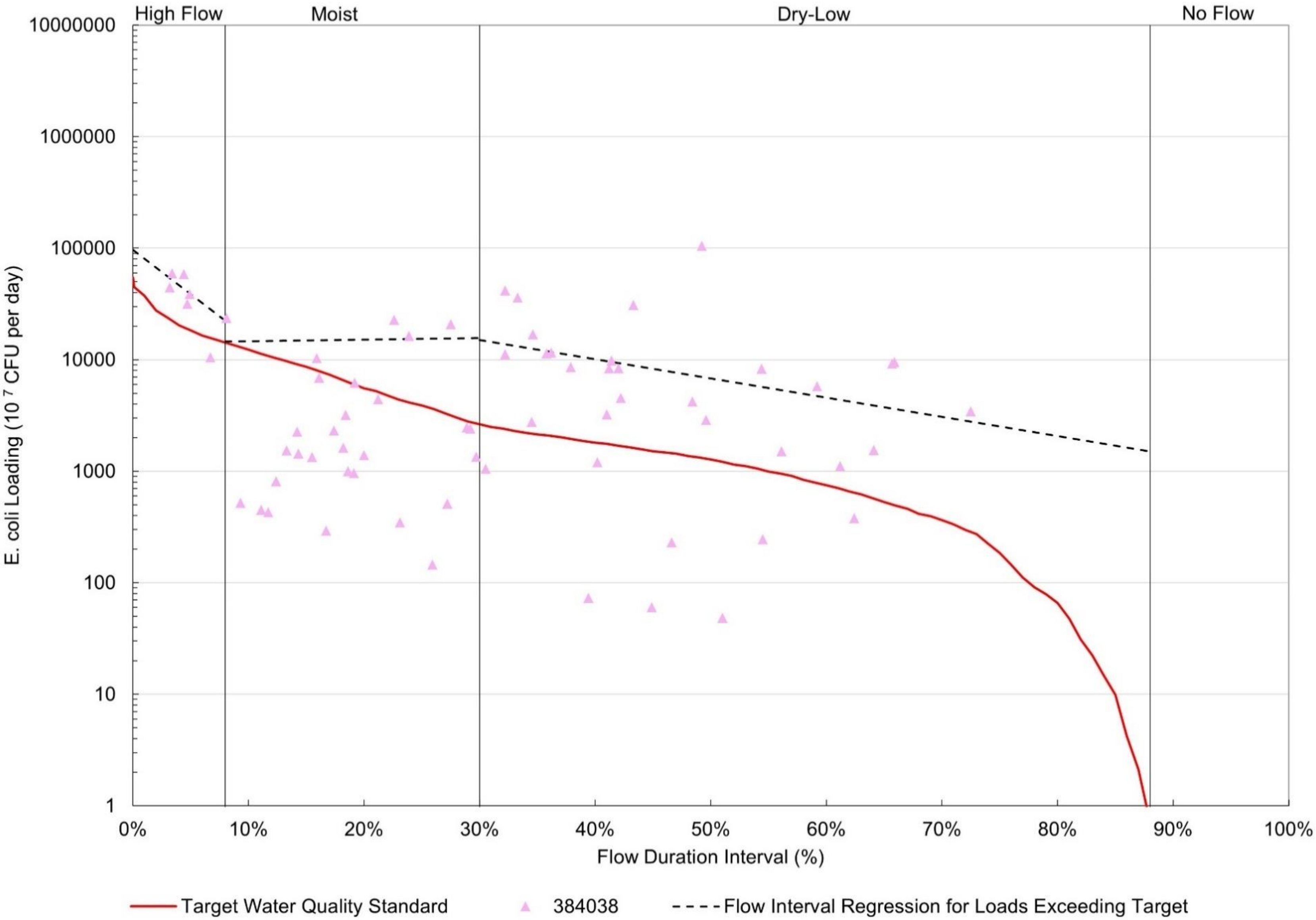


Figure 22. Load Duration Curve and flow zone exceedance regressions for site 384038 on Crooked Creek (ND-09020105-017-S_00).

7.2.1 Load Duration Curve Results

Tables 16-19 detail estimated existing loads and TMDL targets for flow zones based on load duration curves (**Figures 19-22**).

Table 16. Load duration curve results for the Wild Rice River.

Water body name	Wild Rice River				
Water body ID	ND-09020105-018-S_00 & ND-09020105-022-S_00*				
Site # 385573		Flow Zones			
		High	Moist	Dry	Low
E. coli (*10^7 CFU/day*)	Existing Load	658,962	172,941	27,129	2,334
	TMDL	176,985	53,014	10,328	487

*no water quality data available; combined TMDL based on downstream segment water quality

Table 17. Load duration curve results for Shortfoot Creek.

Water body name	Shortfoot Creek				
Water body ID	ND-09020105-016-S_00				
Site # 384037		Flow Zones			
		High	Moist	Dry	Low
E. coli (*10^7 CFU/day*)	Existing Load	224,415	27,422	10,861	141
	TMDL	42,019	12,586	2,452	116

Table 18. Load duration curve results for Tributary to the Wild Rice River.

Water body name	Tributary to the Wild Rice River			
Water body ID	ND-09020105-014-S_00			
Site # 385435		Flow Zones		
		High-Moist	Dry	Low
E. coli (*10^7 CFU/day*)	Existing Load	19,733	4,169	302
	TMDL	12,047	1,647	78

Table 19. Load duration curve results for Crooked Creek.

Water body name	Crooked Creek			
Water body ID	ND-09020105-017-S_00			
Site # 384038		Flow Zones		
		High	Moist	Dry-Low
E. coli (*10^7 CFU/day*)	Existing Load	46,205	15,055	4,756
	TMDL	20,246	6,065	790

8.0 TMDL ALLOCATIONS

The existing *E. coli* load in each water body is equal to the sum of sources, grouped as point and nonpoint. The TMDL is the combination of sources that can meet the loading capacity and support the water quality standard. Sources (existing and future) are represented as wasteload allocations (WLAs, or point sources), load allocations (LAs, or nonpoint sources), and a margin of safety (MOS, including seasonality) to account for uncertainty.

$$TMDL = WLA + LA + MOS$$

8.1 Margin of Safety

TMDLs account for unknowns using a margin of safety (MOS). An MOS acknowledges the uncertainty in TMDL development and can be included as 1) conservative assumptions (implicit) or, 2) a standalone number (explicit). The TMDLs in this document were developed using both implicit and explicit MOS.

The main source of uncertainty in the TMDLs was the result of flow data estimates. Flow for each TMDL was based on a drainage area ratio from a single streamgaging station which may have over-or under-estimated flow for individual sites, potentially impacting loading and reduction calculations. Further, known and unknown water control structures throughout the watershed add uncertainty to flow data estimates. To account for this, each TMDL included an explicit 10% MOS.

$$MOS = 10\% \times TMDL$$

The TMDLs also included an implicit MOS based on conservative TMDL targets. TMDLs (*daily* loads) were developed based on a *monthly* water quality target (monthly *E. coli* geometric mean ≤ 126 CFU/100 mL).

8.1.1 Seasonality

To support water quality standards under changing conditions, TMDLs must also account for seasonal variation. The summer season is considered the critical period when recreation is most likely to occur. As a result, *E. coli* water quality standards supporting recreation use apply during the recreation season, May 1 – September 30.

To account for seasonality, TMDLs were developed for multiple flow zones which typically correlate with seasons (high flows in the spring and low flows in the fall). Further, March and April flow data were used to help represent changing climate conditions (for example, capturing seasonal shifts such as earlier spring runoff).

8.2 Wasteload Allocations

Wasteload allocations represent point sources of *E. coli* in the water bodies. Permit writers reference **Table 24** in **Section 10.1** Wasteload Allocation Implementation for permit information that supports the assumptions of each WLA as required under 40 CFR 122.44(d)(1)(vii)(B).

Wasteload allocations for permitted POTWs were calculated based on:

1) Average daily discharge during the recreation period (May – September) from 2007 to 2021. Calculating WLAs based on average daily discharge during the recreation period accounts for variability in volume and duration of facility discharges. Average daily discharge was calculated by dividing the total volume discharged by the number of days discharging as reported on facility Discharge Monitoring Reports (DMRs).

2) The *E. coli* TMDL target, 126 CFU/100 mL. Calculating WLAs based on the TMDL target, which is based on numeric water quality criteria, ensures permitted dischargers are meeting water quality standards.

The above criteria are represented by the following equation:

WLA = POTW Average Daily Discharge * 126 CFU / 100 mL * Unit Conversion

TMDL allocations would need to be adjusted in the future if facility capacity increases or a new wasteload is added to a stream segment. WLA considerations and calculations, including DMR data, are detailed in Appendix B.

8.3 Load Allocations

Load allocations represent nonpoint sources of *E. coli* in the watersheds. Due to the small volume and infrequent discharge from point sources, the majority of loading was attributed to nonpoint sources. Where no point source discharge was permitted or contributing, loading was entirely allocated to nonpoint sources (less a margin of safety).

LA = TMDL – WLA(s) – MOS

Nonpoint source loads were allocated as single loads for each TMDL due to limited data on individual nonpoint source contribution (for example, natural background vs. septic systems vs. agricultural runoff, etc.).

9.0 TMDL RESULTS

Five *E. coli* impaired water bodies were assigned four *E. coli* TMDLs to support state water quality standards and recreation use. A combined TMDL was developed for two (connected) stream segments due to no water quality data being available for the upstream segment.

Each TMDL includes targets and allocations for different flow zones to represent seasonal variation and to help identify potential sources. Allocations, including MOS, were estimated based on available data and reasonable assumptions. Each TMDL was developed in consideration of critical elements such as beneficial use impairment, state water quality standards, pollutant sources, and margins of safety. Actual reductions needed to meet water quality standards may be higher or lower depending on future monitoring.

9.1 TMDL for the Wild Rice River

E. coli concentration in the Wild Rice River (ND-09020105-018-S_00 & ND-09020105-022-S_00) exceeded the water quality target during the recreation season from June-September 2011-2014 (**Table 6**). This is illustrated in the load duration curve for site 385573 (co-located with USGS streamflow station) (**Figure 19**), where the majority of *E. coli* loads fell above the TMDL target line in the moist, dry, and low flow zones.

The majority of the TMDL was allocated to nonpoint sources. An WLA for a permitted wastewater treatment facility was included in all flow zones based on a history of periodic discharge at different times of year. The facility is estimated to contribute less than one percent of the load during high, moist, and dry flow conditions, but has the potential to contribute nearly one-quarter of the TMDL based on average discharge during low flow.

Table 20. *E. coli* TMDL for the Wild Rice River (ND-09020105-018-S_00 & ND-09020105-022-S_00) based on site 385573.

