Root River Watershed Total Maximum Daily Load Report for Bacteria, Nitrate and Suspended Solids

Minnesota Pollution Control Agency

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Top: Forestville Creek in the South Branch of the Root River. (Shaina Keseley, MPCA)

Bottom: Crop rotation in the Root River Watershed. (John Gregor, Coldsnap Photography)

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Acronyms

AUs	animal units
AUID	Assessment Unit ID
BMP	Best Management Practice
CAFO	Concentrated Animal Feeding Operation
CAG	Citizen Advisory Group
cfu	colony-forming unit
DNR	Minnesota Department of Natural Resources
E. coli	Escherichia coli
EPA	Environmental Protection Agency
FBA	fish bioassessments
FDC	Flow duration curves
GW	Groundwater
HSPF	Hydrologic Simulation Program-Fortran
HUC	hydrologic unit codes
IBI	index of biological integrity
in/yr	inches per year
IPHT	Imminent Public Health Threats
ITPHS	imminent threat to public health or safety
kg/year	kilograms per year
km^2	square kilometer
LA	Load Allocation
lb	pound
lb/day	pounds per day
lb/yr	pounds per year
LDC	Load duration curve
LGU	Local Government Unit
m	meter
MBA	macroinvertebrate bioassessments
MCL	maximum contaminant level
mg/L	milligrams per liter
mg/m^2-day	milligram per square meter per day
mL	milliliter
MOS	Margin of Safety
MPCA	Minnesota Pollution Control Agency
MS4	Municipal Separate Storm Sewer Systems
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NRS	Nutrient Reduction Strategy
NTU	Nephelometric Turbidity Unit
OLA	Open lot agreement
RRW	Root River Watershed

SAG	Stakeholder Advisory Group
SID	Stressor Identification
SSTS	Subsurface Sewage Treatment Systems
SWCD	Soil and Water Conservation Districts
SMWI	Southeast Minnesota Wastewater Initiative
SWPPP	Stormwater Pollution Prevention Plan
TAG	Technical Advisory Group
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
WLA	Wasteload Allocation
WPLMP	Watershed Pollutant Load Monitoring Program
WRAPS	Watershed Restoration and Protection Strategy
WWTP	Wastewater Treatment Plant

Executive Summary

The Clean Water Act (1972) requires that each state develop a plan to identify and restore any waterbody that is by state regulations, deemed impaired. A Total Maximum Daily Load Study (TMDL) is required by the U.S. Environmental Protection Agency (EPA) as a result of the federal Clean Water Act. A TMDL identifies the pollutant that is causing the impairment and how much of that pollutant can enter the waterbody and still allow it to meet water quality standards.

This TMDL study includes calculations for bacteria, nitrate, and total suspended solids (TSS) pollutants on 30 stream reaches located in the Root River Watershed (RRW) (hydrologic unit code (HUC) 07040008) in southeastern Minnesota that are on the 2012 EPA 303(d) list of impaired waters.

Information from multiple sources was used to evaluate the ecological health of each waterbody:

- All available water quality data over the past 10 years
- Published studies
- Stressor Identification (SID) investigations
- Hydrologic Simulation Program-Fortran (HSPF) model
- Stakeholder input

A load duration curve (LDC) model was applied to each impaired stream. These models were then used to determine the pollutant reductions needed for the impaired waterbodies to meet water quality standards.

The findings from this TMDL study were used to aid the selection of implementation activities as part of the RRW Watershed Restoration and Protection Strategy (WRAPS) process. The purpose of the WRAPS report is to support local working groups and jointly develop scientifically-supported restoration and protection strategies to be used for subsequent implementation planning. Following completion, the WRAPS report will be publically available on the Minnesota Pollution Control Agency (MPCA) RRW website:

http://www.pca.state.mn.us/index.php/water/water-types-and-programs/watersheds/root-river.html

1. Project Overview

1.1 Context and Purpose

The passage of Minnesota's Clean Water Legacy Act (CWLA) in 2006 provided a policy framework and resources to state and local governments to accelerate efforts to monitor, assess and restore impaired waters and to protect unimpaired waters. The result has been a comprehensive watershed approach that integrates water resource management efforts with local government and local stakeholders and develops restoration and protection studies for Minnesota's 80 major watersheds. For the RRW, the approach began with intensive watershed monitoring in 2008. The subsequent assessment of collected chemical and biological data examined designated use support in each of the streams in the watershed. The results of the assessment are documented in detail at the MPCA's RRW web page: http://www.pca.state.mn.us/index.php/view-document.html?gid=17986.

This TMDL study addresses aquatic recreation, aquatic life and drinking water impairments on 30 assessment units (AUIDs) in the RRW. Many of these were documented in the 2011 Root River Monitoring and Assessment Report. The impaired water bodies are located throughout the RRW (Figure 1).

Completed studies for this watershed that were referenced in the development of this TMDL include:

- RRW SID Report (Schauls and Laing MPCA 2014b)
- RRW Monitoring and Assessment Report (MPCA 2012)
- Lower Mississippi River Basin Fecal Coliform Implementation Plan (Cannon River Watershed Partnership and MPCA 2007)
- Revised Regional TMDL Evaluation of Fecal Coliform Bacteria Impairments in the Lower Mississippi River Basin in Minnesota (MPCA 2006)

The findings from this TMDL study will be used to aid the selection of implementation activities as part of the Root River WRAPS process. The purpose of the WRAPS report is to support local working groups and jointly develop scientifically-supported restoration and protection strategies to be used for subsequent implementation planning. Following completion, the WRAPS report will be publically available on the MPCA RRW website:

http://www.pca.state.mn.us/index.php/water/water-types-and-programs/watersheds/root-river.html

The goal of this TMDL study was to quantify, where applicable, the pollutant reductions needed to meet State water quality standards for select waterbodies in the RRW (Table 1). This RRW TMDL Study was established in accordance with Section 303(d) of the Clean Water Act and provides wasteload allocations (WLAs) and load allocations (LAs) for the watershed areas as appropriate.

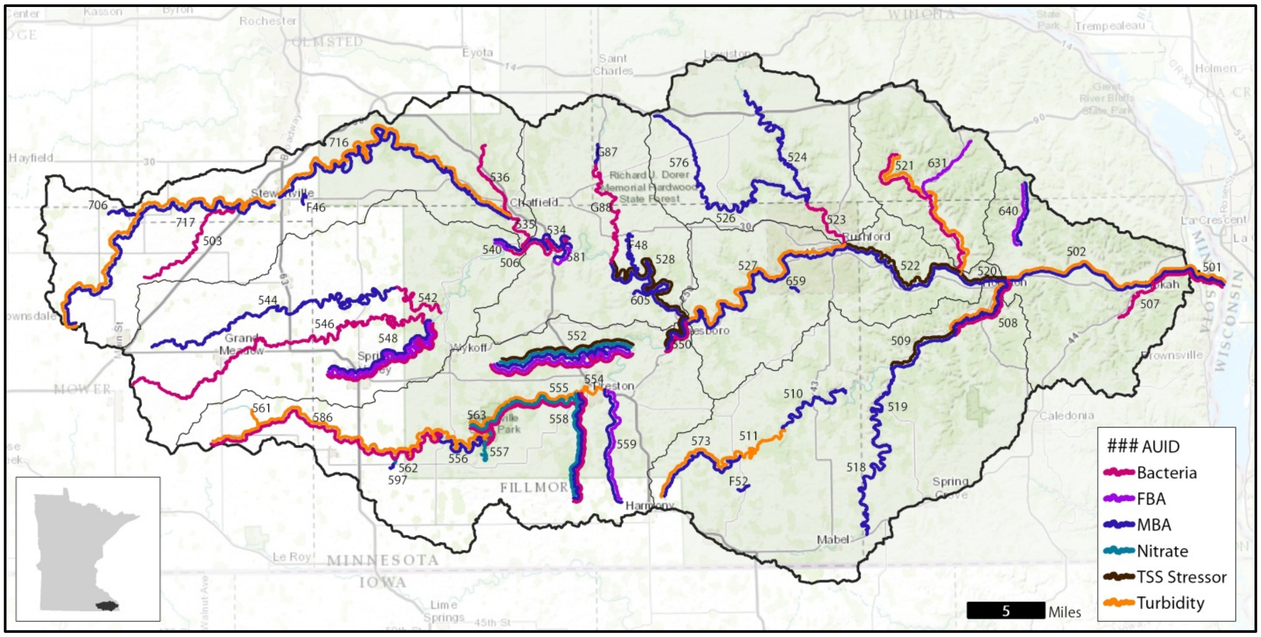


Figure 1. Impaired streams in the RRW. Colors depict impairment and stressor type. (FBA = fish bioassessment; MBA = macroinvertebrate bioassessment)

1.2 Problem Identification

This TMDL study addresses 38 impairments on 30 AUIDs throughout the RRW:

- 17 AUIDs not supporting aquatic life use with the pollutant being sediment,
- 15 AUIDs not supporting aquatic recreation use with the pollutant being bacteria, and
- 6 AUIDs not supporting for drinking water use with the pollutant being nitrate.

The streams addressed in this study were placed by the MPCA on the state of Minnesota's 303(d) list of impaired waters between 1994 and 2012 (Table 1).

Table 1. Impaired stream reaches in the RRW and associated 303(d) list information as of 2012, sorted by 10 HUC subwatershed areas. Note: mercury impairments that have been addressed via a separate state-wide TMDL are not included here.

10 HUC Name/ 10 HUC Number	Listed Waterbody Name (Location Description)	AUID	Listed Pollutant (Beneficial Use)	Listing Year	Target Start & Completion Dates	Impairment Addressed By
Root River (Lower)/ 0704000809	Root River (Thompson Cr to Mississippi R)	07040008-501	Turbidity (Aquatic Life)	1994	2009-2013	TSS TMDL in this report*
			Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	TSS TMDL in this report*
			Fecal Coliform	1994	NA	Completed Fecal Coliform TMDL+
	Root River (S Fk Root R to Thompson Cr)	07040008-502	Turbidity (Aquatic Life)	2012	2011-2015	TSS TMDL in this report*
			Aquatic Macroinvertebrate Bioassessments (Aquatic Life)			

10 HUC Name/ 10 HUC Number	Listed Waterbody Name (Location Description)	AUID	Listed Pollutant (Beneficial Use)	Listing Year	Target Start & Completion Dates	Impairment Addressed By
	Thompson Creek (T103 R5W S12, south line to Root R)	07040008-507	*E. coli* (Aquatic Recreation)	2012	2011-2015	*E. coli* TMDL in this report
	Silver Creek (T105 R6W S35, north line to T104 R6W S14, south line)	07040008-640	Aquatic Macroinvertebrate Bioassessments; Fish Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report
City of Rushford-Root River/ 070400807	Root River (Money Cr to S Fk Root R)	07040008-520	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	TSS TMDL in this report*
	Root River (Rush Cr to Money Cr)	07040008-522	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	TSS TMDL in this report*

10 HUC Name/ 10 HUC Number	Listed Waterbody Name (Location Description)	AUID	Listed Pollutant (Beneficial Use)	Listing Year	Target Start & Completion Dates	Impairment Addressed By
	Unnamed creek (T104 R8W S32, east line to Unnamed cr)	07040008-659	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^
	Root River (M Br Root R to Rush Cr)	07040008-527	Turbidity (Aquatic Life)	2010	2008-2012	TSS TMDL in this report*
			Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	
Trout Run-Root River/ 0704000803	Trout Run Creek (T105 R10W S18, north line to Unnamed cr)	07040008-G87	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^
	Trout Run Creek	07040008-G88	*E. coli*	2012	2011-2015	*E. coli* TMDL in this report

10 HUC Name/ 10 HUC Number	Listed Waterbody Name (Location Description)	AUID	Listed Pollutant (Beneficial Use)	Listing Year	Target Start & Completion Dates	Impairment Addressed By
	(Unnamed cr to M Br Root R)		(Aquatic Recreation)			
	Root River, Middle Branch (Trout Run Cr to S Br Root R)	07040008-528	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	TSS TMDL in this report*
	Root River, Middle Branch (N Br Root R to Lynch Cr)	07040008-534	*E. coli* (Aquatic Recreation)	2010	2011-2015	*E. coli* TMDL in this report
			Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2016-2020	Not addressed in this report*^
	Money Creek (Unnamed cr to M Br Root R)	07040008-F48	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^

10 HUC Name/ 10 HUC Number	Listed Waterbody Name (Location Description)	AUID	Listed Pollutant (Beneficial Use)	Listing Year	Target Start & Completion Dates	Impairment Addressed By
	Wadden Valley Creek - Unnamed Creek (Unnamed cr to M Br Root R)	07040008-605	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^
	Rice Creek (T104 R11W S23, west line to M Br Root R)	07040008-581	Aquatic Macroinvertebrate Bioassessments; Fish Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^
Middle Branch Root River/ 0704000802	Root River, Middle Branch (Upper Bear Cr to N Br Root R)	07040008-506	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^
			E. coli	2012	2011-2015	*E. coli* TMDL in this report
	Upper Bear Creek	07040008-540	Aquatic Macroinvertebrate Bioassessments;	2012	2011-2015	Not addressed in this report*^

10 HUC Name/ 10 HUC Number	Listed Waterbody Name (Location Description)	AUID	Listed Pollutant (Beneficial Use)	Listing Year	Target Start & Completion Dates	Impairment Addressed By
	(T104 R11W S18, west line to M Br Root R)		Fish Bioassessments (Aquatic Life)			
	Bear Creek (Kedron Cr to M Br Root R)	07040008-542	*E. coli* (Aquatic recreation)	2012	2011-2015	*E. coli* TMDL in this report
	Bear Creek (Headwaters to Kedron Cr)	07040008-544	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^
	Deer Creek (Headwaters to M Br Root R)	07040008-546	*E. coli* (Aquatic recreation)	2012	2011-2015	*E. coli* TMDL in this report
	Spring Valley Creek (T103 R13W S29, west line to Deer Cr)	07040008-548	Aquatic Macroinvertebrate Bioassessments; Fish Bioassessments; (Aquatic Life)	2012	2011-2015	Not addressed in this report*^

10 HUC Name/ 10 HUC Number	Listed Waterbody Name (Location Description)	AUID	Listed Pollutant (Beneficial Use)	Listing Year	Target Start & Completion Dates	Impairment Addressed By
			E. coli (Aquatic Recreation)			*E. coli* TMDL in this report
Money Creek/ **0704000806**	Corey Creek (T105 R6W S18, east line to Money Cr)	07040008-631	Fish Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^
	Money Creek (T105 R7W S21, north line to Root R)	07040008-521	Turbidity (Aquatic Life)	2008	2008-2012	Proposed List Correction**
			Fecal Coliform (Aquatic Recreation)	1994	NA	Completed Fecal Coliform TMDL+
North Branch Root River/ **0704000801**	Robinson Creek (Headwaters to N Br Root R)	07040008-503	Fecal coliform (Aquatic Recreation)	1994	NA	Completed Fecal Coliform TMDL+
	Root River, North Branch (Mill Cr to M Br Root R)	07040008-535	*E. coli* (Aquatic recreation)	2012	2011-2015	*E. coli* TMDL in this report