E. coli unit: CFU x 10^7/day	Flow Zone			
	High	Moist	Dry	Low
Existing Load	658,962	172,941	27,129	2,334
TMDL	176,985	53,014	10,328	487
WLA*	110 (<1% of TMDL)	110 (<1% of TMDL)	110 (1% of TMDL)	110 (23% of TMDL)
LA	159,176.5 (89% of TMDL)	47,602.6 (89% of TMDL)	9,185.2 (89% of TMDL)	328.3 (67% of TMDL)
MOS	17,698.5 (10% of TMDL)	5,301.4 (10% of TMDL)	1,032.8 (10% of TMDL)	48.7 (10% of TMDL)
Reduction Needed	*73%*	*69%*	*62%*	*79%*

*See **Table 24** for permit information on WLA.

9.2 TMDL for Shortfoot Creek

E. coli concentration in Shortfoot Creek (ND-09020105-016-S_00) exceeded the water quality target during the recreation season from June-September 2018-2021 (**Table 6**). Flow data were estimated for Shortfoot Creek based on drainage area, adding uncertainty to loading calculations. The majority of *E. coli* loads fell above the TMDL target line, especially in low flow conditions where all loads exceed the target (**Figure 20**). Permitted wastewater treatment facilities had never reported any discharges and so were excluded from WLAs. The TMDL was entirely allocated to nonpoint sources (less an MOS).

Table 21. *E. coli* TMDL for Shortfoot Creek (ND-09020105-016-S_00) based on site 384037.

E. coli unit: CFU x 10^7/day	Flow Zone			
	High	Moist	Dry	Low
Existing Load	224,415	27,422	10,861	141
TMDL	42,019	12,586	2,452	116
WLA*	0	0	0	0
LA	37,817.1 (90% of TMDL)	11,327.4 (90% of TMDL)	2,206.8 (90% of TMDL)	104.4 (90% of TMDL)
MOS	4,201.9 (10% of TMDL)	1,258.6 (10% of TMDL)	245.2 (10% of TMDL)	11.6 (10% of TMDL)
Reduction Needed	*81%*	*54%*	*77%*	*18%*

*See **Table 24** for permit information on WLA.

9.3 TMDL for Tributary to the Wild Rice River

E. coli concentration in the Tributary to the Wild Rice River (ND-09020105-014-S_00) exceeded the water quality target during the recreation season from June-September 2008-2009 (**Table 7**). Flow data were estimated for the tributary based on drainage area, adding uncertainty to loading calculations. Nearly all *E. coli* loads fell above the TMDL target line. No data was available to represent high flow periods and as a result the high and moist flow zones were combined (**Figure 21**).

The majority of the TMDL was allocated to nonpoint sources. WLAs for two permitted wastewater treatment facilities were included in the high-moist flow zone based on their history of recurring discharge at the beginning of the recreation season (spring). The facilities are estimated to contribute up to one-quarter of the TMDL during high-moist flows and are not anticipated to impact dry-low flow targets.

Table 22. *E. coli* TMDL for Tributary to the Wild Rice River (ND-09020105-014-S_00) based on site 385435.

E. coli unit: CFU x 10^7/day	Flow Zone		
	High - Moist	Dry	Low
Existing Load	19,733	4,169	302
TMDL	12,047	1,647	78
WLA #1*	2,500 (21% of TMDL)	NA	NA
WLA #2*	505.6 (4% of TMDL)	NA	NA
LA	7,837.7 (65% of TMDL)	1,482.3 (90% of TMDL)	70.2 (90% of TMDL)
MOS	1,204.7 (10% of TMDL)	164.7 (10% of TMDL)	7.8 (10% of TMDL)
Reduction Needed	*39 %*	*60 %*	*74 %*

*See **Table 24** for permit information on WLA.

9.4 TMDL for Crooked Creek

E. coli concentration in Crooked Creek (ND-09020105-017-S_00) exceeded the water quality target during the recreation season from June-September 2018-2021 (**Table 8**). Flow data were estimated for the tributary based on drainage area, adding uncertainty to loading calculations. The majority of *E. coli* loads fell above the TMDL target line in high and dry-low flows. No data was available to represent low flow and as a result the dry and low flow zones were combined (**Figure 22**).

The majority of the TMDL was allocated to nonpoint sources. An WLA for a permitted wastewater treatment facility was included in the high and moist flow zones based on history of recurring discharge at the beginning of the recreation season (spring). The facility is estimated to contribute up to 12% of the TMDL during high and moist flows and is not anticipated to impact dry-low flow targets.

Table 23. *E. coli* TMDL for Crooked Creek (ND-09020105-017-S_00) based on site 384038.

E. coli unit: CFU x 10^7/day	Flow Zone		
	High	Moist	Dry - Low
Existing Load	46,205	15,055	4,756
TMDL	20,246	6,065	790
WLA*	706 (3% of TMDL)	706 (12% of TMDL)	NA
LA	17,515.4 (87% of TMDL)	4,752.5 (78% of TMDL)	711 (90% of TMDL)
MOS	2,024.6 (10% of TMDL)	606.5 (10% of TMDL)	79 (10% of TMDL)
Reduction Needed	*56%*	*60%*	*83%*

*See **Table 24** for permit information on WLA.

10.0 IMPLEMENTATION

TMDLs are implemented through water quality permits as wasteload allocations, and through local watershed projects and voluntary activities as load allocations and reductions. Successful implementation of the Wild Rice River and tributaries *E. coli* TMDLs, to support recreation, ultimately depends on voluntary local participation to reduce nonpoint source pollution.

10.1 Wasteload Allocation Implementation

WLAs detailed below are based on the NDDEQ’s 2024 Memorandum on incorporating non-continuous small dischargers into TMDLs and NDPDES permits. Following Memorandum guidance, facilities that had not reported a discharge within 10 years, are covered under a “no-discharge” permit, or discharge to a location that does not affect the impaired reach, were not assigned WLAs. Where applicable (based on discharge volume, frequency and timing, proximity and transit time to impaired reach, relative contribution of discharge to watershed, and applicable permit conditions), concentration-based WLAs were assigned. Facilities that did not meet any of these criteria were assigned a load-based WLA. The below WLAs will ensure facilities meet water quality standards and support TMDL targets. The next permit renewal cycle (beginning October 1, 2024) should incorporate WLAs from this TMDL document.

Permit writers reference **Table 24** (below) for permit information that supports the assumptions of each WLA as required under 40 CFR 122.44(d)(1)(vii)(B). Descriptions of individual WLA calculations and determinations are detailed in Appendix B.

Table 24. NDPDES permit-writer reference for wasteload allocation implementation.

Permitted POTW	Receiving Water Body	*E. coli* Wasteload Allocation
City of Gwinner	Tributary to the Wild Rice River (ND-09020105-014-S_00)	2,500 x 10^7 CFU/day This shall apply only during the recreation season May 1 to September 30.
City of Milnor*	Tributary to the Wild Rice River (ND-09020105-014-S_00)	Concentration-based: Not to exceed 126 CFU/100 mL as a geometric mean of representative samples collected during any 30-day consecutive period. This shall apply only during the recreation season May 1 to September 30.
City of Cayuga	Shortfoot Creek (ND-09020105-016-S_00)	Not assigned. Facility has never reported a discharge and is not anticipated to discharge.
City of Forman	Crooked Creek (ND-09020105-017-S_00)	Concentration-based: Not to exceed 126 CFU/100 mL as a geometric mean of representative samples collected during any 30-day consecutive period. This shall apply only during the recreation season May 1 to September 30.
City of Rutland	Intermittent drainage ditch ~2 miles north of the Wild Rice River (ND-09020105-018-S_00)	Concentration-based: Not to exceed 126 CFU/100 mL as a geometric mean of representative samples collected during any 30-day consecutive period. This shall apply only during the recreation season May 1 to September 30.

*The City of Milnor WLA developed in this report is consistent with the 2018 WLA developed for a different section of the Wild Rice River (ND-09020105-012-S_00).

10.2 Load Allocation Implementation

The majority of *E. coli* loading in the Wild Rice River and tributaries is due to nonpoint sources. Runoff (nonpoint) sources that add *E. coli* to water bodies do not have permits with water quality limits. Instead, reducing *E. coli* from nonpoint sources relies on widespread voluntary efforts of landowners and residents in the watershed.

10.2.1 Best Management Practices Addressing Nonpoint Sources

Load allocation reductions are typically implemented through best management practices (BMPs). BMPs are methods, measures, or practices that are determined to be a reasonable and cost-effective means for a landowner to meet nonpoint source pollution control needs (EPA, 2001).

The Natural Resource Conservation Service (NRCS) is a leading agency in the development and implementation of BMPs. The agency has cataloged and described in detail over 100 BMPs to protect water quality. NRCS BMPs are recommended for mitigation based on their credibility and thorough designs. These recommendations do not exclude use of other BMPs as means for mitigation.

Specific BMPs recommended to support reduction of *E. coli* bacteria nonpoint source pollution in the TMDL water bodies are described below.

10.2.1.1 Cropland Management

Vegetative Barrier (NRCS Practice Standard 601)

Vegetative barriers are permanent strips of stiff, dense vegetation established along the general contour of slopes or across concentrated flow areas. Vegetation is used to reduce erosion, manage water flow, stabilize slopes, and trap sediment. Reducing erosion helps reduce movement and rate of movement of sediment (and bacteria) into an adjacent water body. This practice applies to all areas where erosion and sediment (and bacteria) transport are concerns.

Cover Crop (NRCS Practice Standard 340)

Cover crops are grasses, legumes, and forbs planted for seasonal vegetative cover. Cover crops reduce erosion, maintain soil health, and use excess nutrients. This practice applies to all areas where vegetation can protect or improve natural resources (for example, surface water quality). Similar to vegetative barriers, cover crops help manage water flow and reduce movement and rate of movement of sediment (and bacteria) from runoff. Selection of species and timeline of cover crops is based on the desired outcome, such as reducing water quality degradation by utilizing excessive soil nutrients.

Nutrient Management (NRCS Practice 590)

Nutrient management addresses the rate, source, placement, and timing of plant nutrients and soil amendments while reducing environmental impacts. This practice applies to all fields where plant nutrients and soil amendments are applied. Successful management is based on the four R’s of nutrient stewardship – apply the *right nutrient source* at the *right rate* at the *right time* in the *right place* – to improve nutrient use efficiency by the crop and to reduce nutrient losses (to surface water). Nutrient management planning improves plant health and productivity while reducing the risk of pathogen (*E. coli*) transport to surface water.

Drainage Water Management (NRCS Practice 554)

Drainage water management addresses drainage volume and water table elevation by regulating flow from a surface or subsurface agricultural system. Managing drainage water reduces nutrient, pathogen, and pesticide loading from drainage systems into downstream receiving waters and improves plant health and productivity. This practice applies to agricultural land with surface or subsurface drainage systems that can be adapted, or are partially adapted, to allow management of drainage volume and water table by changing the elevation of water level at the outlets. Water control structures for outlets set just below the root zone of actively growing crops prior to and during liquid manure applications help prevent direct leakage of manure into drain pipes through soil macro pores (cracks, wormholes, root channels).

10.2.1.2 Livestock Management

Access Control, Fencing, Water Well & Tank Development (NRCS Practice 472, 382, 642)

Access control is the temporary or permanent exclusion of animals, people, vehicles, and equipment from an area, such as livestock exclusion from riparian areas. Fencing installation limits access to surface water, reducing erosion and reducing bacteria deposition of fecal matter from livestock wading in streams. Where the quality and quantity of water is appropriate for livestock use, a water well and tank provide an alternative water source.

Waste Storage Facility (NRCS Practice 313)

Waste storage facilities are agricultural waste containments used to store manure, agricultural by-products, wastewater, and contaminated runoff. This practice applies where regular storage is needed, and soils, geology, and topography are suitable for construction. Impoundments such as pits or dugouts are designed and constructed to store manure and prevent waste from reaching surface waters.

10.2.1.3 Septic System Analysis

Septic systems fail when one or more components do not work properly, and untreated waste leaves the system. Untreated septic system waste is a potential source of *E. coli*. Wastes may pond in the leach field and ultimately run off directly into nearby streams. System failure is often the result of improper maintenance (age, inadequate pumping, use of harmful household chemicals), improper installation, or location. In the absence of an existing data, an area-wide septic system analysis is recommended to identify possible *E. coli* bacteria discharges from failing or improperly functioning septic systems.

10.2.1.4 E. coli Bacteria Source Tracking Analysis

Source tracking analysis provides insight to sources (for example, wildlife, livestock, human) and points of entry into a watershed. The Wild Rice Watersheds area contains many temporary and seasonal wetlands that support wildlife. In particular, Section 303(d) *E. coli* impaired segment ND-09020105-018-S_00 flows through a national wildlife refuge (Lake Tewaukon) known to attract hundreds of thousands of birds during migration. Advances in technology and widespread use have decreased the cost of source tracking; local watershed agency partners are recommended to use source tracking in their water quality monitoring programs to help identify *E. coli* sources and support management planning.

10.2.1.5 Education and Outreach

Promotion of informational and educational opportunities on watershed practices and water quality encourages land owners and watershed users to network and share ideas that work best in their community. Multiple agencies and organizations host similar venues throughout North Dakota, such as:

a) State funded Water Education Foundation Water Tours. Tours connect participants with projects and plans in North Dakota that address water use, water quality, and sustainability. To learn more visit https://ndwater.org/nd-water-education-foundation/.
b) Soil Conservation District sponsored multi-day workshops/summits. SCDs bring speakers to present on a wide range of topics and involve participants in learning activities.
c) Soil Conservation District sponsored field day demonstrations.
d) North Dakota State University and NDDEQ sponsored "Leadership Academy" focused on watershed restoration and resource conservation activities.
e) NDDEQ annually sponsored "Water Quality Certification" workshop. Participants use a hands-on approach to better understand water quality sampling procedures and techniques.
f) River Keepers annually sponsored river events. Activities include canoeing, excursions, and fishing presented under the theme of environmental education. To learn more visit https://www.riverkeepers.org/.

10.2.2 BMP Cost-share Opportunities

Many BMPs can be implemented with little cost to landowners; others may require significant investment. To help offset expenses, some BMPs are eligible for cost-share assistance. Individuals interested in learning more about BMPs and cost-share opportunities to help reduce nonpoint source pollution in the Wild Rice watersheds should contact the local SCD:

Wild Rice Soil Conservation District
https://www.wildricescd.com/
701-724-6226 Ext. 3
8991 Hwy 32 Suite 2
Forman, ND 58032

10.3 Effectiveness

TMDLs were estimated based on available data and reasonable assumptions and are intended to guide implementation. Actual reductions needed to meet water quality standards may be higher or lower depending on future monitoring. Point source pollution will be addressed and managed through state and federal permits using the established WLAs (**Table 24**). Water quality monitoring in the Wild Rice watershed has been conducted, and is ongoing, thanks to the Wild Rice Soil Conservation District through Section 319 Nonpoint Source project funding (https://www.wildricescd.com/).

In 2022 the Wild Rice SCD began a new project, the Wild Rice River PTMApp Prioritization and Implementation Project, using the Prioritize, Target and Measure Application (PTMApp) mapping system to prioritize areas for watershed planning (visit deq.nd.gov and enter search criteria "NPS Task Force Members Binder Past Projects"). The project prioritizes 12-digit HUCs (subwatersheds) that PTMApp identifies as the highest sources of nutrients and sediments. Although project prioritization focuses on nutrients and sediments, water quality monitoring continues to include *E. coli* bacteria sampling. The entire project, expected to span roughly 10 years, will focus on the top five to seven subwatersheds in the Western Wild Rice HUC 8 in Sargent County.

Phase I of the PTMApp project focused on three 12-digit HUCs. Two of the priority HUCs coincide with impaired segments and water quality monitoring stations addressed in this TMDL: water quality monitoring site 384037 on Shortfoot Creek (ND-09020105-016-S_00) and 384038 on Crooked Creek (ND-09020105-017-S_00). Site 385234 on the Wild Rice River (directly downstream of the confluence of the Storm Lake watershed and the Wild Rice River) was also prioritized in Phase I (ND-09020105-012-S_00, *E. coli* TMDL approved by EPA in 2018). Water quality data collected under the Wild Rice PTMApp project will be compared to TMDLs to determine *E. coli* bacteria reduction progress.

At this time there are no active monitoring projects on the three additional impaired segments addressed in this report (ND-09020105-014-S_00, ND-09020105-018-S_00, ND-09020105-022-S_00). However, additional subwatersheds prioritized under future phases of the Wild Rice River PTMApp Project should continue collecting *E. coli* data to determine reduction progress. Further, where no projects are planned future monitoring should be conducted following implementation of BMPs in order to compare conditions to TMDLs and determine *E. coli* bacteria reduction progress. The NDDEQ will continue assisting the Wild Rice SCD with sampling location prioritization, with consideration of reaches where little or no data is available (or where new data is needed).

11.0 PUBLIC PARTICIPATION

Outreach with the Sisseton-Wahpeton Oyate of the Lake Traverse Reservation was conducted prior to a public comment period. A draft of this report (and summary) were shared with the tribe in February 2023 with an invitation to collaborate and discuss any questions or concerns regarding the TMDLs, as well as notice of the upcoming public comment period.

A draft report and summary were available to the public and open to comment during a 30-day period, July 26-August 25, 2023. During the public comment period the report was posted on the department webpage at https://deq.nd.gov/PublicNotice.aspx. Copies of the report were available to anyone who submitted a request and were emailed or mailed to participating agencies and partners, including:

- Sisseton-Wahpeton Oyate of the Lake Traverse Reservation
- Wild Rice Soil Conservation District
- Sargent County Water Resource District
- Natural Resource Conservation Service (State Office)
- South Dakota Department of Agriculture and Natural Resources

- U.S. Environmental Protection Agency, Region 8
- Tewaukon National Wildlife Refuge

The draft report and summary were also shared with the following NDPDES permitted facilities:

- City of Cayuga, ND
- City of Forman, ND
- City of Gwinner, ND
- City of Milnor, ND
- City of Rutland, ND

The 30-day public notice soliciting comment and participation was published in the Sargent County Teller, the Daily News (Wahpeton), and the Fargo Forum.

No comments were received during the public comment period.

References

Bluemle, J.P. (1979). Geology of Ransom and Sargent Counties, North Dakota. North Dakota Geological Survey. 69(1). https://www.dmr.nd.gov/ndgs/documents/outofprint/Bulletins/Bulletin%2069.pdf

Bryce, S.A., Omernik, J.M., Pater, D.A., Ulmer, M., Schaar, J., Freeouf, J., Johnson, R., Kuck, P., and Azevedo, S.H. (1996). Ecoregions of North Dakota and South Dakota. Reston, Virginia, U.S. Geological Survey (map scale 1:1,500,000). https://gaftp.epa.gov/EPADataCommons/ORD/Ecoregions/nd/ndsd_front.pdf. Accessed 3/29/2022.

Clean Water Act of 1972, 33 U.S.C. § 1251 et seq. https://www.govinfo.gov/content/pkg/USCODE-2020-title33/pdf/USCODE-2020-title33.pdf

DWR. (2021). Watershed data – MapServices. North Dakota Department of Water Resources. https://mapservice.dwr.nd.gov/. Accessed 7/22/2022.

EPA. (2001). Protocol for Developing Pathogen TMDLs. EPA 841-R-00-002. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. https://nepis.epa.gov/Exe/ZyPDF.cgi/20004QSZ.PDF?Dockey=20004QSZ.PDF

EPA. (2007). An Approach for Using Load Duration Curves in the Development of TMDLs. EPA-841-B-07-006. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. https://nepis.epa.gov/Exe/ZyPDF.cgi/P1008ZQA.PDF?Dockey=P1008ZQA.PDF

EPA. (2013). Primary Distinguishing Characteristics of Level III Ecoregions of the Continental United States. U.S. Environmental Protection Agency. https://www.epa.gov/eco-research/level-iii-and-iv-ecoregions-continental-united-states. Accessed 5/9/2022.

ND GIS HUB. (2022). https://gishubdata-ndgov.hub.arcgis.com/

NDAWN. (2022). Weather data – NDAWN Center. North Dakota Agricultural Weather Network. https://ndawn.ndsu.nodak.edu/. Accessed 5/31/2022.

NDDEQ. (2019a). North Dakota 2018 Integrated Section 305(b) Water Quality Assessment Report and Section 303(d) List of Waters Needing Total Maximum Daily Loads. North Dakota Department of Environmental Quality, Bismarck, North Dakota. https://deq.nd.gov/publications/WQ/3_WM/TMDL/1_IntegratedReports/2018_Final_ND_Integrated_Report_20190426.pdf

NDDEQ. (2019b). Standards of Quality for Waters of the State. North Dakota Century Code 33-16-02.1. North Dakota Department of Environmental Quality, Bismarck, North Dakota. https://www.ndlegis.gov/information/acdata/pdf/33.1-16-02.1.pdf

NDDoH. (2013). Water Quality Assessment Methodology for North Dakota's Surface Waters. North Dakota Department of Environmental Quality (formerly North Dakota Department of Health). https://deq.nd.gov/publications/WQ/3_WM/AssessmentMethodology/Final_ND_AssessmentMethodology_20140401.pdf

NDIT. (2022). Aerial imagery data – North Dakota GIS Hub Data Portal. North Dakota Information Technology. https://gishubdata-ndgov.hub.arcgis.com/. Accessed 6/14/2022.

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

SDDANR. (2021). Surface Water Quality Standards. South Dakota Administrative Rules 74:51:01. South Dakota Department of Agriculture and Natural Resources. https://sdlegislature.gov/Rules/Administrative/28222

SDDANR. (2021). Uses Assigned to Streams. South Dakota Administrative Rules 74:51:03. South Dakota Department of Agriculture and Natural Resources. https://sdlegislature.gov/Rules/Administrative/28368

USDA. (2020). Cropland Data Layer. U.S. Department of Agriculture Statistics Service. https://nassgeodata.gmu.edu/CropScape/. Accessed 5/9/2022.