10 HUC Name/ 10 HUC Number	Listed Waterbody Name (Location Description)	AUID	Listed Pollutant (Beneficial Use)	Listing Year	Target Start & Completion Dates	Impairment Addressed By
	Mill Creek (T105 R12W S14, north line to N Br Root R)	07040008-536	*E. coli* (Aquatic recreation)	2012	2011-2015	*E. coli* TMDL in this report
	Unnamed creek (Unnamed cr to N Br Root R)	07040008-706	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^
	Root River, North Branch (Unnamed cr to Mill Cr)	07040008-716	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	TSS TMDL in this report*
			Turbidity (Aquatic Life)	2008	2008-2012	
	Unnamed creek (Unnamed cr to Unnamed cr)	07040008-F46	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^

10 HUC Name/ 10 HUC Number	Listed Waterbody Name (Location Description)	AUID	Listed Pollutant (Beneficial Use)	Listing Year	Target Start & Completion Dates	Impairment Addressed By
	Root River, North Branch (Headwaters to Carey Cr)	07040008-717	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	TSS TMDL in this report*
			Turbidity (Aquatic Life)	2008	2008-2012	
Rush Creek/ **0704000805**	Rush Creek (Pine Cr to Root R)	07040008-523	*E. coli* (Aquatic Recreation)	2012	2011-2015	*E. coli* TMDL in this report
	Rush Creek (Unnamed cr to Pine Cr)	07040008-524	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^
	Pine Creek (T104 R9W S4, north line to Rush Cr)	07040008-526	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^

10 HUC Name/ 10 HUC Number	Listed Waterbody Name (Location Description)	AUID	Listed Pollutant (Beneficial Use)	Listing Year	Target Start & Completion Dates	Impairment Addressed By
	Pine Creek (Headwaters to T105 R9W S32, south line)	07040008-576	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^
South Branch Root River/ 0704000804	Root River, South Branch (Duschee Cr to M Br Root R)	07040008-550	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	TSS TMDL in this report*
			E. coli (Aquatic Recreation)			*E. coli* TMDL in this report
	Watson Creek (T103 R11W S30, west line to S Br Root R)	07040008-552	Aquatic Macroinvertebrate Bioassessments Fish Bioassessments (Aquatic Life)	2012	2011-2015	TSS TMDL in this report*
			E. coli (Aquatic Recreation)			*E. coli* TMDL in this report

10 HUC Name/ 10 HUC Number	Listed Waterbody Name (Location Description)	AUID	Listed Pollutant (Beneficial Use)	Listing Year	Target Start & Completion Dates	Impairment Addressed By
			Nitrates (Drinking Water)			Nitrate TMDL in this report
	Root River, South Branch (Willow Cr to Camp Cr)	07040008-554	Turbidity (Aquatic Life)	2006	2008-2012	TSS TMDL in this report
	Root River, South Branch (Canfield Cr to Willow Cr)	07040008-555	Turbidity (Aquatic Life)	2004	2008-2012	TSS TMDL in this report
			Nitrates (Drinking Water)	2010	2011-2015	Nitrate TMDL in this report
			Fecal Coliform (Aquatic Recreation)	1994	NA	Completed Fecal Coliform TMDL+
	Root River, South Branch (T102 R12W S21, north line to Canfield Cr)	07040008-556	Turbidity (Aquatic Life)	2006	2008-2012	TSS TMDL in this report*
			Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	

10 HUC Name/ 10 HUC Number	Listed Waterbody Name (Location Description)	AUID	Listed Pollutant (Beneficial Use)	Listing Year	Target Start & Completion Dates	Impairment Addressed By
	Canfield Creek (T102 R12W S25, west line to S Br Root R)	07040008-557	Nitrates (Drinking Water)	2010	2011-2015	Nitrate TMDL in this report
	Willow Creek (T101 R11W S12, west line to S Br Root R)	07040008-558	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^
			E. coli (Aquatic Recreation)	2012		*E. coli* TMDL in this report
			Nitrates (Drinking Water)	2010		Nitrate TMDL in this report
	Camp Creek (Headwaters to S Br Root R)	07040008-559	Aquatic Macroinvertebrate Bioassessments Fish Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^
	Judicial Ditch 1 (Unnamed cr to S Br Root R)	07040008-561	Turbidity (Aquatic Life)	2006	2008-2012	Not addressed in this report^

10 HUC Name/ 10 HUC Number	Listed Waterbody Name (Location Description)	AUID	Listed Pollutant (Beneficial Use)	Listing Year	Target Start & Completion Dates	Impairment Addressed By
	Etna Creek (Unnamed cr to S Br Root R)	07040008-562	Nitrates (Drinking Water)	2010	2011-2015	Nitrate TMDL in this report
	Forestville Creek (Unnamed cr to S Br Root R)	07040008-563	Turbidity (Aquatic Life)	2006	2008-2012	Not addressed in this report**
			Fecal Coliform (Aquatic Recreation)	2008	2011-2015	*E. coli* TMDL in this report
			Nitrates (Drinking Water)	2010	2011-2015	Nitrate TMDL in this report
	Root River, South Branch (Headwaters to T102 R12W S16, south line)	07040008-586	Turbidity (Aquatic Life)	2004	2008-2012	Not addressed in this report**
			Fecal Coliform (Aquatic Recreation)	1994	NA	Completed Fecal Coliform TMDL+
	Etna Creek (T102 R13W S36, west line to Unnamed cr)	07040008-597	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^
South Fork Root River/ 0704000808	Root River, South Fork	07040008-508	Turbidity (Aquatic Life)	2012	2011-2015	TSS TMDL in this report

10 HUC Name/ 10 HUC Number	Listed Waterbody Name (Location Description)	AUID	Listed Pollutant (Beneficial Use)	Listing Year	Target Start & Completion Dates	Impairment Addressed By
	(Beaver Cr to Root R)		Aquatic Macroinvertebrate Bioassessments (Aquatic Life)			TSS TMDL in this report*
			E. coli (Aquatic Recreation)			*E. coli* TMDL in this report
	Root River, South Fork (Riceford Cr to Beaver Cr)	07040008-509	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	TSS TMDL in this report*

10 HUC Name/ 10 HUC Number	Listed Waterbody Name (Location Description)	AUID	Listed Pollutant (Beneficial Use)	Listing Year	Target Start & Completion Dates	Impairment Addressed By
	Root River, South Fork (Wisel Cr to T102 R8W S2, east line)	07040008-510	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^
	Root River, South Fork (T102 R9W S26, west line to Wisel Cr)	07040008-511	Turbidity (Aquatic Life)	2008	2008-2012	TSS TMDL in this report
	Riceford Creek (T101 R7W S19, south line to T102 R7W S30, north line)	07040008-518	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^

10 HUC Name/ 10 HUC Number	Listed Waterbody Name (Location Description)	AUID	Listed Pollutant (Beneficial Use)	Listing Year	Target Start & Completion Dates	Impairment Addressed By
	Riceford Creek (T102 R7W S19, south line to S Fk Root R)	07040008-519	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^
	Root River, South Fork (Headwaters to T102 R9W S27, east line)	07040008-573	Turbidity (Aquatic Life)	2012	2011-2015	TSS TMDL in this report*
			Aquatic Macroinvertebrate Bioassessments (Aquatic Life)			
	Sorenson Creek (Unnamed cr to Unnamed cr)	07040008-F52	Aquatic Macroinvertebrate Bioassessments (Aquatic Life)	2012	2011-2015	Not addressed in this report*^

*Suspended sediment stressor of aquatic community addressed. Other conclusive stressors not addressed. See the RRW SID Report for a description of stressors per AUID.
** Since the time of impairment listing, more information and analysis confirms aquatic life use support and thus these AUIDs will be considered for list correction.
^TSS TMDL is being deferred until assessment can be made based on new assessment criteria for channelized reaches (TALU).
*^Numeric reduction calculations were not applicable to address stressor(s) affecting the aquatic community, and/or further information is needed.
+Regional Fecal Coliform TMDL Document. Available online at http://www.pca.state.mn.us/index.php/view-document.html?gid=8006

1.3 Priority Ranking

The MPCA's schedule for TMDL completions, as indicated on the 303(d) impaired waters list, reflects Minnesota's priority ranking of this TMDL. MPCA has aligned our TMDL priorities with the watershed approach and our WRAPS cycle. The schedule for TMDL completion corresponds to the WRAPS report completion on the ten-year cycle. MPCA developed a state plan Minnesota's TMDL Priority Framework Report to meet the needs of EPA's national measure (WQ-27) under EPA's Long-Term Vision for Assessment, Restoration and Protection under the Clean Water Act Section 303(d) Program. As part of these efforts, MPCA identified water quality impaired segments which will be addressed by TMDLs by 2022. The Root River Watershed waters addressed by this TMDL are part of that MPCA prioritization plan to meet EPA's national measure.

1.4 Description of the Impairments and Pollutant Stressors

The following section describes the stream impairments and the pollutant stressors that are addressed by the 38 TMDLs in this study (Table 2). A total of 17 TSS, 15 bacteria and 6 nitrate TMDLs were completed. Various factors impacted whether or not an impaired reach received a TMDL calculation in this report. These factors included: previous TMDL addressed the impairment, non-pollutant stressor (e.g., physical habitat), and additional information collected since assessment that determined a list correction is needed.

Table 2. Parameters addressed in this TMDL per impaired stream AUID.

● = conventional pollutant (addressing turbidity, bacteria, or nitrate impairments)

O = Pollutant identified through the SID process, partially addressing FBA or MBA impairments

AUID	Stream Name	Designated Use Class	Turbidity/TSS	Bacteria	Nitrate
07040008-501	Root River	2B, 3C	●		
07040008-502	Root River	2B, 3C	●		
07040008-506	Root River, Middle Branch	2B, 3C		●	
07040008-507	Thompson Creek	1B, 2A, 3C		●	
07040008-508	Root River, South Fork	2B, 3C	●	●	
07040008-509	Root River, South Fork	2B, 3C	O		
07040008-511	Root River, South Fork	1B, 2A, 3C	●		
07040008-520	Root River	2B, 3C	O		
07040008-522	Root River	2B, 3C	O		
07040008-523	Rush Creek			●	

AUID	Stream Name	Designated Use Class	Turbidity/TSS	Bacteria	Nitrate
07040008-527	Root River	2B, 3C	●		
07040008-528	Root River, Middle Branch	2B, 3C	○		
07040008-534	Root River, Middle Branch	2B, 3C		●	
07040008-535	Root River, North Branch	2B, 3C		●	
07040008-536	Mill Creek	1B, 2A, 3C		●	
07040008-542	Bear Creek	2B, 3C		●	
07040008-546	Deer Creek	2B, 3C		●	
07040008-548	Spring Valley Creek	1B, 2A, 3C		●	
07040008-550	Root River, South Branch	1B, 2A, 3C	○	●	
07040008-552	Watson Creek	1B, 2A, 3C	○	●	●
07040008-554	Root River, South Branch	1B, 2A, 3C	●		
07040008-555	Root River, South Branch	1B, 2A, 3C	●		●
07040008-556	Root River, South Branch	1B, 2A, 3C	●		
07040008-557	Canfield Creek	1B, 2A, 3C			●
07040008-558	Willow Creek	1B, 2A, 3C		●	●
07040008-562	Etna Creek	1B, 2A, 3C			●
07040008-563	Forestville Creek	1B, 2A, 3C		●	●
07040008-573	Root River, South Fork	2B, 3C	●		
07040008-716	Root River, North Branch	2B, 3C	●		
07040008-717	Root River, North Branch	2B, 3C	●		
07040008-G88	Trout Run Creek	1B, 2A, 3C		●	

AUID	Stream Name	Designated Use Class	Turbidity/TSS	Bacteria	Nitrate
TOTAL			17	15	6

1.4.1 Stream Bacteria

The stream bacteria impairments in the RRW were characterized by high Escherichia coli (*E. coli*) or fecal coliform concentrations during April through October. Minnesota *E. coli* water quality standards were developed to directly protect primary (swimming and other recreation where immersion and inadvertently ingesting water is likely) and secondary (boating and wading where the likelihood of ingesting water is much smaller) body contact during the warm season months, since there is very little swimming in Minnesota in the cold season months. The *E. coli* LDCs and TMDLs were developed for all stream *E. coli* or fecal coliform impairments. Stream fecal coliform data was converted to *E. coli* using an equivalence of 200 org fecal coliforms to 126 org *E. coli* based on past and current standards described in Section 2.2.2.

1.4.2 Stream Turbidity/Total Suspended Solids

The stream turbidity impairments in the RRW were characterized by high turbidity levels. Turbidity is a physical characteristic of water that describes the degree to which light is scattered and absorbed in the water column (therefore reducing water clarity). Turbidity is caused by suspended sediment or impurities, such as clay, silt, fine organic matter, algae, and other organic and inorganic sources. Because turbidity is a physical characteristic of water and not a pollutant, LDCs and TMDLs were developed based on recently promulgated state water quality standards for TSS, a measure of suspended sediment and the primary cause of turbidity in the RRW. For warmwater streams and rivers in the RRW the TSS standard is 65 mg/L; for coldwater streams the standard is 10 mg/L.

1.4.3 Stream Nitrate

The stream nitrate impairments in the RRW were characterized by high nitrate levels in coldwater (1B, 2A, 3C use class) streams. The EPA regulates nitrate in drinking water to protect public health. Nitrate may cause health problems if present in public or private water supplies in amounts greater than the drinking water standard set by the EPA. The nitrate LDCs and TMDLs were developed for all stream nitrate impairments. Refer to Section 2.2.3 Use Class: Drinking Water, for more background on nitrate.

1.4.4 Stream Fish and Macroinvertebrate Bioassessments

The fish or macroinvertebrate bioassessment impairments in the RRW were characterized by low index of biological integrity (IBI) scores for fish and/or macroinvertebrates. The presence of a healthy, diverse, and reproducing aquatic community is a good indication that the aquatic life beneficial use is being supported by a lake, stream, or wetland. The aquatic community integrates the cumulative impacts of pollutants, habitat alteration, and hydrologic modification on a waterbody over time. Monitoring of the aquatic community is accomplished using an IBI, which incorporates multiple attributes of the aquatic community, called “metrics”, to evaluate complex biological systems. For further information regarding the development of stream IBIs, refer to the MPCA *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment: 305(b) Report and 303(d) List*.

A SID Study was completed by the MPCA (2014b) to determine the cause of low fish and macroinvertebrate scores that resulted in aquatic life impairments on 38 stream reaches in the RRW.

In the case of many stressors, a mass reduction is not the appropriate means of addressing impairments, thus no TMDL is computed (e.g., habitat related stressors). Dissolved oxygen (DO) and temperature stressors can sometimes be linked to a mass pollutant, but no such linkages were made in the RRW

Six stream reaches in the RRW that had sediment identified as a stressor received TSS TMDL calculations. This determination was made based on chemistry data sets that confirmed the exceedance on adjacent reaches or watershed character supporting the exceedance (Table 3).