USDA. Natural Resources Conservation Services Conservation Practices. U.S. Department of Agriculture. https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/technical/cp/ncps/?cid=nrcs143_026849
Conservation Practice Standard Access. Control Code 472. (2017).
Conservation Practice Standard Cover Crop. Code 340. (2014).
Conservation Practice Standard Drainage Water Management. Code 554. (2020).
Conservation Practice Standard Fence. Code 382. (2021).
Conservation Practice Standard Nutrient Management. Code 590. (2019).
Conservation Practice Standard Vegetative Barrier. Code 601. (2021).
Conservation Practice Standard Waste Storage Facility. Code 313. (2016).
Conservation Practice Standard Water Well. Code 642. (2020).

USDOC. (n.d.). National Weather Service Climate Zones. U.S. Department of Commerce. https://www.weather.gov/jetstream/climates. Accessed 6/6/2022.

USFWS. (n.d.). Tewaukon National Wildlife Refuge. U.S. Fish and Wildlife Service. https://www.fws.gov/refuge/tewaukon. Accessed 6/7/2022.

USGS. (2022). Elevation data – The National Map Viewer. U.S. Geological Survey. https://apps.nationalmap.gov/downloader/#/. Accessed 3/30/2022.

USGS. (2022). Streamflow data – National Water Dashboard. U.S. Geological Survey. https://dashboard.waterdata.usgs.gov/app/nwd/?aoi=default. Accessed 5/3/2022.

USGS. (2017). Watershed data – StreamStats. U.S. Geological Survey. https://streamstats.usgs.gov/ss/. Accessed 4/29/2022.

Appendix A – Water Quality Monitoring Data

Tables A1 – A4 detail *E. coli* results for sites used to develop TMDLs for the Wild Rice River and tributaries. Footnotes for each are combined and listed following **Table A4**.

Table A1. *E. coli* results for site 385435 (ND-09020105-014-S_00) May-September 2008-2009*.

Date	Time	Result (CFU/100mL)
5/12/2008	10:14	150
5/27/2008	19:55	5 [a/]
6/3/2008	10:24	2100 [b/]
6/10/2008	09:12	490
6/18/2008	09:34	620
6/24/2008	09:44	800 [c/]
6/30/2008	10:01	1600 [d/]
7/7/2008	09:44	310
7/15/2008	09:28	740
7/21/2008	09:33	250
7/27/2008	09:17	340
8/6/2008	10:15	120
8/11/2008	10:40	410
8/18/2008	09:58	290
8/25/2008	09:22	500
9/2/2008	09:58	1200 [b/]
9/8/2008	11:19	130
9/15/2008	09:47	250
9/22/2008	10:25	650
9/29/2008	09:56	370
6/1/2009	10:42	220
6/9/2009	10:35	800 [c/]
6/15/2009	10:44	800 [c/]
6/23/2009	11:17	800 [c/]
6/30/2009	10:21	180
7/6/2009	10:27	140
7/13/2009	10:11	220
7/21/2009	10:10	170
7/27/2009	10:10	100
8/3/2009	10:30	140
8/10/2009	10:26	100
8/17/2009	10:06	220

8/24/2009	09:34	800 [c/]
9/1/2009	12:24	110
9/14/2009	10:35	140
9/28/2009	09:27	230

Table A2. *E. coli* results for site 385573 (ND-09020105-018_00) May-September 2011-2014*.

Date	Time	Result (CFU/100mL)
5/18/2011	09:37	30
5/23/2011	11:53	50
5/25/2011	10:30	10
5/31/2011	10:41	190
6/1/2011	10:08	120
6/6/2011	11:17	200
6/7/2011	09:23	80
6/13/2011	10:32	60
6/14/2011	09:54	370
6/20/2011	10:07	150
6/21/2011	10:28	190
6/27/2011	10:21	350
6/28/2011	09:36	70
7/5/2011	15:00	570
7/6/2011	09:12	80
7/11/2011	09:35	40
7/12/2011	08:51	60
7/18/2011	09:50	80
7/19/2011	09:00	30
7/25/2011	09:35	160
8/1/2011	08:58	460
8/2/2011	09:28	10
8/8/2011	09:35	40
8/9/2011	09:00	30
8/15/2011	09:00	280
8/16/2011	09:54	1900 [d/]
8/22/2011	10:41	300
8/23/2011	07:42	260
8/29/2011	11:48	330
8/30/2011	09:58	200

9/6/2011	09:14	220
9/7/2011	06:58	250
9/12/2011	09:45	500
9/13/2011	14:38	350
9/19/2011	10:11	360
9/20/2011	09:00	280
9/26/2011	09:45	230
9/27/2011	09:43	520
4/30/2012	11:40	10
5/7/2012	09:00	80
5/9/2012	09:33	70
5/14/2012	10:20	70
5/16/2012	09:26	150
5/21/2012	15:13	60
5/23/2012	07:30	800 [c/]
5/30/2012	09:51	110
6/4/2012	11:01	680
6/6/2012	10:50	800 [c/]
6/11/2012	11:32	800 [c/]
6/13/2012	10:35	8000 [d/]
6/18/2012	10:48	760
6/20/2012	10:34	2000 [d/]
6/25/2012	11:31	260
6/27/2012	10:49	490
7/9/2012	15:04	800 [c/]
7/11/2012	10:34	6300 [d/]
7/23/2012	10:46	800 [c/]
7/24/2012	09:48	270
7/30/2012	10:28	150
7/31/2012	10:31	140
8/6/2012	10:20	70
8/7/2012	10:48	40
5/7/2013	11:30	10
5/6/2013	14:45	5 [a/]
5/13/2013	13:00	10
5/14/2013	11:00	10
5/21/2013	09:00	100

5/22/2013	11:00	3800 [d/]
5/28/2013	11:15	60
5/29/2013	11:00	60
6/5/2013	10:45	410
6/4/2013	14:00	90
6/11/2013	15:00	210
6/12/2013	09:13	220
6/18/2013	17:30	800 [c/]
6/19/2013	10:30	1000 [d/]
6/24/2013	15:00	2900 [d/]
6/26/2013	11:00	1500 [d/]
7/1/2013	10:30	270
7/8/2013	14:00	290
7/10/2013	10:00	310
7/15/2013	10:15	130
7/17/2013	09:45	330
7/22/2013	15:00	130
7/30/2013	11:00	110
7/31/2013	10:30	270
8/5/2013	14:30	100
8/7/2013	10:30	130
8/13/2013	10:00	70
8/14/2013	09:45	70
8/19/2013	15:00	60
8/21/2013	10:15	100
8/26/2013	10:30	620
8/28/2013	11:15	160
9/3/2013	11:30	70
9/4/2013	10:30	80
9/9/2013	14:30	360
9/11/2013	10:30	210
9/16/2013	12:10	570
9/18/2013	11:45	470
9/24/2013	10:30	80
9/25/2013	11:00	120
5/5/2014	11:00	10
5/7/2014	10:45	30

5/12/2014	08:45	30
5/14/2014	10:00	140
5/19/2014	09:00	10
5/21/2014	09:45	70
5/27/2014	10:00	30
5/28/2014	11:00	30
6/2/2014	09:30	280
6/4/2014	09:00	170
6/9/2014	09:30	280
6/10/2014	10:30	320
6/16/2014	09:45	290
6/24/2014	08:30	180
6/25/2014	09:00	80
6/30/2014	09:00	2400 [d/]
7/8/2014	17:15	60
7/9/2014	10:15	70
7/14/2014	09:30	20
7/15/2014	10:30	50
7/22/2014	09:45	50
7/23/2014	10:30	60
7/28/2014	10:00	140
7/30/2014	09:45	200
8/4/2014	12:00	190
8/5/2014	10:30	180
8/13/2014 **	08:00	440
8/18/2014	15:00	210
8/19/2014	18:00	260
8/25/2014	16:15	190
8/26/2014	09:15	10
9/2/2014	11:30	300
9/3/2014	10:30	540
9/8/2014	11:00	800 [c/]
9/10/2014	11:15	800 [c/]
9/15/2014	15:15	220
9/16/2014	10:45	1700 [d/]
9/22/2014	11:30	480

Table A3. *E. coli* results for site 384037 (ND-09020105-016-S_00), May-Sept 2018-2021.**

Date	Time	Result (CFU/100mL)
5/2/2018	10:05	5 [a/]
5/7/2018	10:41	5 [a/]
5/9/2018	09:02	20
5/14/2018	10:40	5 [a/]
5/16/2018	10:00	310
5/23/2018	09:55	20
5/30/2018	09:51	98
6/4/2018	09:40	130
6/6/2018	09:11	560
6/11/2018	08:25	530
6/13/2018	09:07	180
6/18/2018	09:50	200
7/9/2018	07:42	160
7/11/2018	08:25	20
7/16/2018	09:14	110
7/18/2018	09:23	110
7/23/2018	09:20	31
8/1/2018	09:24	74
8/6/2018	09:09	260
8/13/2018	09:25	170
8/20/2018	09:28	350
8/27/2018	09:33	200
9/4/2018	09:25	150
9/24/2018	09:02	270
5/6/2019	08:55	20
5/13/2019	08:53	10
5/20/2019	08:51	1100
5/22/2019	09:03	41
5/29/2019	08:59	31
6/3/2019	09:10	10
6/10/2019	08:43	240
6/12/2019	09:12	74

6/17/2019	08:44	160
6/24/2019	08:55	200
7/1/2019	08:47	130
7/8/2019	08:38	210
7/9/2019	09:05	340
7/16/2019	08:53	74
7/22/2019	08:51	52
8/5/2019	09:05	85
8/6/2019	08:35	40
8/14/2019	08:56	390
8/19/2019	09:00	230
8/20/2019	08:48	110
9/3/2019	09:24	720
9/9/2019	08:52	430
9/11/2019	08:52	290
9/16/2019	08:57	170
9/18/2019	09:06	41
5/4/2020	09:15	160
5/6/2020	09:05	340
5/11/2020	09:11	52
5/18/2020	09:09	41
5/20/2020	09:19	74
6/1/2020	09:13	160
6/3/2020	09:26	41
6/8/2020	09:31	460
6/15/2020	08:07	110
6/22/2020	09:10	580
7/6/2020	09:12	24000
7/15/2020	09:13	4200
7/20/2020	09:05	840
7/22/2020	07:10	880
7/27/2020	09:11	2200
8/3/2020	09:11	280

8/5/2020	09:09	570
8/10/2020	09:35	1100
8/12/2020	09:25	2500
9/2/2020	09:04	360
9/9/2020	09:37	2000
9/14/2020	09:36	1300
9/16/2020	09:23	2600
9/21/2020	09:02	1800
5/3/2021	09:25	110
5/5/2021	09:18	380
5/10/2021	09:14	290

Table A4. *E. coli* results for site 384038 (ND-09020105-017-S_00), May-Sept 2018-2021.**