Table 3. Root River determination of TSS TMDL calculation based on the SID study. Each reach was a new 2012 303(d) list entry for biota (fish and/or macroinvertebrates) and the SID process determined sediment as a biotic stressor.

Stream reach AUID	TSS information present?	Data confirm exceedance?	Do adjacent AUIDs and/or watershed character support TSS WQS exceedance?*	Calculate TSS TMDL?
07040008-509	N	--	Y (A, C)	Y
07040008-520	Y	Y	Y (A, C)	Y
07040008-522	N	--	Y (A, C)	Y
07040008-528	N	--	Y (A, C)	Y
07040008-550	Y	Y	Y (A, C)	Y
07040008-552	Y	Y	Y (C)	Y

*A = Adjacent; C=Character

2. Applicable Water Quality Standards and Numeric Water Quality Targets

2.1 State of Minnesota Designated Uses

Each stream reach has a Designated Use Classification defined by Minn. R. 7050.1040, which sets the optimal purpose for that waterbody. The streams addressed by this TMDL fall into one of the following two designated use classifications:

1B, 2A, 3C – drinking water use after approved disinfectant; a healthy cold water aquatic community; industrial cooling and materials transport without a high level of treatment

2B, 3C – a healthy warm water aquatic community; industrial cooling and materials transport without a high level of treatment

Class 1 waters are protected for aquatic consumption (i.e. drinking water), Class 2 waters are protected for aquatic life and aquatic recreation, and Class 3 waters are protected for industrial consumption as defined by Minn. R. ch. 7050.0140. The most protective of these classes is 1B. These water bodies are currently assessed by the MPCA for the beneficial use of domestic consumption for the EPA's Safe Drinking Water Act nitrate primary standards. In the RRW, all class 1B waters are also class 2A waters.

The Minnesota narrative water quality standard for all Class 2 waters (Minn. R. 7050.0150, subp. 3) states that "the aquatic habitat, which includes the waters of the state and stream bed, shall not be degraded in any material manner, there shall be no material increase in undesirable slime growths or aquatic plants, including algae, nor shall there be any significant increase in harmful pesticide or other residues in the waters, sediments, and aquatic flora and fauna; the normal fishery and lower aquatic biota upon which it is dependent and the use thereof shall not be seriously impaired or endangered, the species composition shall not be altered materially, and the propagation or migration of the fish and other biota normally present shall not be prevented or hindered by the discharge of any sewage, industrial waste, or other wastes to the waters".

The impaired waters addressed in this TMDL are both Class 2B waters for which aquatic life and recreation are the protected beneficial uses and Class 1B/2A for which aquatic life, aquatic recreation and drinking water are the protected beneficial uses.

2.2 State of Minnesota Standards and Criteria for Listing

2.2.1 Use Class: Aquatic Life

A. Turbidity and TSS

Turbidity is a measure of reduced transparency due to suspended particles such as sediment, algae, and organic matter. The Minnesota turbidity standard is 10 Nephelometric Turbidity Units (NTU) for class 2A waters and 25 NTU for class 2B waters. The state of Minnesota, in 2014, amended state water quality standards and replaced stream water quality standards for turbidity with standards for TSS. One component of the rationale for this change is that the NTUs are not concentration-based and therefore not well-suited to load-based studies (Markus 2011).

The new TSS criteria are stratified by geographic region and stream class due to differences in natural background conditions resulting from the varied geology of the state and biological sensitivity. The assessment period for these samples is April through September; any TSS data collected outside of this period was not considered for assessment purposes. The TSS standard for all class 2A streams is 10 mg/L, and the TSS standard for class 2B streams in the South River Nutrient Region is 65 mg/L (Table 4). For assessment, this concentration is not to be exceeded in more than 10% of samples within a 10-year period. The TSS results are available for the watershed from state-certified laboratories, and the existing data covers a large spatial and temporal scale in the watershed. The TSS LDCs and the TMDLs were developed for all stream turbidity impairments (Heiskary et al. 2013).

Table 4. TSS standard by stream class and river nutrient region.

Stream Class (River Nutrient Region)	Turbidity (NTU)	Total Suspended Solids (mg/L)
2A – Coldwater (Statewide)	10	10
2B – Coolwater or warmwater (South River Nutrient Region)	25	65

B. Biotic Integrity

Minnesota's standard for biotic integrity is set forth in Minn. R. 7050.0150 (3) and (6). The standard uses an IBI, which evaluates and integrates multiple attributes of the aquatic community, or "metrics," to evaluate a complex biological system. Each metric is based upon a structural (e.g., species composition) or functional (e.g., feeding habits) aspect of the aquatic community that changes in a predictable way in response to human disturbance. Fish and macroinvertebrate IBIs are expressed as a score that ranges from 0-100, with 100 being the best score possible. The MPCA has evaluated fish and macroinvertebrate communities at numerous reference sites across Minnesota that has been minimally impacted by human activity, and has established IBI impairment thresholds based on stream drainage area, ecoregion, and major basin. A stream's biota is considered to be impaired when the IBI falls below the threshold established for that category of stream. The MPCA has two documents that further describe the development of fish and macroinvertebrate IBIs (MPCA 2014c and MPCA 2014d)

2.2.2 Use Class: Aquatic Recreation

A. Bacteria (Fecal coliform and *E. coli*)

Fecal coliform

The fecal coliform standard contained in Minn. R. 7050.0222, subp. 5, states that fecal coliform concentrations shall "not exceed 200 organisms per 100 milliliters as a geometric mean of not less than five samples in any calendar month, nor shall more than 10% of all samples taken during any calendar month individually exceed 2000 organisms per 100 milliliters. The standard applies only between April 1 and October 31." Impairment assessment is based on the procedures contained in the Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment (MPCA 2012).

E. coli

With the revisions of Minnesota's water quality rules in 2008, the State changed to an *E. coli* standard because it is a superior potential illness indicator and costs for lab analysis are less (MPCA 2007). The revised standards now state:

"*E. coli* concentrations are not to exceed 126 colony forming units per 100 milliliters (cfu/100 ml) as a geometric mean of not less than five samples representative of conditions within any calendar month, nor shall more than 10% of all samples taken during any calendar month individually exceed 1,260 cfu/100 ml. The standard applies only between April 1 and October 31."

The *E. coli* concentration standard of 126 cfu/100 ml was considered reasonably equivalent to the fecal coliform standard of 200 cfu/100 ml from a public health protection standpoint. The SONAR (Statement of Need and Reasonableness) section that supports this rationale uses a log plot to show the relationship between these two parameters. The relationship has an R2 value of 0.69. The following regression equation was deemed reasonable to convert fecal coliform data to *E. coli* equivalents:

E. coli concentration (equivalents) = 1.80 x (Fecal Coliform Concentration)$^{0.81}$

Although surface water quality standards are now based on *E. coli*, wastewater treatment facilities (WWTPs) are permitted based on fecal coliform concentrations.

2.2.3 Use Class: Drinking Water

A. Nitrate nitrogen (nitrate-N)

Nitrate-N (referred to as 'nitrate' throughout this document) poses a risk to human health at concentrations exceeding 10 mg/L in drinking water. Humans, especially infants under six months of age, who are exposed to nitrate in drinking water at concentrations exceeding the 10 mg/L federal safe drinking water standard (which is incorporated by reference into Minn. R. ch. 7050.0221), can develop methemoglobinemia, a blood disorder that interferes with the ability of blood to carry oxygen. The 10 mg/L standard is an acute toxicity standard. Long term, chronic exposure to nitrate in drinking water is less well understood but has been linked to the development of cancer, thyroid disease, and diabetes in humans.

The MPCA incorporated the EPA maximum contaminant levels (MCLs) as standards by reference in the State's Water Quality Standards (Minn. R. ch. 7050.0221). The nitrate and nitrite MCLs are applied as Class 1 Domestic Consumption standards. Class 1 waters are protected as a source of drinking water. In Minnesota, all groundwater (GW) and selected surface waters are designated Class 1. The Minnesota Department of Health (MDH) monitors municipal finished water supplies for compliance with drinking water standards. The following applies to assessment of Class 1B and 1C listed surface waters for potential impairment by nitrate.

Southeast Minnesota is particularly affected by nitrate contamination of its drinking water because of the prevailing karst geology and the region's rural character, including plentiful agriculture. Nitrate concentrations are higher during baseflow and diluted during precipitation in the coldwater streams in the watershed. Enhanced surface water-ground water interaction is a defining characteristic of karst that often contributes to drinking water quality problems. In recognition of the trend of increasing nitrate concentrations in Minnesota streams and the public health and economic impact arising from elevated nitrate concentrations in drinking water (a particular concern in Southeast Minnesota's karst region), the MPCA assesses Class 1B and 1C designated surface waters for potential impairment by nitrate.

Data requirements and determination of impaired condition:

When assessing drinking water-protected surface waters Class 1B and 1C, the MPCA compares 24-hour average nitrate concentrations to the 10 mg/L standard. Two 24-hour averages exceeding 10 mg/L within a 3-year period indicate impairment.

Single measurements of nitrate concentrations under relatively stable conditions are generally considered to be sufficiently representative of 24-hour average concentrations for the purpose of assessments. When concentrations are more variable, multiple samples or time-weighted composite samples may be necessary in order to calculate a sufficiently accurate average concentration. The necessary number and type of samples can vary considerably from one situation to another and the determination of adequacy for the purpose of assessment will necessarily involve considerable professional judgment. (MPCA 2014e)

For more background on nitrogen, please refer to *Nitrogen in Minnesota Surface Waters* (MPCA 2013); specifically Section A2, *Nitrogen in Waters: Forms and Concerns*.

Analysis of Impairment

The criteria used for determining impairments are outlined in the MPCA document *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment – 305(b) Report and 303(d) List, January 2010*. The applicable water body classifications and water quality standards are specified in Minn. R. ch. 7050.0407 and Minn. R. ch.7050.2222 (5), respectively.

3. Watershed and Water Body Characterization

3.1 Root River Watershed Description

The RRW is an 8-digit hydrologic unit (HUC) that covers 1,064,961 acres in southeast Minnesota within the Lower Mississippi River Basin, with a small portion in northeast Iowa. The watershed primarily lies within the Driftless Area ecoregion with a small portion in part of the Western Corn Belt Plains ecoregion (EPA 2015). The watershed drains west to east before joining the Mississippi River at Navigation Pool 7, approximately five miles east of the small town of Hokah, Minnesota. Fillmore County has the most area within this watershed, followed by Houston, Winona, Mower, Olmsted, and Dodge Counties.

The RRW contains 850 miles of cold-water streams that support trout populations. Karst geology creates these streams and occurs when water wears away at the rock and creates sinkholes, springs, caves, disappearing streams, and underground tunnels. There are more surface karst features in the Root River than any other watershed in Minnesota, and Fillmore County alone has more of these features than all other counties combined (DNR 2013). This geology makes the GW highly susceptible to pollution (MPCA 1989) because contaminants on the land can easily reach GW, which then mixes with rivers and streams.

3.2 Streams by Subwatershed (10 HUC)

Total watershed and direct drainage areas were delineated using ArcGIS. The direct drainage areas include only the area downstream of any impaired upstream reach (Table 5). The Root River 8 HUC watershed is comprised of nine 10 HUC subwatersheds:

1. Root River (Lower)
2. City of Rushford-Root River
3. Trout Run-Root River
4. Middle Branch Root River
5. Money Creek
6. North Branch Root River
7. Rush Creek
8. South Branch Root River
9. South Fork Root River

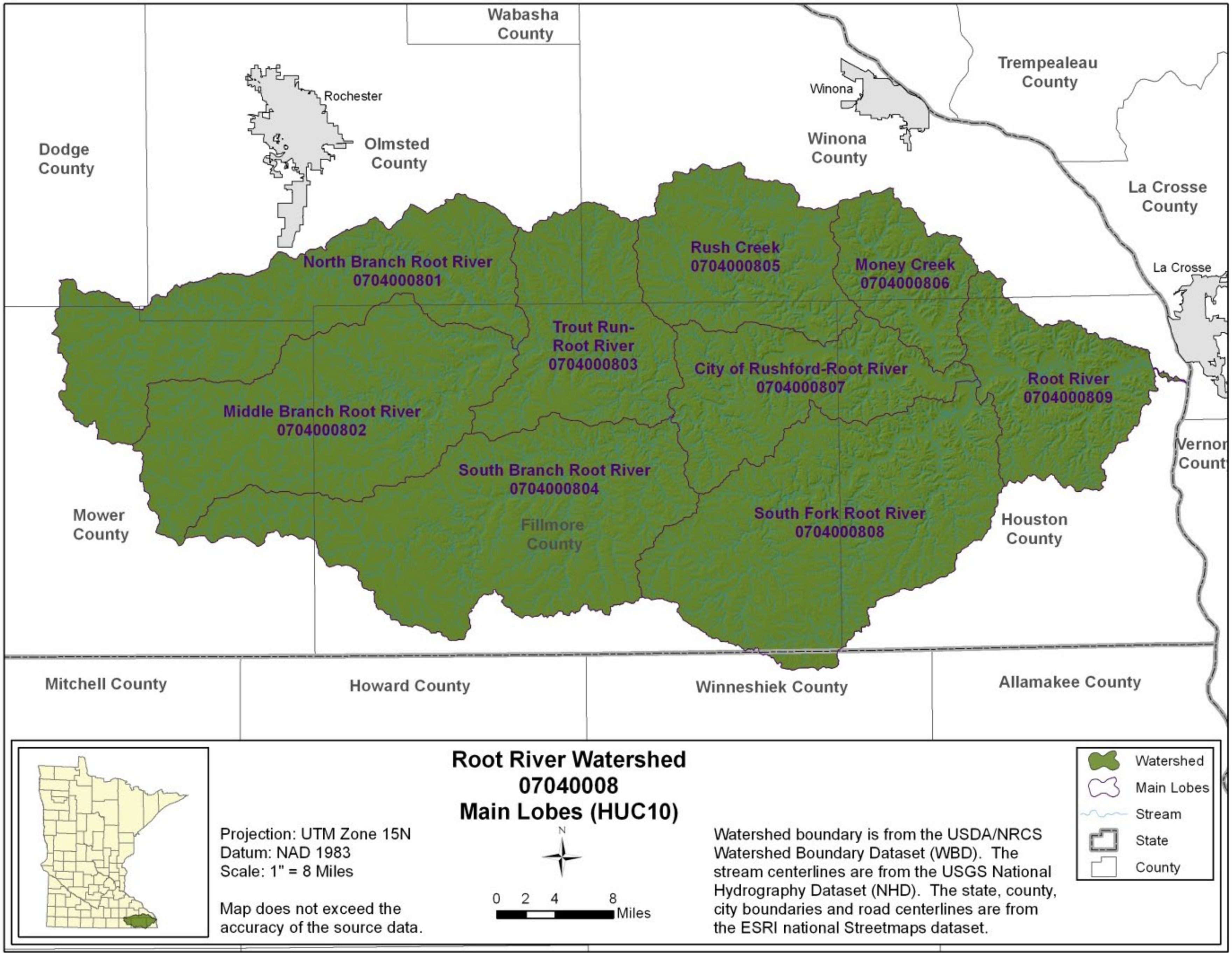


Figure 2. The RRW 10 digit HUC subwatersheds.

Table 5. Summary data for the 30 impaired AUIDs in the RRW addressed with TMDL calculations in this report.

HUC 10 Name	Stream	AUID#	Stream Miles	Watershed Area Square Miles	Designated Trout Stream?
Root River	Root River (Lower), Thompson Ck to Mississippi R	07040008-501	5.7	1661.4	No
Root River	Root River, SF Root to Thompson Creek	07080008-502	11.1	1614.0	No
Root River	Thompson Creek, T103 R5W S12, south line to Root R	07040008-507	5.2	37.1	Yes
City of Rushford-Root River	Root River, Money Creek to SF Root River	07040008-520	3.4	1247.8	No
City of Rushford-Root River	Root River, Rush Creek to Money Creek	07040008-522	12.6	1165.8	No
City of Rushford-Root River	Root River, MB Root River to Rush Creek	07040008-527	20.2	991.4	No
Trout Run-Root River	Trout Run, Unnamed Creek to MB Root River	07040008-G88	11.9	32.0	Yes
Trout Run-Root River	MB Root River, Trout Run to SB Root River	07040008-528	16.3	618.0	No
Trout Run-Root River	MB Root River, NB Root River to Lynch Creek	07040008-534	6.1	482.7	No
Middle Branch Root River	MB Root River, upper Bear Creek to NB Root R	07040008-506	1.6	240.9	No
Middle Branch Root River	Bear Creek, Kedron Creek to MB Root River	07040008-542	7.2	99.5	No

HUC 10 Name	Stream	AUID#	Stream Miles	Watershed Area Square Miles	Designated Trout Stream?
Middle Branch Root River	Deer Creek, headwaters to MB Root River	07040008-546	37.9	58.8	No
Middle Branch Root River	Spring Valley Creek, T103 R13W S29, west line to Deer Cr	07040008-548	17.6	30.1	Yes
North Branch Root River	NB Root River, Mill Creek to MB Root River	07040008-535	3.7	231.6	No
North Branch Root River	Mill Creek, T105 R12W S14, north line N Br Root R	07040008-536	8.1	31.9	Yes
North Branch Root River	Root River, North Branch, Unnamed cr to Mill cr	07040008-716	33.6	227.8	No
North Branch Root River	Root River, North Branch, Headwaters to Carey Cr	07040008-717	33.1	116.1	No
Rush Creek	Rush Creek, Pine Creek to Root River	07040008-523	5.5	135.2	Yes
South Branch Root River	SB Root River, Duschee Cr to MB Root River	07040008-550	3.6	286.4	Yes
South Branch Root River	Watson Creek, T103 R11W R30 west line to SB Root R	07040008-552	16.9	34.0	Yes
South Branch Root River	Willow Cr to Camp Cr	07040008-554	3.0	211.2	Yes
South Branch Root River	SB Root River, Canfield Cr to Willow Creek	07040008-555	12.0	142.5	Yes
South Branch Root River	SB Root River, T102 R12W S21,	07040008-556	8.1	69.4	Yes

HUC 10 Name	Stream	AUID#	Stream Miles	Watershed Area Square Miles	Designated Trout Stream?
	north line to Canfield Cr				
South Branch Root River	Canfield Creek T102 R12W S25, west line to S Br Root R	07040008-557	2.1	28.9	Yes
South Branch Root River	Willow Creek, T101 R11W S12 to SB RR	07040008-558	9.9	35.8	Yes
South Branch Root River	Etna Creek, unnamed creek to SB Root River	07040008-562	0.69	6.8	Yes
South Fork Root River	SF Root River Beaver Creek to Root River	07040008-508	8.5	292.0	No
South Fork Root River	SF Root River Riceford Creek to Beaver Creek	07040008-509	6.7	212.6	No
South Fork Root River	Root River, South Fork, T102 R9W S26, west line to Wisel Cr	07040008-511	6.6	32.1	Yes
South Fork Root River	SF Root River Headwaters to T102 R9W S27, east line	07040008-573	11.5	22.3	No

3.3 Land Use

The RRW has a diverse landscape (Figure 3). According to the 2011 National Land Cover Dataset, cropland was the most prevalent use (48%) (Homer 2015). Of that 48% cropland, 41% was corn/soybeans and 7% was other (not corn/soybeans) (USDA 2011). Forest/shrub (26%) and pasture/grassland (20%) were the next most common land uses and found primarily in the rolling hills and bluff regions located in the eastern half of the watershed. Some development (5%) exists in the watershed, located around the cities and communities including Chatfield, Rushford, Stewartville, Preston, Spring Valley, Houston, Lanesboro, Grand Meadow, Hokah, and Mabel. The population of the watershed is 43,600. Very few areas of wetlands (0.5%) and open water (0.2%) exist in the watershed.

Abundant recreational opportunities exist in the RRW. There are two state parks (Beaver Creek Valley and Forestville-Mystery Cave) and two trout hatcheries that draw visitors and anglers from around the state and region. The 42-mile Root River Trail allows for bicycling and cross-country skiing while the more than 80-mile water trail provides a place to enjoy canoeing/kayaking/tubing activities. Hunting and fishing are also popular, with trout fishing on the 850-miles of coldwater streams being heralded as the best in the state.

Three distinct land forms make up the RRW (Figure 4): 1) Uplands, till covered karst in the western part of the watershed, which tends to be flat and used for cropland; 2) Driftless, near-surface karst in the central part, where the land is steep and rugged, with soluble limestone underneath. Water has carved sinkholes, caves and tunnels throughout this limestone; 3) Driftless, bluffland karst in the eastern portion, dominated by steep bluffs. More detail about these three regions can be found in the RRW SID Report (MPCA 2014b).

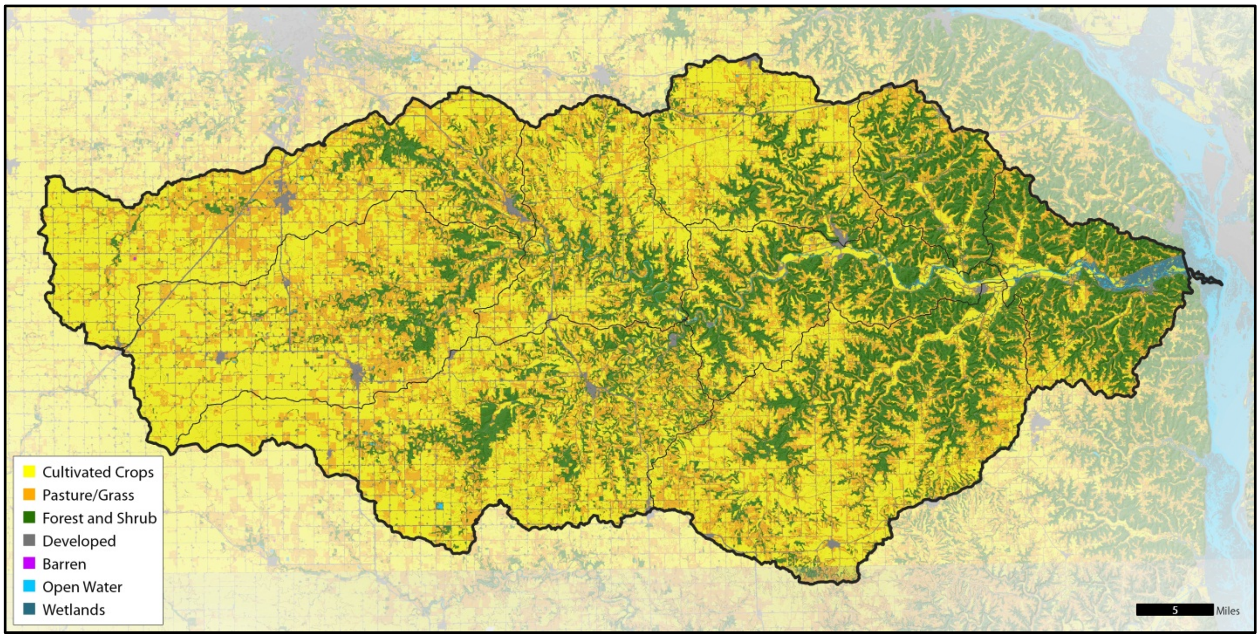


Figure 3. Land use in the RRW based on National Land Cover Dataset, 2011.

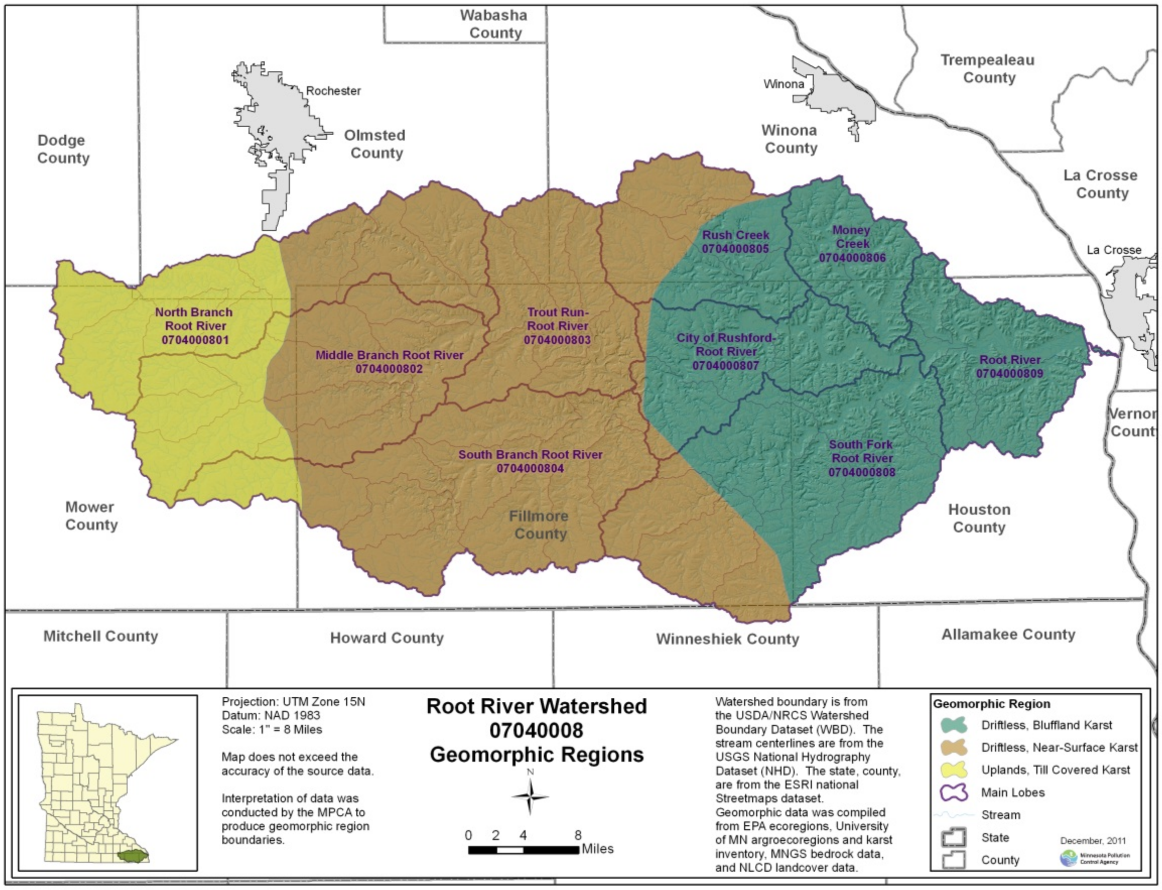


Figure 4. The three RRW Geomorphic Regions (from west to east): 1) Uplands, till covered karst; 2) Driftless, near-surface karst; and 3) Driftless, bluffland karst (GIS data used geomorphic data compiled by EPA ecoregions, the University of MN agroecoregions, MGS bedrock data, and NLCD land cover data).

3.4 Current Water Quality

In this section, current water quality is discussed within each 10-HUC subwatershed (Figure 2). The existing stream water quality conditions were quantified using data downloaded from the MPCA EQuIS database and available for the 10-year assessment period (2000 through 2010) used by the MPCA to identify stream impairments in the RRW.

The RRW was assessed by the MPCA in 2011. During that assessment process, 110 AUIDs were analyzed, however only 84 AUIDs datasets were deemed assessable (met data requirements per parameter). Through the assessment process it was found that a total of 54 AUIDs are impaired in the RRW (47 for aquatic life, and/or 19 for aquatic recreation). Through a state-wide assessment effort of drinking water sources in 2010 (coldwater, class 1B/2A streams), it was found that six stream reaches in the RRW are not supporting for drinking water use based on elevated nitrate levels. Two of the aquatic life impairments were deferred due to an impending use class change that will occur in 2016 (they are currently incorrectly listed as class 2B warm water, that will change to class 2A coldwater).

Macroinvertebrate and Fish IBI scores, as well as other assessment information, can be found in the RRW Monitoring and Assessment Report (MPCA 2013), while further information on stressors can be found in the RRW SID Report (MPCA 2014b).

3.4.1 Root River (Lower)

The Lower Root Subwatershed has four impaired AUIDs; one for aquatic recreation, and three for aquatic life (Figure 5).

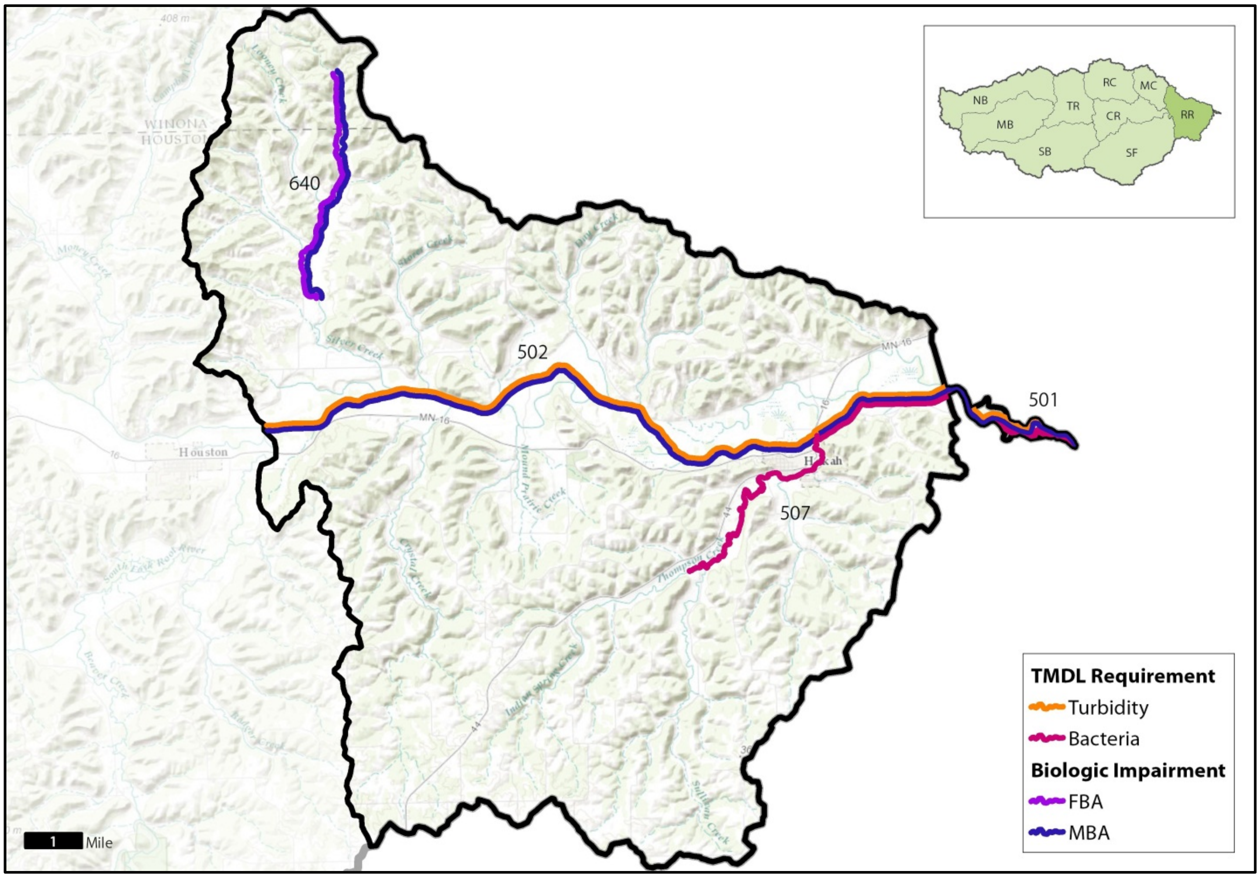


Figure 5. Impairments for bacteria, fish bioassessment (FBA), aquatic macroinvertebrate bioassessment (MBA) and turbidity in the Lower Root Subwatershed of the Root River. Last three-digits of impaired AUID appear next to stream reaches.