Date	Time	Result (CFU/100mL)
5/2/2018	09:40	5 [a/]
5/7/2018	10:20	5 [a/]
5/9/2018	08:42	20
5/14/2018	10:20	10
5/16/2018	09:38	30
6/18/2018	09:30	2400
6/20/2018	09:45	1500
6/25/2018	09:00	2300
6/27/2018	09:30	340
7/9/2018	07:21	10000
7/16/2018	09:34	2000
7/18/2018	09:42	390
7/23/2018	08:59	620
8/1/2018	09:00	340
8/6/2018	09:30	930
5/6/2019	09:15	5 [a/]
5/13/2019	08:25	31
5/20/2019	09:10	380
5/22/2019	09:25	210
5/29/2019	09:20	5 [a/]

6/3/2019	08:48	20
6/10/2019	09:13	20
6/12/2019	09:33	20
6/17/2019	08:20	31
6/24/2019	08:30	20
7/1/2019	09:06	10
7/8/2019	08:10	5 [a/]
7/9/2019	08:39	63
7/16/2019	09:17	5 [a/]
7/22/2019	08:29	52
8/5/2019	08:42	110
8/6/2019	09:13	63
8/14/2019	09:14	110
8/19/2019	08:32	110
8/20/2019	08:26	160
9/3/2019	09:00	630
9/9/2019	09:15	130
9/11/2019	08:26	210
9/16/2019	09:19	240
9/18/2019	08:37	260
5/4/2020	08:59	10
5/6/2020	08:45	85
5/11/2020	09:37	5 [a/]
5/18/2020	08:43	10
5/20/2020	08:50	20
6/1/2020	09:33	41
6/3/2020	08:58	31
6/8/2020	09:07	110
6/15/2020	09:25	20
6/22/2020	09:36	84
7/6/2020	08:46	2400
7/15/2020	09:28	280
7/20/2020	08:44	600

7/22/2020	08:48	230
7/27/2020	09:27	330
8/3/2020	08:50	500
8/5/2020	08:46	840
8/10/2020	09:52	590
8/12/2020	09:02	2200
8/17/2020	09:17	160
8/17/2020	09:36	980
9/2/2020	09:20	680
9/9/2020	09:11	700
9/14/2020	09:09	550
9/16/2020	09:41	720
9/21/2020	09:21	1000
5/3/2021	09:08	200
5/5/2021	08:35	200
5/5/2021	08:52	74
5/10/2021	08:54	74
5/12/2021	08:47	150

Tables A1-A4 Footnotes:

* Sample analysis conducted using membrane filtration methods.
** Sample analysis conducted using multi-well distribution (Quanti-Tray) methods.
[a/] Non-detect, assigned ½ lower detection limit
[b/] Result > 800 CFU/100mL 1st dilution
[c/] Too numerous to count, assigned upper detection limit
[d/] 2nd dilution
[e/] Two samples collected. Higher value (listed) was used in calculations and for daily load estimates in Load Duration Curve.

Appendix B – Permitted Facilities

Permit writers reference Table 24 in Section 10.1 Wasteload Allocation Implementation for permit information that supports the assumptions of each WLA as required under 40 CFR 122.44(d)(1)(vii)(B).

Appendix B details permitted facilities in the watershed area for each TMDL water body, including *E. coli* WLA considerations and calculations.

B-1. WLA Considerations for Permitted Facilities

Table B-1.1. NDPDES permitted facilities in the Storm Lake watershed (0902010506) based on ECHO 06/13/2022.

Permit Number	Description	# of Permits	Wasteload Allocation Rationale
ND0020010	Gwinner, ND POTW Permit	1	WLA applies. Discharges treated wastewater to impaired segment
NDG320338	Milnor, ND POTW Permit	1	WLA applies. Discharges treated wastewater to impaired segment
NDPG00015	Pretreatment General Permit (Bobcat Company)	1	WLA does not apply. Facility discharges to POTW
NDR05####	Industrial Stormwater General Permit	4	WLA does not apply. Facilities do not discharge *E. coli*
NDR32####	Mining, Excavation, and Paving Materials Stormwater General Permit	2	WLA does not apply. Facilities do not discharge *E. coli*

Table B-1.2. NDPDES permitted facilities in the Crooked Creek watershed (0902010504) based on ECHO 06/13/2022.

Permit Number	Description	# of Permits	Wasteload Allocation Rationale
NDG320009	Cogswell, ND POTW Permit	1	WLA does not apply. Discharges to closed basin not contributing to impaired segment
NDG321369	Forman, ND POTW Permit	1	WLA applies. Discharges treated wastewater to impaired segment

Table B-1.3. NDPDES permitted facilities in the Lake Tewaukon-Wild Rice River watershed (0902010503) based on ECHO 06/13/2022.

Permit Number	Description	# of Permits	Wasteload Allocation Rationale
NDG321300	Rutland, ND POTW Permit	1	WLA applies. Potential for treated wastewater discharge to contribute to impaired segment
SDP######	Individual Pretreatment Permits	1	WLA does not apply. Facilities discharge to POTWs and are permitted by SD
SDR10####	Construction Stormwater General Permit	1	WLA does not apply. Facilities do not discharge *E. coli* and are permitted by SD

Permit writers reference Table 24 in Section 10.1 Wasteload Allocation Implementation for permit information that supports the assumptions of each WLA as required under 40 CFR 122.44(d)(1)(vii)(B).

Table B-1.4. NDPDES permitted facilities in the Shortfoot Creek-Wild Rice River watershed (0902010505) based on ECHO 06/13/2022.

Permit Number	Description	# of Permits	Wasteload Allocation Rationale
NDG321598	Cayuga, ND POTW Permit	1	WLA not assigned. No discharge reported within 10 years. Future discharge not anticipated.
NDG321539	Lidgerwood, ND POTW Permit	1	WLA does not apply. Discharges to surface waters not contributing to impaired segment
SDG589805	Veblen Flats Housing WWTP	1	WLA does not apply. Zero discharge facility permitted by EPA
SDR10####	Construction Stormwater General Permit	1	WLA does not apply. Facilities do not discharge *E. coli* and are permitted by SD

Table B-1.5. Permitted Concentrated Animal Feeding Operations/Animal Feeding Operations in TMDL watershed area.

Facility Size	# of Permits	Wasteload Allocation Rationale
Large	1	WLAs do not apply. Zero discharge facilities. Under NDAC 33.1-16-03.1-12 permitted CAFO/AFO facilities are prohibited from discharging manure or process wastewater
Medium	4	
Small	4	

B-2. DMR Data and WLA Calculations

Table B-2.1. City of Gwinner (NDPDES permit ND0020010) DMR data during the recreation season 2007-2021.

Discharge Start	Number of Days Discharging	Discharge Volume (Millions of gallons)	Estimated Discharge Flow (Millions of gallons per day)
05/21/21	7	38	5.4
05/17/20	14	40	2.9
06/04/19	14	75	5.4
05/17/18	7	46	6.6
05/09/17	7	90	13
05/06/16	7	47	6.7
06/22/15	14	47	3.4
06/11/14	14	47	3.4
06/24/13	13	47	3.6
05/30/12	6	31	5.2
05/06/11	32	57	1.8
04/30/10	13	33	2.5
06/04/09	13	34	2.6

Permit writers reference Table 24 in Section 10.1 Wasteload Allocation Implementation for permit information that supports the assumptions of each WLA as required under 40 CFR 122.44(d)(1)(vii)(B).

06/11/08	7	34	4.9
05/30/07	27	66	2.4
		Average Daily Discharge	5.2 MGD
		WLA = 5.2 * 126 CFU/100mL * 378,541 x 10^4 mL/MG	2,500 x 10^7 CFU/day

Table B-2.2. City of Milnor (NDPDES permit NDG320388) DMR data during the recreation season 2007-2021.

Discharge Start	Number of Days Discharging	Discharge Volume (Millions of gallons)	Estimated Discharge Flow (Millions of gallons per day)
05/07/07	8	1.029	0.129
07/08/08	8	1.029	0.129
05/05/09	8	12.349	1.544
05/06/10	8	1.234	0.154
05/04/11	8	14.407	1.801
09/27/11	4	6.174	1.544
07/26/13	9	17.49	1.943
06/23/14	8	8.23284	1.029
05/16/16	6	6.174	1.029
06/15/17	7	6.174	0.882
06/11/18	4	6.174	1.544
05/09/19	7	7.203	1.029
04/27/20	7	7.203	1.029
		Average Daily Discharge	1.060 MGD
		WLA = 5.2 * 126 CFU/100mL * 378,541 x 10^4 mL/MG	505.6 x 10^7 CFU/day

Table B-2.3. City of Forman (NDPDES permit NDG321369) DMR data during the recreation season 2007-2021.

Discharge Start	Number of Days Discharging	Discharge Volume (Millions of gallons)	Estimated Discharge Flow (Millions of gallons per day)
05/01/07	6	8.76	1.46
07/03/07	7	13.13	1.88
07/01/08	7	10.57	1.51
04/29/09	4	7.66	1.92
07/28/09	6	10.77	1.80
06/10/10	8	10.9	1.36
05/23/11	8	11.6	1.45
07/09/12	8	10.77	1.35

07/02/13	7	11.3	1.61
06/10/14	7	10.2	1.46
06/17/15	6	8.4	1.40
07/06/16	8	8.011	1.00
05/31/17	7	8.011	1.14
06/06/18	6	9.302	1.55
07/09/19	7	12.038	1.72
05/20/20	7	7.289	1.04
05/11/21	6	9.477	1.58
Average Daily Discharge			1.48 MGD
WLA = 5.2 * 126 CFU/100mL * 378,541 x 10^4 mL/MG			706 x 10^7 CFU/day

Table B-2.4. City of Rutland (NDPDES permit NDG321300) DMR data during the recreation season 2007-2021.

Discharge Start	Number of Days Discharging	Discharge Volume (Millions of gallons)	Estimated Discharge Flow (Millions of gallons per day)
08/29/19	5	1.306	0.2612
07/30/16	7	1.306	0.1866
06/06/12	8	1.5	0.1875
07/28/11	6	1.47	0.245
05/03/11	7	1.633	0.2333
09/25/10	6	1.47	0.245
04/29/10	7	1.633	0.2333
09/23/09	8	1.63	0.2038
06/26/08	5	1.47	0.294
Average Daily Discharge			0.23 MGD
WLA = 5.2 * 126 CFU/100mL * 378,541 x 10^4 mL/MG			110 x 10^7 CFU/day

Permit writers reference Table 24 in Section 10.1 Wasteload Allocation Implementation for permit information that supports the assumptions of each WLA as required under 40 CFR 122.44(d)(1)(vii)(B).

Appendix C – Load Duration Curve Data

C-1. LDC Data for the Wild Rice River

Table C-1.1. Summary of load duration curve results for the Wild Rice River (ND-09020105-018-S_00 and ND-09020105-022-S_00) based on site 385573.