3.4.1.1 Aquatic Recreation Use Support Determination

There is one aquatic recreation use impairment on the Assessment Unit ID (AUID) ending in -507, based on fecal coliform bacteria. This impairment was addressed in the *Revised Regional Total Maximum Daily Load Evaluation of Fecal Coliform Bacteria Impairments in the Lower Mississippi River Basin in Minnesota* (MPCA 2006).

3.4.1.2 Aquatic Life Use Support Determination

There are three AUIDs with impaired aquatic life use: one for fish bioassessments (FBA) and aquatic macroinvertebrate bioassessment (MBA) (AUID -640) and two for MBA and turbidity (AUIDs -501 and -502).

The impaired AUIDs for MBA and turbidity have the same three conclusive stressors found, one of which is TSS. This corroborates the turbidity impairments (Table 6).

Table 6. Turbidity impairments in the Lower Root Subwatershed (TSS values reported)*.

Reach Name	AUID	Date range of data	Number of values out of all values on record above 65 mg/L TSS standard	TSS identified as a biological stressor
Root River	07040008-501	2008-2010	24/54	NA
Root River	07040008-502	2008-2012	87/192	Yes

*Note: listed based on turbidity, but TMDL based on TSS standard and data.

Table 7. Aquatic life use impairments in the Lower Root Subwatershed that are not addressed in this TMDL.

Reach Name	AUID	Listed Stressor	Conclusive Stressor
Silver Creek	07040008-640	Fish and Aquatic Macroinvertebrate Bioassessments	Physical habitat

3.4.2 City of Rushford-Root River

The city of Rushford Subwatershed has four impaired AUIDs, all for aquatic life. One has a conclusive stressor of TSS that led to a TSS TMDL calculation (Figure 6).

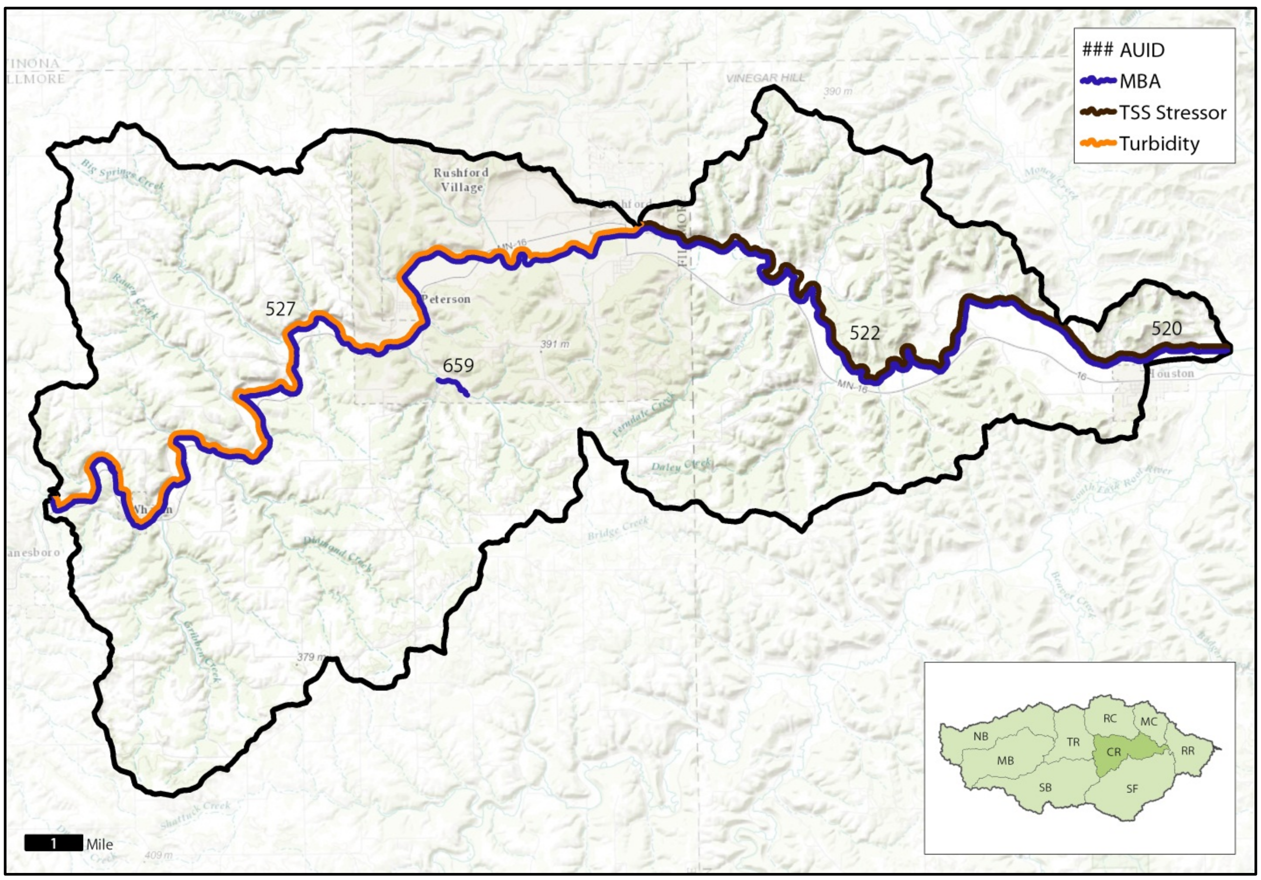


Figure 6. Impairments for MBA, TSS and turbidity in the city of Rushford Subwatershed of the Root River. Last three-digits of impaired AUID appear next to stream reaches.

3.4.2.1 Aquatic Life Use Support Determination

Within the city of Rushford Subwatershed, there are four aquatic life use impairments. One AUID is for turbidity and MBA, and four are MBAs only.

The other two aquatic life use impairments are based on aquatic macroinvertebrate bioassessment. In addition, through SID it was found that these two AUIDs (07040008-522 and 07040008-520) have a TSS conclusive stressor impacting the aquatic macroinvertebrate community. There were three biological stations on the consecutive AUIDs, one sampled in 2004 (04LM118) and two sampled in 2008 (08LM057 and 08LM065). The following excerpt from the Root River SID Report explains the reasoning for the judgment that TSS was a conclusive stressor of the aquatic macroinvertebrate communities:

> *"The chemical data is supported well by biological data. The macroinvertebrates within these reaches are generally tolerant to TSS. All of the stations are lacking in intolerant macroinvertebrates and nearly all have reduced long-lived macroinvertebrates. The TSS station index scores are variable throughout the reach, but some are quite elevated…. The upstream stations have a lack of TSS intolerant taxa compared to the average and four of the seven visits had elevated TSS tolerant taxa. The macroinvertebrate community is influenced by the elevated TSS levels throughout these reaches." (MPCA, 2014)*

Because of this conclusion, a TSS TMDL was computed for AUIDs 07040008-522 and 07040008-520. It should be noted that TSS was also found as a conclusive stressor on AUID 07040008-527, but this reach was already listed for turbidity.

One AUID (07040008-659) in the city of Rushford Subwatershed is not addressed in this TMDL report (Table 8). A conclusive physical habitat stressor, which is a non-pollutant stressor, was found on this AUID.

Table 8. Aquatic life use impairments in the city of Rushford Subwatershed that are not addressed in this TMDL.

Reach Name	AUID	Listed Stressor	Conclusive Stressor
Unnamed Creek	07040008-659	Aquatic Macroinvertebrate Bioassessment	Physical habitat

3.4.3 Trout Run

The Trout Run Subwatershed has seven impaired stream reaches: two aquatic recreation use impairments, six aquatic life use impairments, and one determined through the SID process to be impaired by excess TSS concentrations (Figure 7).

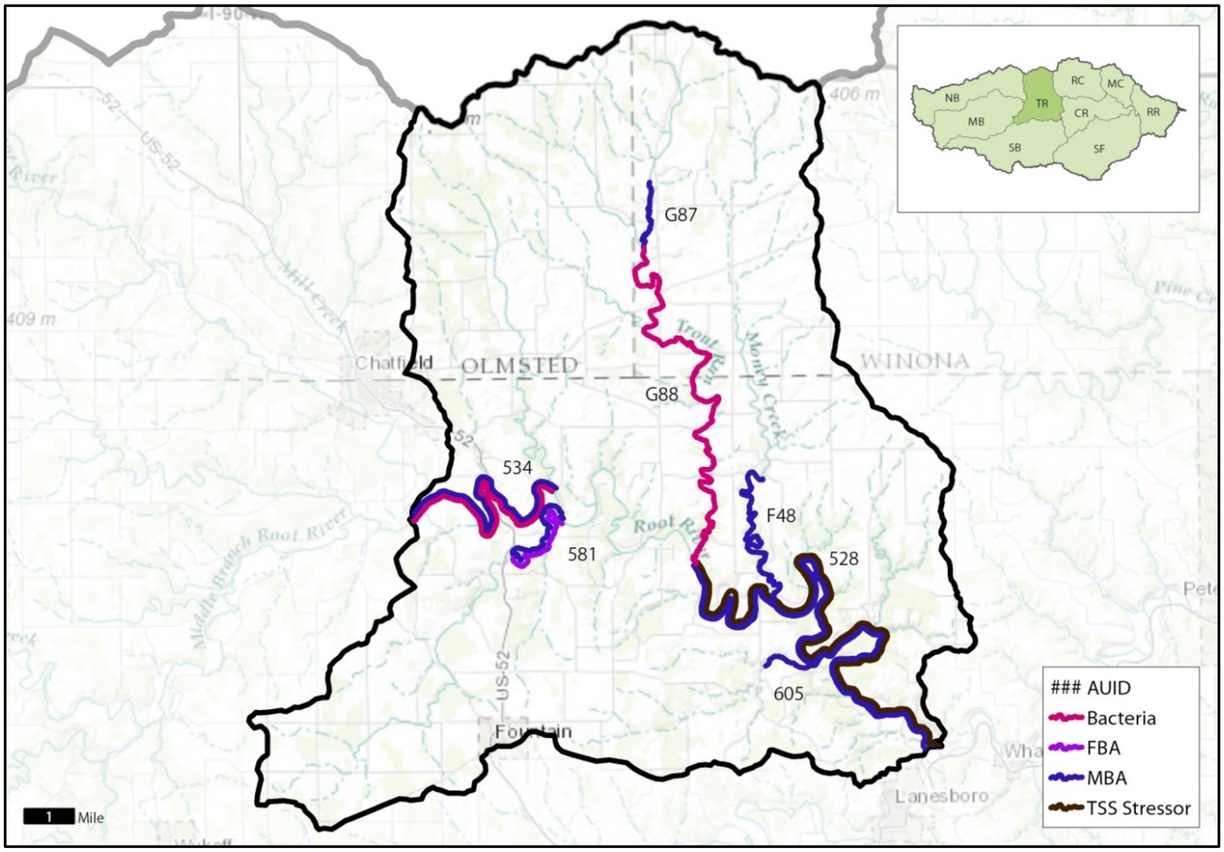


Figure 7. Impairments for bacteria, FBA, aquatic MBA and TSS in the Trout Run Subwatershed of the Root River. Last three-digits of impaired AUID appear next to stream reaches.

3.4.3.1 Aquatic Recreation Use Support Determination

Two AUIDs in the Trout Run Subwatershed have impaired aquatic recreation. A majority of the samples for each AUID exceeded the standard (Table 9).

Table 9. *E. coli* impairments in the Trout Run Subwatershed of the Root River. The standard is exceeded when geometric mean of at least five samples in two years exceed the water quality standard of 126 org/100mL.

Reach Name	AUID	Date range of data	Number of samples out of all values on record above 126 org/100 mL	Geomean (org/100 mL)
Trout Run Creek	07040008-G88	2008-2009	15/15	478
Middle Branch	07040008-534	2007-2008	16/22	264

3.4.3.2 Aquatic Life Use Support Determination

Within the Trout Run Subwatershed, there were five aquatic life use impairments. Four of those were for aquatic macroinvertebrate assessment impairments and the fifth had both aquatic macroinvertebrates and fish bioassessment impairments.

On one AUID, 07040008-528 (Root River, Middle Branch), the TSS was found to be a conclusive stressor to the aquatic macroinvertebrate community. There were two biological sampling locations on this AUID where aquatic macroinvertebrates were sampled in 2008 (08LM069 and 08LM070). The following excerpt from the Root River SID Report explains the reasoning for the judgment that TSS is a conclusive stressor of the aquatic macroinvertebrate community:

> *"Stations 08LM069 and 08LM070 had elevated TSS station index scores for macroinvertebrates; both scores were in the most tolerant quartile of scores from warm water stations in the Root River. Station 08LM070 had no TSS intolerant taxa, whereas the upstream station 08LM069 had three TSS intolerant taxa. Both stations had an elevated presence of TSS tolerant taxa and individuals. Station 08LM070 also had a low percentage of generally intolerant macroinvertebrate individuals and a low percentage of long-lived macroinvertebrate individuals. The macroinvertebrate community in this reach is likely influenced by the elevated TSS, with more response demonstrated on the downstream reach near station 08LM070." (MPCA 2014)*

Because of this conclusion, a TSS TMDL was computed on AUID 07040008-528.

Four AUIDs in the Trout Run Subwatershed are not addressed in this TMDL report (Table 10). One AUID had a conclusive stressor of nitrate found. However, nitrate is not being addressed with a TMDL calculation because, although levels were found to be stressing the aquatic communities in this cold water reach, concentrations did not exceed the drinking water standard of 10 mg/L.

Two AUIDs have conclusive physical habitat stressors, which are non-pollutant stressors. Two other AUIDs need more information before any conclusive stressors can be determined.

Table 10. Aquatic life use impairments in the Trout Run Subwatershed that are not addressed in this TMDL.

Reach Name	AUID	Listed Stressor	Conclusive Stressor(s)
Root River, Middle Branch	07040008-534	Aquatic Macroinvertebrate Bioassessments	Physical habitat
Money Creek	07040008-F48	Aquatic Macroinvertebrate Bioassessments	None identified
Wadden Valley Creek (Unnamed Creek)	07040008-605	Aquatic Macroinvertebrate Bioassessments	None identified
Rice Creek	07040008-581	Fish and Aquatic Macroinvertebrate Bioassessments	Nitrate; Physical habitat

3.4.4 Middle Branch Root River

The Middle Branch of the Root River has six impairments. Four impairments are for aquatic recreation use; and four impairments for aquatic life use based on fish and/or aquatic macroinvertebrate communities (Figure 8).

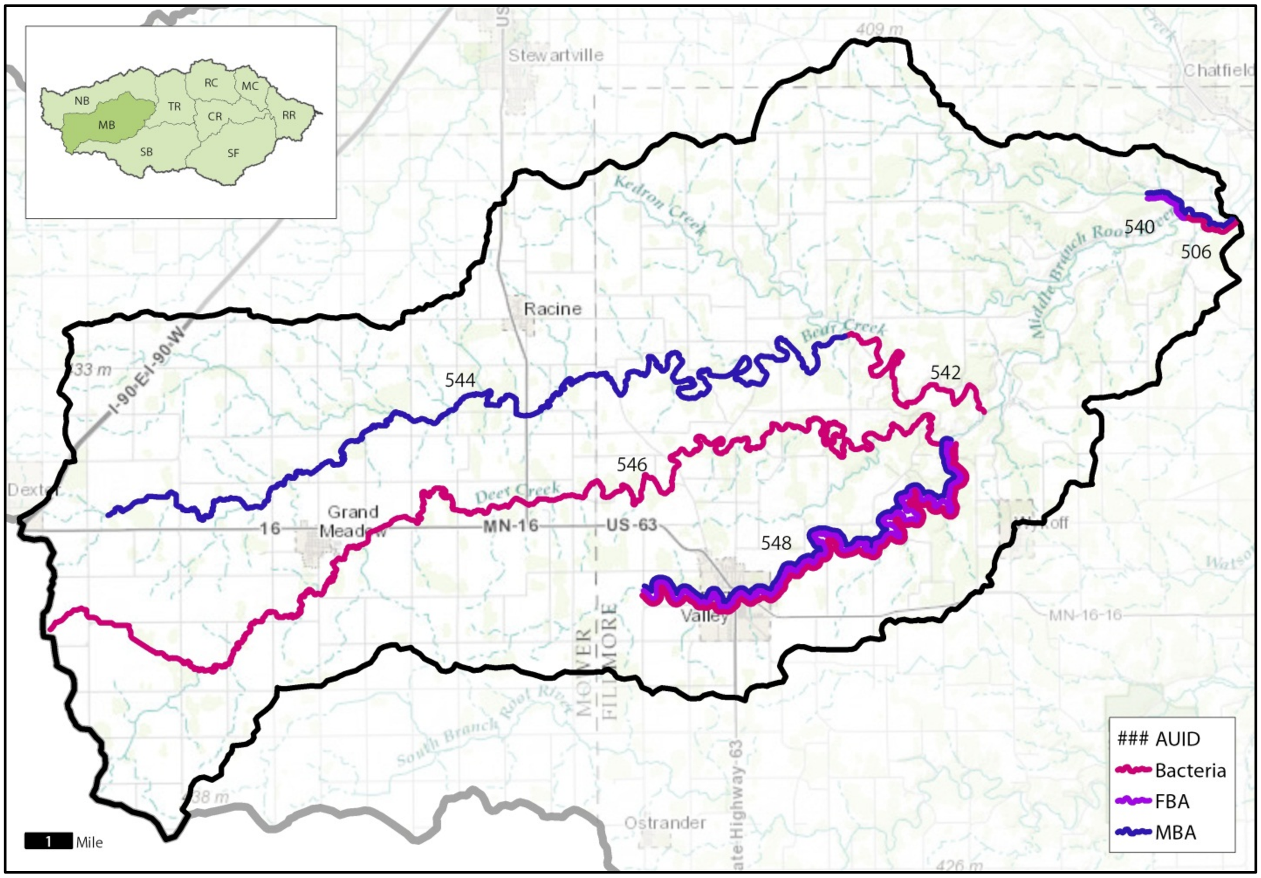


Figure 8. Impairments for bacteria, FBA and aquatic MBA in the Middle Branch Subwatershed of the Root River. Last three-digits of impaired AUID appear next to stream reaches.

3.4.4.1 Aquatic Recreation Use Support Determination

Four AUIDs have impaired aquatic recreation use based on fecal coliform and *E. coli* data (Table 11). The data exceeded the standard in all the samples for each AUID.

Table 11. *E. coli* impairments in the Middle Branch Subwatershed. The standard is exceeded when geometric mean of at least five samples in two years exceed the water quality standard of 126 org/100mL.

Reach Name	AUID	Date range of data	Number of samples out of all values on record above 126 org/100 mL	Geomean (org/100 mL)
Middle Branch Root River	07040008-506	2008-2009	15/15	419
Bear Creek	07040008-542	2008-2009	15/15	395
Deer Creek	07040008-546	2008-2009	15/15	525
Spring Valley Creek	07040008-548	2008-2009	15/15	754

3.4.4.2 Aquatic Life Use Support Determination

Three AUIDs have impairments aquatic life. All three listings were based on aquatic MBA. Two of those were also based on FBA (Table 12).

Through the SID process, it was found that two of the impairments can be attributed to high nitrate levels being a stressor. One of those also had temperature found to be a stressor. The third reach with only a MBA listing was due to a physical habitat stressor, which is non-pollutant, and will not be covered in this TMDL report.

Table 12. Aquatic life use impairments in the Middle Branch Subwatershed that are not addressed in this TMDL.

Reach Name	AUID	Listed Stressor	Conclusive Stressor(s)
Middle Branch Root River	07040008-506	Aquatic Macroinvertebrate Bioassessments	Physical habitat
Upper Bear Creek	07040008-540	Fishes and Aquatic Macroinvertebrate Bioassessments	Physical habitat
Bear Creek	07040008-544	Aquatic Macroinvertebrate Bioassessments	Physical habitat
Spring Valley Creek	07040008-548	Fish and Aquatic Macroinvertebrate Bioassessments	Nitrate, physical habitat, and temperature

Nitrate is not being addressed with a TMDL calculation because, although levels were found to be stressing the aquatic communities in this cold water reach, concentrations did not exceed the drinking water standard of 10 mg/L.

Temperature was found to be a stressor of the aquatic communities, but more information is needed to determine the cause of the limiting temperatures. Lack of shade was the most likely cause identified per the SID Report.

3.4.5 Money Creek

The Money Creek Subwatershed has impairments for aquatic recreation and aquatic life use: one bacteria impairment, one turbidity impairment, and one FBA impairment (Figure 9).

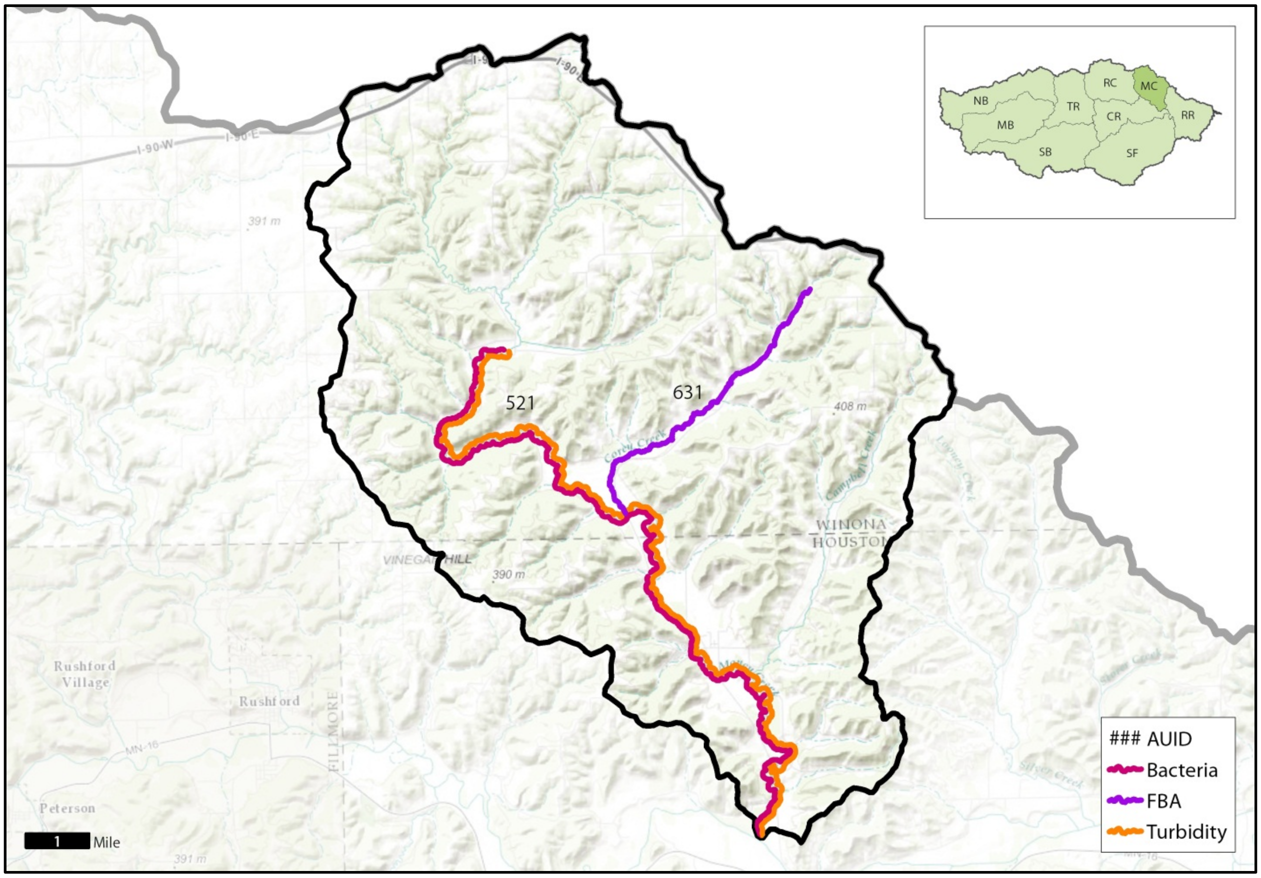


Figure 9. Impairments for bacteria, FBA, and turbidity in the Money Creek Subwatershed of the Root River. Last three-digits of impaired AUID appear next to stream reaches.

3.4.5.1 Aquatic Recreation Use Support Determination

There is one aquatic recreation use impairment based on fecal coliform bacteria. This impairment was addressed in the *Revised Regional Total Maximum Daily Load Evaluation of Fecal Coliform Bacteria Impairments in the Lower Mississippi River Basin in Minnesota* approved by EPA in 2006.

3.4.5.2 Aquatic Life Use Support Determination

The one turbidity impairment is not addressed in this TMDL. Since the time of impairment listing, more information and analysis confirms aquatic life use support and this AUID will be considered for list correction (removal of this listing).

There is one aquatic life use impairment based on FBA. Three conclusive stressors were identified through the SID process: temperature, physical habitat and physical connectivity (Table 13).

More information is needed to determine the cause of the limiting temperatures. Lack of stream cover, pasture and fine sediment in the stream bottom which absorbs more solar energy were the reasons given in the SID Report (MPCA 2014b). Physical habitat and physical connectivity are both non-pollutant stressors.

Table 13. Aquatic life use impairments in the Money Creek Subwatershed that are not addressed in this TMDL.

Reach Name	AUID	Listed Stressor	Conclusive Stressor
Corey Creek	07040008-631	Fish Bioassessment	Temperature; Physical habitat; Physical connectivity

3.4.6 North Branch of the Root River

There are nine impairments on the North Branch of the Root River Subwatershed. Three are for aquatic recreation use and six for aquatic life use based on the macroinvertebrate community assessment and turbidity levels (Figure 10).

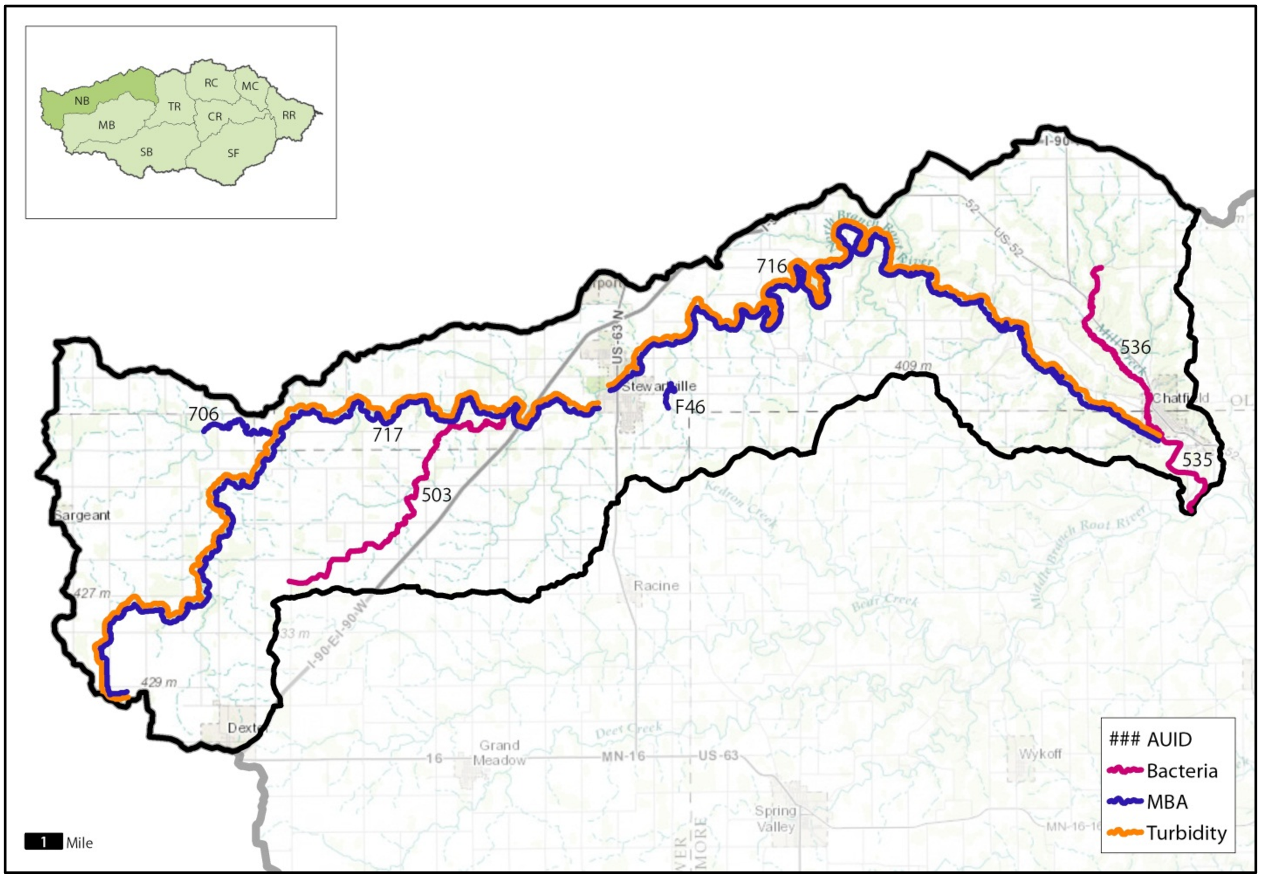


Figure 10. Impairments for bacteria, aquatic MBA, and turbidity in the North Branch Subwatershed. Last three-digits of impaired AUID appear next to stream reaches.