E. coli (10 ^{7} CFU / **DAY**)						*E. coli* (10 ^{7} CFU / **PERIOD**)		
Flow Zone	Median	Existing Load	TMDL	Days		Existing Load	Target Load	Reduction
High	4.01%	658,962	176,985	29		19,217,626	5,161,502	73.14%
Moist	19%	172,941	53,014	80		13,887,195	4,257,006	69.35%
Dry	51.5%	27,129	10,328	157		4,257,832	1,621,036	61.93%
Low	80.5%	2,334	487	55		127,765	26,679	79.12%
			Total	321		37,490,419	11,066,223	70.48%

Table C-1.2. Load duration curve results for ALL flow zones (0.01%-88%) for the Wild Rice River (ND-09020105-018-S_00 and ND-09020105-022-S_00) based on site 385573.

Flow Zone	% Ranking		% Ranking	
High	> 0.0001		<0.08	
Moist	>0.08		<0.3	
Dry	>0.3		<0.73	
Low	>0.73		<0.88	
Date	*E. coli* Concentration (CFU / 100 mL)	Q (Flow, CFS)	% Ranking	*E. coli* Load (10 ^{7} CFU / day)
5/31/2011	190	404.0	8.0	187824
6/6/2011	200	383.0	8.7	187432
6/14/2011	370	316.0	11.4	286091
6/20/2011	150	354.0	9.8	129930
6/21/2011	190	352.0	9.9	163649
6/27/2011	350	420.0	7.5	359694
7/5/2011	570	362.0	9.7	504893
7/25/2011	160	361.0	9.7	141333
8/1/2011	460	888.0	1.6	999509
8/15/2011	280	345.0	10.2	236370
8/16/2011	1900	340.0	10.4	1580697
8/22/2011	300	271.0	13.4	198933
8/23/2011	260	266.0	13.8	169228
8/29/2011	330	229.0	15.9	184912

8/30/2011	200	227.0	16.0	111089
9/6/2011	220	204.0	17.2	109817
9/7/2011	250	202.0	17.3	123568
9/12/2011	500	180.0	18.5	220221
9/13/2011	350	175.0	18.9	149873
9/19/2011	360	161.0	19.8	141822
9/20/2011	280	155.0	20.4	106195
9/26/2011	230	132.0	22.3	74288
9/27/2011	520	127.0	22.8	161593
5/16/2012	150	50.1	40.8	18388
5/23/2012	800	27.3	55.8	53440
6/4/2012	680	16.1	64.2	26789
6/6/2012	800	11.4	68.9	22316
6/11/2012	800	5.7	74.6	11119
6/13/2012	8000	6.6	73.9	128805
6/18/2012	760	8.5	72.0	15751
6/20/2012	2000	20.7	60.5	101302
6/25/2012	260	8.1	72.6	5179
6/27/2012	490	5.0	75.2	5959
7/9/2012	800	2.1	79.3	4013
7/11/2012	6300	1.1	81.6	16957
7/23/2012	800	1.2	81.5	2329
7/24/2012	270	1.3	81.3	826
7/30/2012	150	3.1	77.1	1145
7/31/2012	140	1.9	79.9	665
5/22/2013	3800	124.0	23.1	1152979
6/5/2013	410	48.3	41.9	48456
6/11/2013	210	36.7	49.7	18858
6/12/2013	220	30.8	53.6	16580
6/18/2013	800	12.2	67.6	23882
6/19/2013	1000	10.7	69.7	26182
6/24/2013	2900	239.0	15.5	1695946
6/26/2013	1500	193.0	17.9	708377
7/1/2013	270	54.1	38.5	35742
7/8/2013	290	48.1	42.0	34132
7/10/2013	310	49.0	41.3	37168

7/15/2013	130	52.0	39.5	16541
7/17/2013	330	50.1	40.8	40455
7/22/2013	130	57.8	36.7	18386
7/31/2013	270	64.4	33.4	42547
8/7/2013	130	71.2	30.8	22648
8/26/2013	620	55.4	37.9	84046
8/28/2013	160	55.2	38.0	21611
9/9/2013	360	51.3	40.0	45189
9/11/2013	210	35.4	50.4	18190
9/16/2013	570	28.6	54.9	39889
9/18/2013	470	25.8	57.0	29671
5/14/2014	140	185.0	18.3	63375
6/2/2014	280	66.0	32.7	45219
6/4/2014	170	59.6	35.7	24792
6/9/2014	280	56.0	37.6	38367
6/10/2014	320	58.0	36.6	45414
6/16/2014	290	112.0	24.6	79475
6/24/2014	180	96.4	26.8	42459
6/30/2014	2400	346.0	10.2	2031905
7/28/2014	140	55.8	37.6	19115
7/30/2014	200	48.4	41.9	23686
8/4/2014	190	59.7	35.7	27755
8/5/2014	180	57.4	36.8	25281
8/13/2014	440	46.6	42.9	50171
8/18/2014	210	40.8	46.9	20965
8/19/2014	260	38.4	48.5	24430
8/25/2014	190	46.2	43.2	21479
9/2/2014	300	32	52.6	23490
9/3/2014	540	28.7	54.8	37922
9/8/2014	800	16.4	63.9	32103
9/10/2014	800	14.3	65.7	27993
9/15/2014	220	16.5	63.8	8882
9/16/2014	1700	16.3	64.1	67804
9/22/2014	480	13.7	66.4	16091

Table C-1.3. Load duration curve results for HIGH flow zone (0.01%-8%) for the Wild Rice River (ND-09020105-018-S_00 and ND-09020105-022-S_00) based on site 385573.

Slope	Intercept	X	Y	
-7.52	6.12	0.01	1316441	
		8.00	329852	
E. coli (10 ^{7} CFU / day)				
Median	Existing Load	TMDL	Days	
4.01%	658962	176985	29	
Date	*E. coli* Concentration (CFU / 100 mL)	Q (Flow, CFS)	% Ranking	*E. coli* Load (10 ^{7} CFU / day)
6/27/2011	350	420.0	7.5%	359694
8/1/2011	460	888.0	1.6%	999509

Table C-1.4. Load duration curve results for MOIST flow zone (8%-30%) for the Wild Rice River (ND-09020105-018-S_00 and ND-09020105-022-S_00) based on site 385573.

Slope	Intercept	X	Y	
-3.21	5.85	8.00	390335	
		30.00	76623	
E. coli (10 ^{7} CFU / day)				
Median	Existing Load	TMDL	Days	
19.00%	172941	53014	80	
Date	*E. coli* Concentration (CFU / 100 mL)	Q (Flow, CFS)	% Ranking	*E. coli* Load (10 ^{7} CFU / day)
6/6/2011	200	383.0	8.7	187432
6/14/2011	370	316.0	11.4	286091
6/20/2011	150	354.0	9.8	129930
6/21/2011	190	352.0	9.9	163649
7/5/2011	570	362.0	9.7	504893
7/25/2011	160	361.0	9.7	141333
8/15/2011	280	345.0	10.2	236370
8/16/2011	1900	340.0	10.4	1580697
8/22/2011	300	271.0	13.4	198933
8/23/2011	260	266.0	13.8	169228
8/29/2011	330	229.0	15.9	184912

8/30/2011	200	227.0	16.0	111089
9/6/2011	220	204.0	17.2	109817
9/7/2011	250	202.0	17.3	123568
9/12/2011	500	180.0	18.5	220221
9/13/2011	350	175.0	18.9	149873
9/19/2011	360	161.0	19.8	141822
9/20/2011	280	155.0	20.4	106195
9/26/2011	230	132.0	22.3	74288
9/27/2011	520	127.0	22.8	161593
5/22/2013	3800	124.0	23.1	1152979
6/24/2013	2900	239.0	15.5	1695946
6/26/2013	1500	193.0	17.9	708377
5/14/2014	140	185.0	18.3	63375
6/16/2014	290	112.0	24.6	79475
6/24/2014	180	96.4	26.8	42459
6/30/2014	2400	346.0	10.2	2031905

Table C-1.5. Load duration curve results for DRY flow zone (30%-73%) for the Wild Rice River (ND-09020105-018-S_00 and ND-09020105-022-S_00) based on site 385573.

Slope	Intercept	X	Y	
-0.50	4.69	30.00	34786	
		73.00	21157	
E. coli (10 ^{7} CFU / day)				
Median	Existing Load	TMDL	Days	
51.50%	27129	10328	157	
E. coli (10 ^{7} CFU / day)				
Date	*E. coli* Concentration (CFU / 100 mL)	Q (Flow, CFS)	% Ranking	*E. coli* Load (10 ^{7} CFU / day)
5/16/2012	150	50.1	40.8	18388
5/23/2012	800	27.3	55.8	53440
6/4/2012	680	16.1	64.2	26789
6/6/2012	800	11.4	68.9	22316
6/18/2012	760	8.5	72.0	15751
6/20/2012	2000	20.7	60.5	101302
6/25/2012	260	8.1	72.6	5179

6/5/2013	410	48.3	41.9	48456
6/11/2013	210	36.7	49.7	18858
6/12/2013	220	30.8	53.6	16580
6/18/2013	800	12.2	67.6	23882
6/19/2013	1000	10.7	69.7	26182
7/1/2013	270	54.1	38.5	35742
7/8/2013	290	48.1	42.0	34132
7/10/2013	310	49.0	41.3	37168
7/15/2013	130	52.0	39.5	16541
7/17/2013	330	50.1	40.8	40455
7/22/2013	130	57.8	36.7	18386
7/31/2013	270	64.4	33.4	42547
8/7/2013	130	71.2	30.8	22648
8/26/2013	620	55.4	37.9	84046
8/28/2013	160	55.2	38.0	21611
9/9/2013	360	51.3	40.0	45189
9/11/2013	210	35.4	50.4	18190
9/16/2013	570	28.6	54.9	39889
9/18/2013	470	25.8	57.0	29671
6/2/2014	280	66.0	32.7	45219
6/4/2014	170	59.6	35.7	24792
6/9/2014	280	56.0	37.6	38367
6/10/2014	320	58.0	36.6	45414
7/28/2014	140	55.8	37.6	19115
7/30/2014	200	48.4	41.9	23686
8/4/2014	190	59.7	35.7	27755
8/5/2014	180	57.4	36.8	25281
8/13/2014	440	46.6	42.9	50171
8/18/2014	210	40.8	46.9	20965
8/19/2014	260	38.4	48.5	24430
8/25/2014	190	46.2	43.2	21479
9/2/2014	300	32	52.6	23490
9/3/2014	540	28.7	54.8	37922
9/8/2014	800	16.4	63.9	32103
9/10/2014	800	14.3	65.7	27993
9/15/2014	220	16.5	63.8	8882

9/16/2014	1700	16.3	64.1	67804
9/22/2014	480	13.7	66.4	16091

Table C-1.6. Load duration curve results for LOW flow zone (73%-88%) for the Wild Rice River (ND-09020105-018-S_00 and ND-09020105-022-S_00) based on site 385573.