3.4.6.1 Aquatic Recreation Use Support Determination

There are three AUIDs with aquatic recreation use impairments based on fecal coliform and *E. coli* data. The data exceeded the standard in a majority of the samples for each AUID. One AUID (-503) was addressed in the *Revised Regional Total Maximum Daily Load Evaluation of Fecal Coliform Bacteria Impairments in the Lower Mississippi River Basin in Minnesota* (MPCA 2006). The other two are addressed in this TMDL document (Table 14).

Table 14. *E. coli* impairments in the North Branch Subwatershed. The standard is exceeded when geometric mean of at least five samples in two years exceed the water quality standard of 126 org/100mL.

Reach Name	AUID	Date range of data	Number of values out of all values on record above 126 org/100 mL	Geomean (org/100 mL)
Root River, North Branch	07040008-535	2008-2009	15/15	595
Mill Creek	07040008-536	2008-2009	18/19	389

3.4.6.2 Aquatic Life Use Support Determination

There are four AUIDs with aquatic life use impairments based on MBA. Physical habitat was found to be the only conclusive stressor on two of the MBA impairments. Since that is non-pollutant related, they are not addressed in this TMDL report (Table 15).

Two of the MBA listings are also impaired due to turbidity exceedances (Table 16). TSS was found to be a stressor, which reinforces these turbidity impairments.

Table 15. Aquatic life use impairments in the North Branch Subwatershed that are not addressed in this TMDL.

Reach Name	AUID	Listed Stressor	Conclusive Stressor
Unnamed creek	07040008-706	Aquatic Macroinvertebrate Bioassessments	Physical habitat
Unnamed creek	07040008-F46	Aquatic Macroinvertebrate Bioassessments	Physical habitat

Table 16. Turbidity impairments in the North Branch of the Root River (TSS values reported)*.

Reach Name	AUID	Date range of data	Number of values out of all values on record above 65 mg/L TSS standard	TSS identified as a biological stressor
Root River, North Branch	07040008-716	2008-2010	19/59	Yes
Root River, North Branch	07040008-717	2008-2010	15/54	Yes

*Note: listed based on turbidity, but TMDL based on TSS standard and data.

3.4.7 Rush Creek

The Rush Creek Subwatershed has four impaired AUIDs; three for aquatic life use and one for aquatic recreation use (Figure 11).

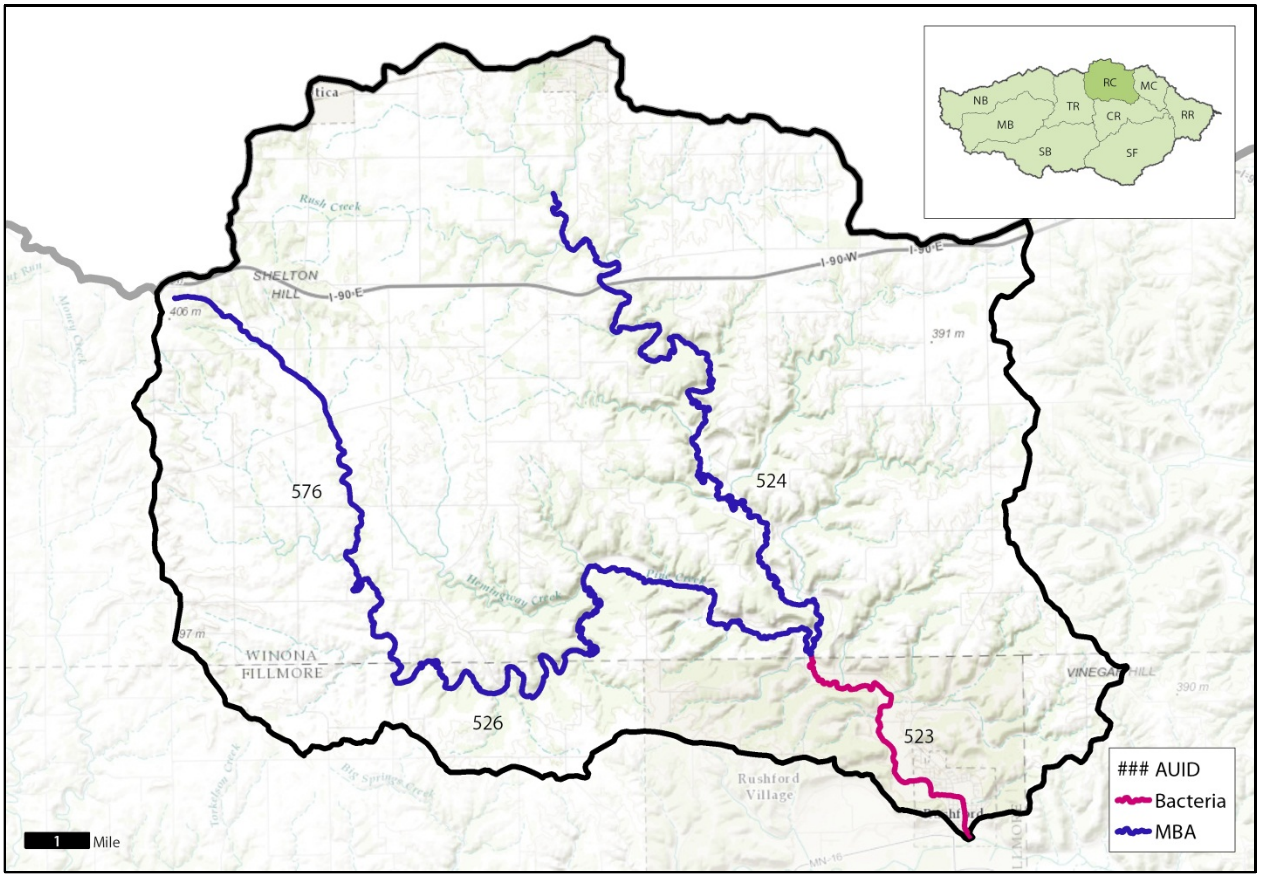


Figure 11. Impairments for bacteria and, aquatic MBA in the Rush Creek Subwatershed of the Root River. Last three-digits of impaired AUID appear next to stream reaches.

3.4.7.1 Aquatic Recreation Use Support Determination

In the Rush Creek Subwatershed there was one aquatic recreation use impairment based on *E. coli* bacteria. A majority of the samples exceeded the standard (Table 17).

Table 17. *E. coli* impairment in the Rush Creek Subwatershed. The standard is exceeded when geometric mean of at least five samples in two years exceed the water quality standard of 126 org/100mL.

Reach Name	AUID	Date range of data	Number of values of all samples on record above 126 org/100 mL	Geomean (org/100 mL)
Rush Creek	07040008-523	2008-2009	13/15	267

3.4.7.2 Aquatic Life Use Support Determination

There are three aquatic life use impairments based on MBA. All three have physical habitat as a conclusive stressor. Since physical habitat is a non-pollutant stressor, it is not addressed in this report (Table 18).

Table 18. Aquatic life use impairments in the Rush Creek Subwatershed that are not addressed in this TMDL.

Reach Name	AUID	Listed Stressor	Conclusive Stressor
Rush Creek	07040008-524	Aquatic Macroinvertebrate Bioassessments	Nitrate; Physical habitat
Pine Creek	07040008-526	Aquatic Macroinvertebrate Bioassessments	Physical habitat
Pine Creek	07040008-576	Aquatic Macroinvertebrate Bioassessments	Physical habitat

Nitrate is not addressed with a TMDL calculation in this report. Although levels were found to be stressing the aquatic communities in this cold water reach, concentrations did not exceed the drinking water standard of 10 mg/L.

3.4.8 South Branch of the Root River

The South Branch of the Root River has aquatic life use impairments and aquatic recreation use impairments. There are also six drinking water use impairments based on nitrate concentrations (Figure 12).

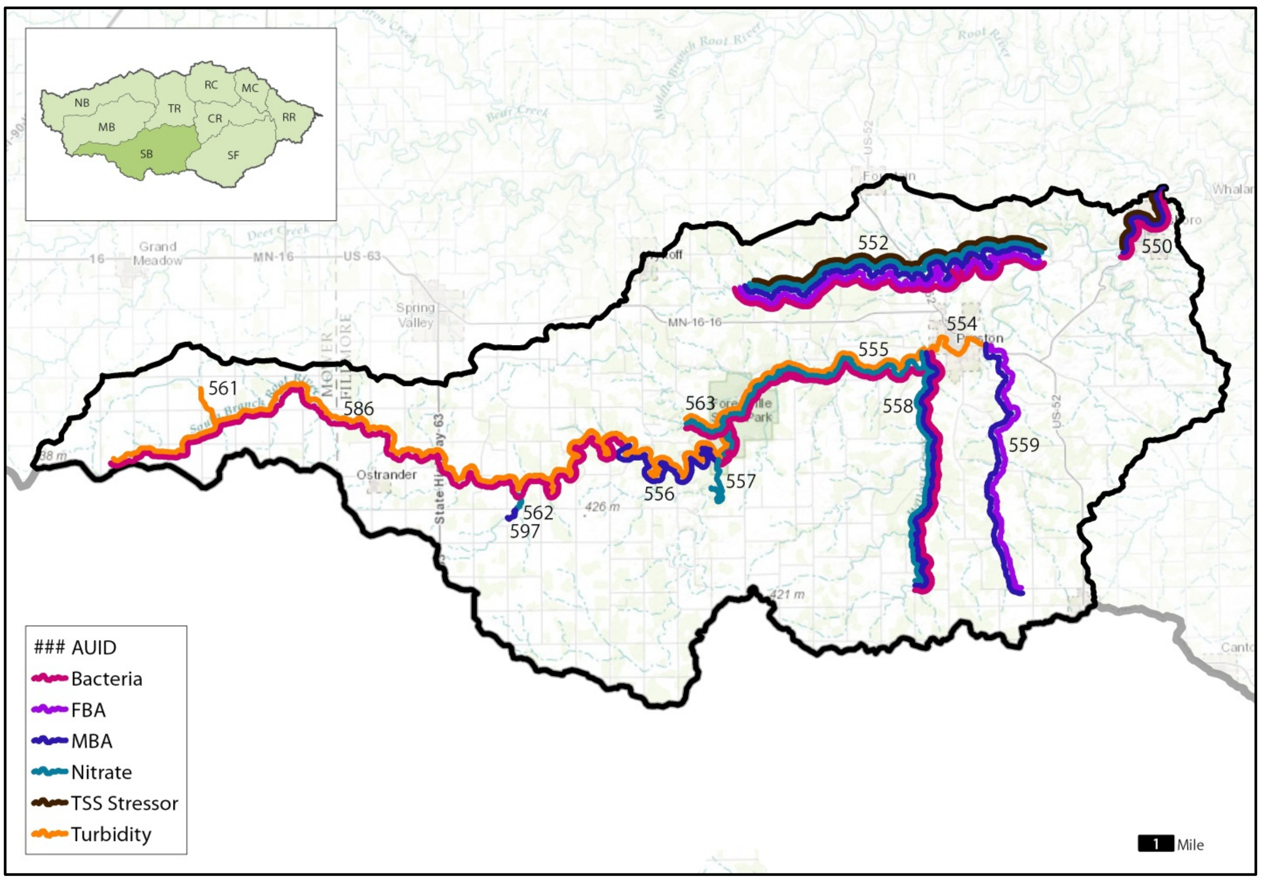


Figure 12. Impairments for bacteria, FBA, aquatic MBA, nitrate, TSS and turbidity in the South Branch of the Root River. Last three-digits of impaired AUID appear next to stream reaches.

3.4.8.1 Aquatic Recreation Use Support Determination

There is one aquatic recreation use impairment based on fecal coliform bacteria that was addressed in the *Revised Regional Total Maximum Daily Load Evaluation of Fecal Coliform Bacteria Impairments in the Lower Mississippi River Basin in Minnesota* (MPCA 2006). Three aquatic recreation use impairments are based on *E. coli* bacteria and are addressed in this report (Table 19).

Table 19. *E. coli* impairments in the South Branch Subwatershed. The standard is exceeded when geometric mean of at least five samples in two years exceed the water quality standard of 126 org/100mL.

Reach Name	AUID	Date range of data	Number of values of all values on record above 126 org/100 mL	Geomean (org/100 mL)
South Branch	07040008-550	2008-2009	9/15	176
Watson Creek	07040008-552	2008-2009	15/15	603
Willow Creek	07040008-558	2008-2009	15/15	918
Unnamed Creek to South Branch (Forestville Creek)*	07040008-563	1999-2007	15/18	551

*Note: listed based on fecal coliform measurements, but TMDL based on conversion to E.coli

3.4.8.2 Aquatic Life Use Support Determination

Within the South Branch Subwatershed, there are nine aquatic life use impairments. Six of those are for MBA impairments, two for FBA impairments and five for turbidity (Table 20).

Table 20. Turbidity impairments in the South Branch Subwatershed (TSS values reported)*.

Reach Name	AUID	Date range of data	Number of values of all values on record above 65 mg/L TSS standard	TSS identified as a biological stressor
Root River, South Branch**	07040008-554			NA
Root River, South Branch	07040008-555	1999-2010	34/121	NA
Root River, South Branch**	07040008-556			Inconclusive

*Note: listed based on turbidity, but TMDL based on TSS standard and data.
**No TSS data for this AUID.

On one AUID, 07040008-552 (Watson Creek), TSS was found to be a conclusive stressor to the aquatic macroinvertebrate and fish communities. There were two biological sampling locations on this AUID where aquatic macroinvertebrates and fish were sampled in 2004 and 2008, respectively (04LM057 and 08LM004). The following excerpts from the Root River SID Report explain the reasoning for the judgment:

> *"The fish population does show a number of fish species that are tolerant to high TSS…. It also shows that the population composition doesn't vary widely across the Watson Creek Watershed, suggesting a system-wide issue.*

The macroinvertebrate community in Watson Creek points to TSS as a stressor. A majority of the metrics are worse than the average for similar stations in the watershed.