Slope	Intercept	X	Y	
-13.02	13.85	73.00	22111	
		88.00	246	
Median	Existing Load	TMDL	Days	
80.50%	2334	487	55	
E. coli (10^7 CFU / day)				
Date	*E. coli* Concentration (CFU / 100 mL)	Q (Flow, CFS)	% Ranking	*E. coli* Load (10^7 CFU / day)
6/11/2012	800	5.7	74.6	11119
6/13/2012	8000	6.6	73.9	128805
6/27/2012	490	5.0	75.2	5959
7/9/2012	800	2.1	79.3	4013
7/11/2012	6300	1.1	81.6	16957
7/23/2012	800	1.2	81.5	2329
7/24/2012	270	1.3	81.3	826
7/30/2012	150	3.1	77.1	1145
7/31/2012	140	1.9	79.9	665

C-2. LDC Data for Shortfoot Creek

Table C-2.1. Summary of load duration curve results for Shortfoot Creek (ND-09020105-016-S_00) based on site 384037.

E. coli (10^7 CFU / **DAY**)						*E. coli* (10^7 CFU / **PERIOD**)		
Flow Zone	Median	Existing Load	TMDL	Days		Existing Load	Target Load	Reduction
High	4.01%	224,415	42,019	29		6,544,728	1,225,417	81.28%
Moist	19%	27,422	12,586	80		2,201,973	1,010,676	54.10%
Dry	51.5%	10,861	2,452	157		1,704,567	384,858	77.42%
Low	80.5%	141	116	55		7,701	6,334	17.75%
			Total	321		10,458,969	2,627,284	74.88%

Table C-2.2. Load duration curve results for ALL flow zones (0.01%-88%) for Shortfoot Creek (ND-09020105-016-S_00) based on site 384037.

Flow Zone	% Ranking	% Ranking
High	>0.0001	<0.08
Moist	>0.08	<0.3
Dry	>0.3	<0.73
Low	>0.73	<0.88

Date	*E. coli* Concentration (CFU / 100 mL)	Q (Flow, CFS)	% Ranking	*E. coli* Load (10^7 CFU / day)
5/16/2018	310	6.932510217	54.5	5259
6/4/2018	130	0.733611526	77.2	233
6/6/2018	560	0.947284787	76.3	1298
6/11/2018	530	0.868937924	76.6	1127
6/13/2018	180	0.557924624	78.6	246
6/18/2018	200	3.347547742	65.9	1638
7/9/2018	160	8.903052505	49.2	3486
8/6/2018	260	5.24686561	59.2	3338
8/13/2018	170	0.660012959	77.8	275
8/20/2018	350	0.239788881	81.7	205
8/27/2018	200	0.054605389	85.3	27
9/4/2018	150	0.007122442	87.9	3
9/24/2018	270	0.021367326	86.7	14
5/20/2019	1100	130.8155181	4.4	352102
6/10/2019	240	42.49723729	18.6	24957
6/17/2019	160	37.98635736	20.0	14872
6/24/2019	200	61.0155865	14.3	29860
7/1/2019	130	29.43942695	23.1	9365
7/8/2019	210	49.85709403	16.7	25619
7/9/2019	340	42.97206676	18.4	35750
8/14/2019	390	18.6133151	29.2	17763
8/19/2019	230	53.1809003	16.1	29930
9/3/2019	720	30.62650062	22.6	53957
9/9/2019	430	40.36050469	19.2	42466
9/11/2019	290	95.44072285	8.1	67725
9/16/2019	170	156.9311388	3.2	65279
5/4/2020	160	68.85027271	12.4	26955

5/6/2020	340	104.6998975	6.7	87105
6/1/2020	160	47.72036143	17.4	18683
6/8/2020	460	34.18772162	21.2	38481
6/22/2020	580	12.15563435	40.2	17251
7/6/2020	24000	10.89733627	43.3	639952
7/15/2020	4200	8.736862192	49.6	89789
7/20/2020	840	11.77577078	41.2	24204
7/22/2020	880	11.8469952	41.0	25510
7/27/2020	2200	152.8950884	3.4	823061
8/3/2020	280	27.77752382	23.9	19031
8/5/2020	570	21.08242833	27.5	29404
8/10/2020	1100	16.1204604	32.2	43390
8/12/2020	2500	16.09671893	32.2	98468
9/2/2020	360	14.62474758	34.6	12883
9/9/2020	2000	14.12617664	35.8	69131
9/14/2020	1300	13.9837278	36.2	44482
9/16/2020	2600	13.17651771	37.9	83828
9/21/2020	1800	11.58583899	41.4	51029
5/5/2021	380	6.410197804	56.1	5960
5/10/2021	290	4.700811723	61.2	3336

Table C-2.3. Load duration curve results for HIGH flow zone (0.01%-8%) for Shortfoot Creek (ND-09020105-016-S_00) based on site 384037.

Slope	Intercept	X	Y	
-11.15	5.80	0.01	625790	
		8.00	80478	
E. coli (10^7 CFU / day)				
Median	Existing Load	TMDL	Days	
4.01%	224415	42019	29	
Date	*E. coli* Concentration (CFU / 100 mL)	Q (Flow, CFS)	% Ranking	*E. coli* Load (10^7 CFU / day)
5/20/2019	1100	130.8155181	4.4	352102
9/16/2019	170	156.9311388	3.2	65279
5/6/2020	340	104.6998975	6.7	87105
7/27/2020	2200	152.8950884	3.4	823061

Table C-2.4. Load duration curve results for MOIST flow zone (8%-30%) for Shortfoot Creek (ND-09020105-016-S_00) based on site 384037.

Slope	Intercept	X	Y	
-1.70	4.76	8.00	42186	
		30.00	17825	
E. coli (10 [7] CFU / day)				
Median	Existing Load	TMDL	Days	
19.00%	27422	12586	80	
Date	*E. coli* Concentration (CFU / 100 mL)	Q (Flow, CFS)	% Ranking	*E. coli* Load (10 [7] CFU / day)
6/10/2019	240	42.49723729	18.6	24957
6/17/2019	160	37.98635736	20.0	14872
6/24/2019	200	61.0155865	14.3	29860
7/1/2019	130	29.43942695	23.1	9365
7/8/2019	210	49.85709403	16.7	25619
7/9/2019	340	42.97206676	18.4	35750
8/14/2019	390	18.6133151	29.2	17763
8/19/2019	230	53.1809003	16.1	29930
9/3/2019	720	30.62650062	22.6	53957
9/9/2019	430	40.36050469	19.2	42466
9/11/2019	290	95.44072285	8.1	67725
5/4/2020	160	68.85027271	12.4	26955
6/1/2020	160	47.72036143	17.4	18683
6/8/2020	460	34.18772162	21.2	38481
8/3/2020	280	27.77752382	23.9	19031
8/5/2020	570	21.08242833	27.5	29404

Table C-2.5. Load duration curve results for DRY flow zone (30%-73%) for Shortfoot Creek (ND-09020105-016-S_00) based on site 384037.

Slope	Intercept	X	Y
-4.60	6.40	30.00	105746
		73.00	1115
E. coli (10 [7] CFU / day)			
Median	Existing Load	TMDL	Days
51.50%	10861	2452	157

Date	*E. coli* Concentration (CFU / 100 mL)	Q (Flow, CFS)	% Ranking	*E. coli* Load (10^7 CFU / day)
5/16/2018	310	6.932510217	54.5	5259
6/18/2018	200	3.347547742	65.9	1638
7/9/2018	160	8.903052505	49.2	3486
8/6/2018	260	5.24686561	59.2	3338
6/22/2020	580	12.15563435	40.2	17251
7/6/2020	24000	10.89733627	43.3	639952
7/15/2020	4200	8.736862192	49.6	89789
7/20/2020	840	11.77577078	41.2	24204
7/22/2020	880	11.8469952	41.0	25510
8/10/2020	1100	16.1204604	32.2	43390
8/12/2020	2500	16.09671893	32.2	98468
9/2/2020	360	14.62474758	34.6	12883
9/9/2020	2000	14.12617664	35.8	69131
9/14/2020	1300	13.9837278	36.2	44482
9/16/2020	2600	13.17651771	37.9	83828
9/21/2020	1800	11.58583899	41.4	51029
5/5/2021	380	6.410197804	56.1	5960
5/10/2021	290	4.700811723	61.2	3336

Table C-2.6. Load duration curve results for LOW flow zone (73%-88%) for Shortfoot Creek (ND-09020105-016-S_00) based on site 384037.

Slope	Intercept	X	Y	
-18.46	17.01	73.00	3410	
		88.00	6	
E. coli (10^7 CFU / day)				
Median	Existing Load	TMDL	Days	
80.50%	141	116	55	
Date	*E. coli* Concentration (CFU / 100 mL)	Q (Flow, CFS)	% Ranking	*E. coli* Load (10^7 CFU / day)
6/4/2018	130	0.733611526	77.2	233
6/6/2018	560	0.947284787	76.3	1298
6/11/2018	530	0.868937924	76.6	1127
6/13/2018	180	0.557924624	78.6	246
8/13/2018	170	0.660012959	77.8	275

8/20/2018	350	0.239788881	81.7	205
8/27/2018	200	0.054605389	85.3	27
9/4/2018	150	0.007122442	87.9	3
9/24/2018	270	0.021367326	86.7	14

C-3. LDC Data for Tributary to the Wild Rice River

Table C-3.1. Summary of load duration curve results for Tributary to the Wild Rice River in the Storm Lake Watershed (ND-09020105-014-S_00) based on site 385435.

	E. coli (10 ^{7} CFU / **DAY**)				*E. coli* (10 ^{7} CFU / **PERIOD**)		
Flow Zone	Median	Existing Load	TMDL	Days	Existing Load	Target Load	Reduction
High - Moist	15.01%	19,733	12,047	109	2,160,012	1,318,684	38.95%
Dry	51.50%	4,169	1,647	157	654,328	258,530	60.49%
Low	80.50%	302	78	55	16,561	4,255	74.31%
			Total	321	2,830,900	1,581,469	44.14%

Table C-3.2. Load duration curve results for ALL flow zones (0.01%-88%) for Tributary to the Wild Rice River in the Storm Lake watershed (ND-09020105-014-S_00) based on site 385435.

Flow Zone	% Ranking		% Ranking	
High - Moist	>0.0001		<0.3	
Dry	>0.3		<0.73	
Low	>0.73		<0.88	
Date	*E. coli* Concentration (CFU / 100 mL)	Q (Flow, CFS)	% Ranking	*E. coli* Load (10 ^{7} CFU / day)
5/12/2008	150	5.7	50.4	2084
6/3/2008	800	3.4	60.1	6619
6/10/2008	490	7.1	44.2	8471
6/18/2008	620	9.3	36.4	14130
6/24/2008	800	2.8	63.1	5463
6/30/2008	1600	2.0	67.4	7867
7/7/2008	310	0.4	79.2	266
7/15/2008	740	0.1	84.1	121
7/21/2008	250	0.0	85.7	17
7/27/2008	340	0.0	88.2	3
8/11/2008	410	0.0	100.0	0
8/18/2008	290	0.2	80.8	164

8/25/2008	500	0.1	84.4	68
9/2/2008	800	0.2	81.8	312
9/8/2008	130	0.0	87.9	2
9/15/2008	250	0.1	83.2	60
9/22/2008	650	0.0	100.0	0
9/29/2008	370	0.0	86.3	17
6/1/2009	220	20.4	22.7	10989
6/9/2009	800	13.5	28.3	26443
6/15/2009	800	8.9	37.9	17327
6/23/2009	800	26.0	19.7	50888
6/30/2009	180	24.4	20.6	10747
7/6/2009	140	6.8	45.4	2316
7/13/2009	220	4.5	55.1	2412
7/21/2009	170	8.4	39.2	3496
8/3/2009	140	2.3	65.3	803
8/17/2009	220	3.0	62.1	1597
8/24/2009	800	3.3	60.6	6400
9/14/2009	140	5.5	51.0	1890
9/28/2009	230	5.6	50.8	3124

Table C-3.3. Load duration curve results for HIGH-MOIST flow zone (0.01%-30%) for a Tributary to the Wild Rice River in the Storm Lake watershed (ND-09020105-014-S_00) based on site 385435.

Slope	Intercept	X	Y	
0.07	4.29	0.01	19293	
		30.00	20183	
E. coli (10^7 CFU / day)				
Median	Existing Load	TMDL	Days	
15.01%	19733	12047	109	
Date	*E. coli* Concentration (CFU / 100 mL)	Q (Flow, CFS)	% Ranking	*E. coli* Load (10^7 CFU / day)
6/1/2009	220	20.4	22.7	10989
6/9/2009	800	13.5	28.3	26443
6/23/2009	800	26.0	19.7	50888
6/30/2009	180	24.4	20.6	10747

Table C-3.4. Load duration curve results for DRY flow zone (30%-73%) for Tributary to the Wild Rice River in the Storm Lake watershed (ND-09020105-014-S_00) based on site 385435.

Slope	Intercept	X	Y	
-1.42	4.35	30.00	8426	
		73.00	2063	
E. coli (10 ^{7} CFU / day)				
Median	Existing Load	TMDL	Days	
51.50%	4169	1647	157	
Date	*E. coli* Concentration (CFU / 100 mL)	Q (Flow, CFS)	% Ranking	*E. coli* Load (10 ^{7} CFU / day)
5/12/2008	150	5.7	50.4	2084
6/3/2008	800	3.4	60.1	6619
6/10/2008	490	7.1	44.2	8471
6/18/2008	620	9.3	36.4	14130
6/24/2008	800	2.8	63.1	5463
6/30/2008	1600	2.0	67.4	7867
6/15/2009	800	8.9	37.9	17327
7/6/2009	140	6.8	45.4	2316
7/13/2009	220	4.5	55.1	2412
7/21/2009	170	8.4	39.2	3496
8/3/2009	140	2.3	65.3	803
8/17/2009	220	3.0	62.1	1597
8/24/2009	800	3.3	60.6	6400
9/14/2009	140	5.5	51.0	1890
9/28/2009	230	5.6	50.8	3124

Table C-3.5. Load duration curve results for LOW flow zone (73%-88%) for Tributary to the Wild Rice River in the Storm Lake watershed (ND-09020105-014-S_00) based on site 385435.

Slope	Intercept	X	Y
-23.71	21.56	73.00	18139
		88.00	5
E. coli (10 ^{7} CFU / day)			
Median	Existing Load	TMDL	Days

80.50%	302	78	55	
Date	*E. coli* Concentration (CFU / 100 mL)	Q (Flow, CFS)	% Ranking	*E. coli* Load (10^7 CFU / day)
7/7/2008	310	0.4	79.2	266
7/15/2008	740	0.1	84.1	121
7/21/2008	250	0.0	85.7	17
8/18/2008	290	0.2	80.8	164
8/25/2008	500	0.1	84.4	68
9/2/2008	800	0.2	81.8	312
9/8/2008	130	0.0	87.9	2
9/15/2008	250	0.1	83.2	60
9/29/2008	370	0.0	86.3	17

C-4. LDC Data for Crooked Creek

Table C-4.1. Summary of load duration curve results for Crooked Creek (ND-09020105-017-S_00) based on site 384038.

E. coli (10^7 CFU / **DAY**)						*E. coli* (10^7 CFU / **PERIOD**)		
Flow Zone	Median	Existing Load	TMDL	Days		Existing Load	Target Load	Reduction
High	4.01%	46,205	20,247	29		1,347,493	590,449	56.18%
Moist	19.00%	15,055	6,065	80		1,208,926	486,980	59.72%
Dry-Low	59.00%	4,756	790	212		1,006,788	167,174	83.40%
			Total	321		3,563,206	1,244,603	65.07%

Table C-4.2. Load duration curve results for ALL flow zones (0.01%-88%) for Crooked Creek (ND-09020105-017-S_00) based on site 384038.

Flow Zone	% Ranking		% Ranking	
High	>0.0001		<0.08	
Moist	>0.08		<0.3	
Dry-Low	>0.3		<0.88	
Date	*E. coli* Concentration (CFU / 100 mL)	Q (Flow, CFS)	% Ranking	*E. coli* Load (10^7 CFU / day)
6/18/2018	2400	1.612967625	65.9	9472
6/20/2018	1500	0.936893961	72.5	3439
6/25/2018	2300	1.635846598	65.7	9206
6/27/2018	340	1.864636332	64.1	1551

7/9/2018	10000	4.289807513	49.2	104967
7/16/2018	2000	7.378468922	33.3	36109
7/18/2018	390	4.40420238	48.4	4203
7/23/2018	620	5.502393103	42.0	8348
8/1/2018	340	5.456635156	42.2	4540
8/6/2018	930	2.528126561	59.2	5753
5/20/2019	380	63.03157172	4.4	58608
5/22/2019	210	61.65883331	4.7	31683
8/20/2019	160	26.42521428	15.9	10346
9/3/2019	630	14.75693784	22.6	22749
9/9/2019	130	19.44712739	19.2	6186
9/11/2019	210	45.98673653	8.1	23630
9/16/2019	240	75.61500709	3.2	44405
9/18/2019	260	60.74367438	4.9	38645
7/6/2020	2400	5.250724395	43.3	30835
7/15/2020	280	4.209731106	49.6	2884
7/20/2020	600	5.673985403	41.2	8330
7/22/2020	230	5.708303863	41.0	3213
7/27/2020	330	73.67029435	3.4	59487
8/3/2020	500	13.38419944	23.9	16375
8/5/2020	840	10.15826419	27.5	20879
8/10/2020	590	7.767411469	32.2	11214
8/12/2020	2200	7.755971983	32.2	41752
8/17/2020	160	7.058163294	34.5	2763
8/17/2020	980	7.046723807	34.6	16898
9/2/2020	680	6.806494587	35.8	11325
9/9/2020	700	6.737857666	36.2	11541
9/14/2020	550	6.348915119	37.9	8544
9/16/2020	720	5.58246951	41.4	9835
9/21/2020	1000	3.386088063	54.4	8285
5/3/2021	200	3.088661409	56.1	1512
5/5/2021	200	2.265018367	61.2	1108

Table C-4.3. Load duration curve results for HIGH flow zone (0.01%-8%) for Crooked Creek (ND-09020105-017-S_00) based on site 384038 (*E. coli* samples > 126 CFU/100 mL).

Slope	Intercept	X	Y
-7.95	4.98	0.01	95981

		8.00	22243	
E. coli (10^7 CFU / day)				
Median	Existing Load	TMDL	Days	
4.01%	46205	20246	29	
Date	*E. coli* Concentration (CFU / 100 mL)	Q (Flow, CFS)	% Ranking	*E. coli* Load (10^7 CFU / day)
5/20/2019	380	63.03157172	4.4	58608
5/22/2019	210	61.65883331	4.7	31683
9/16/2019	240	75.61500709	3.2	44405
9/18/2019	260	60.74367438	4.9	38645
7/27/2020	330	73.67029435	3.4	59487

Table C-4.4. Load duration curve results for MOIST flow zone (8%-30%) for Crooked Creek (ND-09020105-017-S_00) based on site 384038 (*E. coli* samples > 126 CFU/100 mL).

Slope	Intercept	X	Y	
0.14	4.15	8.00	14542	
		30.00	15586	
E. coli (10^7 CFU / day)				
Median	Existing Load	TMDL	Days	
19.00%	15055	6065	80	
Date	*E. coli* Concentration (CFU / 100 mL)	Q (Flow, CFS)	% Ranking	*E. coli* Load (10^7 CFU / day)
8/20/2019	160	26.42521428	15.9	10346
9/3/2019	630	14.75693784	22.6	22749
9/9/2019	130	19.44712739	19.2	6186
9/11/2019	210	45.98673653	8.1	23630
8/3/2020	500	13.38419944	23.9	16375
8/5/2020	840	10.15826419	27.5	20879

Table C-4.5. Load duration curve results for DRY-LOW flow zone (30%-88%) for Crooked Creek (ND-09020105-017-S_00) based on site 384038.

Slope	Intercept	X	Y
-1.72	4.69	30.00	15004
		88.00	1507

E. coli (10^7 CFU / day)				
Median	Existing Load	TMDL	Days	
59.00%	4756	790	212	
Date	*E. coli* Concentration (CFU / 100 mL)	Q (Flow, CFS)	% Ranking	*E. coli* Load (10^7 CFU / day)
6/18/2018	2400	1.612967625	65.9	9472
6/20/2018	1500	0.936893961	72.5	3439
6/25/2018	2300	1.635846598	65.7	9206
6/27/2018	340	1.864636332	64.1	1551
7/9/2018	10000	4.289807513	49.2	104967
7/16/2018	2000	7.378468922	33.3	36109
7/18/2018	390	4.40420238	48.4	4203
7/23/2018	620	5.502393103	42.0	8348
8/1/2018	340	5.456635156	42.2	4540
8/6/2018	930	2.528126561	59.2	5753
7/6/2020	2400	5.250724395	43.3	30835
7/15/2020	280	4.209731106	49.6	2884
7/20/2020	600	5.673985403	41.2	8330
7/22/2020	230	5.708303863	41.0	3213
8/10/2020	590	7.767411469	32.2	11214
8/12/2020	2200	7.755971983	32.2	41752
8/17/2020	160	7.058163294	34.5	2763
8/17/2020	980	7.046723807	34.6	16898
9/2/2020	680	6.806494587	35.8	11325
9/9/2020	700	6.737857666	36.2	11541
9/14/2020	550	6.348915119	37.9	8544
9/16/2020	720	5.58246951	41.4	9835
9/21/2020	1000	3.386088063	54.4	8285
5/3/2021	200	3.088661409	56.1	1512
5/5/2021	200	2.265018367	61.2	1108