The biological and chemical evidence confirm that TSS is a stressor to Watson Creek and is shaping the biological (fish and macroinvertebrate) communities present." (MPCA 2014)

Because of this conclusion, a TSS TMDL was computed on AUID 07040008-552.

Four AUIDs in the South Branch Subwatershed are not addressed in this TMDL report (Table 21). All three AUIDs had nitrate determined as a conclusive stressor. Two of those (Willow and Etna Creek) had nitrate TMDLs computed. Camp Creek did not have nitrate values above the 10 mg/L standard, so although nitrate was determined to be a stressor, a TMDL was not computed. Two AUIDs (Willow and Camp Creeks) have conclusive physical habitat stressors which are non-pollutant stressors. Temperature was also found to be a conclusive stressor on Camp Creek. However, more information is needed to determine the cause of the limiting temperatures. Possible causes discussed in the SID Report were cattle in the stream resulting in turbid water, and quarry impacts to area GW levels (MPCA 2014).

Two AUIDs (-563, -586) were listed due to high turbidity in 2004. Since that time, new information and updated TSS standards have led to the conclusion that a 303(d) list correction is needed to remove these listings. This list correction to address both reaches is planned to be on the 2016 303(d) list.

For AUID -561, assessment was deferred until an updated assessment procedure for channelized reaches is in place. Re-assessment will occur when Minnesota's watershed approach is re-started in the RRW in 2018.

Table 21. Aquatic life use impairments in the South Branch Subwatershed that are not addressed in this TMDL.

Reach Name	AUID	Listed Stressor/Pollutant	Conclusive Stressor(s)
Willow Creek	07040008-558	Aquatic Macroinvertebrate Bioassessments	Nitrate, Physical habitat
Camp Creek	07040008-559	Aquatic Macroinvertebrate Bioassessments; FBA	Temperature, Nitrate, Physical habitat
Unnamed Creek to South Branch (Judicial Ditch #1)	07040008-561	Turbidity	NA
Unnamed Creek to South Branch (Forestville Creek)	07040008-563	Turbidity	NA
South Branch, Root River (Hafner)	07040008-586	Turbidity	NA
Etna Creek	07040008-597	Aquatic Macroinvertebrate Bioassessments	Nitrate

3.4.8.3 Drinking Water Use Support Determination

All six of the impaired AUIDs for drinking water use are in the South Branch Subwatershed. All of these AUIDs are class 1B/2A (cold water). Where drinking water use impairments co-existed with aquatic life use impairments, nitrates were found to be a stressor on the biotic community (Table 22).

Table 22. Drinking water use impairments in the South Branch Subwatershed. Nitrate as a stressor to the biotic community is noted when an aquatic life use impairment co-existed on a given AUID.

Reach Name	AUID	Date range of data	Number of samples $\geq$10 mg/L standard	Nitrate as identified stressor?
Watson Creek	07040008-552	2004-2011	15/27	Yes
South Branch	07040008-555	1999-2010	18/186	NA
Canfield Creek	07040008-557	1999-2004	7/10	NA
Willow Creek	07040008-558	2004-2011	13/27	Yes
Etna Creek	07040008-562	1999-2001	4/11	Yes
Forestville Creek	07040008-563	1999-2010	13/75	NA

3.4.9 South Fork Root River

The South Fork Subwatershed has eight impaired AUIDs; eight for aquatic life use and one for aquatic recreation use. One of the aquatic life use impairments had a conclusive stressor of TSS that led to a TSS TMDL calculation (Figure 13).

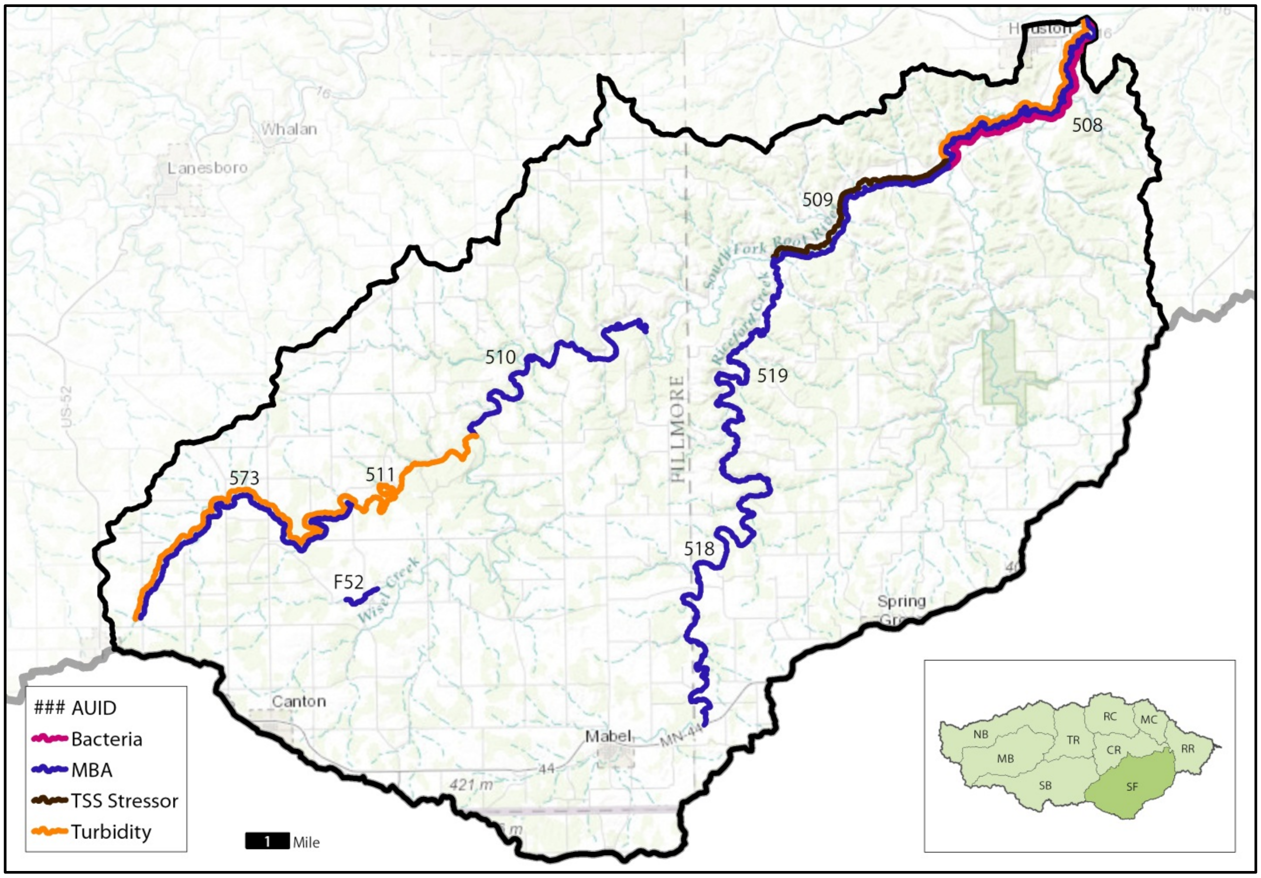


Figure 13. Impairments for bacteria, MBA, TSS and turbidity in the South Fork subwatershed of the Root River. Last three-digits of impaired AUID appear next to stream reaches.

3.4.9.1 Aquatic Recreation Use Support Determination

In the South Fork Subwatershed there was one aquatic recreation use impairment based on *E. coli* bacteria. All of the 15 samples exceeded the standard (Table 23).

Table 23. *E. coli* impairment in the South Fork Subwatershed. The standard is exceeded when geometric mean of at least five samples in two years exceed the water quality standard of 126 org/100mL.

Reach Name	AUID	Date range of data	Number of values of all values on record above 126 org/100 mL	Geomean (org/100 mL)
South Fork	07040008-508	2008-2009	15/15	610

3.4.9.2 Aquatic Life Use Support Determination

There are eight aquatic life use impairments in the South Fork Subwatershed. One is based on turbidity data only, five were based on MBA information only and two were based on turbidity and MBA information. Three of the impairments exceeded the turbidity standard (Table 24).

Table 24. Turbidity impairments in the South Fork Subwatershed (TSS values reported)*.

Reach Name	AUID	Date range of data	Number of values of all values on record above 65 mg/L TSS standard	TSS identified as a biological stressor
South Fork	07040008-508	2008-2010	46/71	Yes
South Fork	07040008-511	2008-2010	22/57	NA
South Fork	07040008-573	2004-2012	31/90	Yes

*Note: listed based on turbidity, but TMDL based on TSS standard and data.

Note that turbidity and TSS samples on AUIDs 07040008-508 and 07040008-573 were taken focused on events for pollutant load monitoring samples. However, multiple samples were also taken during baseflow, and show increased TSS. Continuous turbidity monitoring data also supports the impairment.

One AUID (07040008-509), which has an impairment based on MBA only, has TSS determined as a conclusive stressor through SID. There was one biological station on the AUID (08LM104). The following excerpt from the Root River SID Report explains the reasoning for the judgment that TSS was a conclusive stressor to the aquatic macroinvertebrate community:

> *"The stations in the Lower South Fork River had worse than average TSS station index scores for macroinvertebrates and most other metrics that measure response to elevated TSS. The percentage of TSS tolerant macroinvertebrates was greater than 44% at both stations, whereas the average for warmwater stations in the Root River Watershed is 35.45%. The macroinvertebrate community at these stations is impacted by elevated TSS levels. Given the strong chemical and biological response information, TSS is confirmed as a stressor in the Lower South Fork Root River (both stream reaches)."* (MPCA 2014)

Because of the SID report conclusion, a TSS TMDL was computed for AUID 07040008-509. Note that the AUID consecutively downstream (07040008-508) was listed for turbidity in 2008.

There are four AUIDs in the South Fork Subwatershed that were not addressed with TMDLs in this report. All four were found to have physical habitat as a conclusive stressor, and that is a non-pollutant parameter that cannot have a numeric target. Three of those AUIDs also had nitrate listed as a conclusive stressor, however, the nitrate concentrations did not exceed the standard of 10 mg/L. This shows more evidence that stream biota can be affected by nitrate levels lower than the current standard (Table 25).

Table 25. Aquatic life use impairments in the South Fork Subwatershed that are not addressed in this TMDL.

Reach Name	AUID	Listed Stressor	Conclusive Stressor
Sorenson Creek	07040008-F52	Aquatic Macroinvertebrate Bioassessment	Nitrate; Physical habitat
South Fork	07040008-510	Aquatic Macroinvertebrate Bioassessment	Nitrate; Physical habitat
Riceford Creek	07040008-518	Aquatic Macroinvertebrate Bioassessment	Nitrate; Physical habitat
Riceford Creek	07040008-519	Aquatic Macroinvertebrate Bioassessment	Physical habitat

3.5 Pollutant Source Summary

3.5.1 Bacteria (Fecal coliform and *E. coli*)

Water-borne pathogens pose a potential health risk to those who come into contact with inoculated surface water. These pathogens – bacteria, protozoa, viruses, and others – come from a variety of sources, including agricultural runoff, inadequately treated domestic sewage, and wildlife. Some of these pathogens may cause disease. The following discussion addresses probable point and nonpoint sources of fecal pathogens and the associated indicators: fecal coliform and *E. coli*, the latter being the indicator currently used in Minnesota's water quality standard.

3.5.1.1 Permitted (Point Source)

Wastewater treatment facilities

Permitted sources of bacteria include industrial wastewater effluent, municipal WWTP effluent, and municipal/industrial stormwater runoff. Review of the RRW shows a variety of permitted sources (Table 26).

Table 26. Permitted potential bacteria sources in the RRW.

Facility Name	NPDES Permit #	Design flow (MGD)	Equivalent Bacteria Load as *E. coli*: 126 org / 100 mL[1] [billion org/day]
Canton WWTP	MN0023001	0.065	0.310
Chatfield WWTP	MN0021857	0.487	2.323
Dexter WWTP	MN0023183	0.045	1.321
Fountain WWTP	MN0050873	0.062	0.296
Grand Meadow WWTP	MN0023558	0.120	4.974
Haven Hutterian Brethren	MNG580071	0.011	0.458
Hokah WWTP	MN0021458	0.102	0.486
Houston WWTP	MNG550007	0.250	1.192
Lanesboro WWTP	MNG550012	0.096	0.458
Lewiston WWTP	MN0023965	0.250	1.192
Mabel WWTP	MN0020877	0.189	0.901
MNDOT Enterprise Rest Area	MN0048844	0.006	0.114
MNDOT High Forest Rest Area	MN0044377	0.003	0.016
Ostrander WWTP	MN0024449	0.040	0.188

Facility Name	NPDES Permit #	Design flow (MGD)	Equivalent Bacteria Load as *E. coli*: 126 org / 100 mL[1] [billion org/day]
Peterson WWTP	MN0024490	0.050	0.238
Preston WWTP	MN0020745	0.392	1.869
Racine WWTP	MN0024554	0.039	0.777
Rushford WWTP	MNG550022	0.330	1.574
Spring Valley WWTP	MN0051934	0.936	4.464
Stewartville WWTP	MN0020681	1.111	5.300
Wykoff WWTP	MN0020826	0.049	0.234

[1]126 org/100 mL is the state water quality standard for *E. coli.* Numbers displayed in this table are calculated conversions since facility permit limits are calculated in fecal coliform units.

Livestock facilities with NPDES permits

Animal waste containing fecal bacteria can be transported in watershed runoff to surface waters. The MPCA regulates animal feedlots in Minnesota, though counties may be delegated by the MPCA to administer the program for feedlots that are not under federal regulation. The primary goal of the state program is to ensure that surface waters are not contaminated by the runoff from feeding facilities, manure storage or stockpiles, and cropland with improperly applied manure. Livestock also occur at hobby farms, small-scale farms that are not large enough to require registration but may have small-scale feeding operations and associated manure application or stockpiles.

Livestock manure is often either surface applied or incorporated into farm fields as a fertilizer and soil amendment. Minn. R. ch. 7020, contains manure application setback requirements based on research related to phosphorus transport, and not bacterial transport, and the effectiveness of these current setbacks on bacterial transport to surface waters is not known.

There are 20 active National Pollutant Discharge Elimination System (NPDES) permitted feedlot operations in the RRW, five of which are not Concentrated Animal Feeding Operation (CAFOs). The MPCA currently uses the federal definition of a CAFO in its regulation of animal feedlots. In Minnesota, the following types of livestock facilities are issued, and must operate under, a NPDES Permit or a state issued State Disposal System (SDS) Permit: a) all federally defined CAFOs, some of which are under 1000 animal units (AUs) in size; and b) all CAFOs and non-CAFOs, which have 1000 or more AUs. These feedlots must be designed to totally contain runoff, and manure management planning requirements are more stringent than for smaller feedlots. In accordance with the State of Minnesota's agreement with EPA, CAFOs with state-issued General NPDES Permits must be inspected twice during every 5-year permitting cycle and CAFOs with state issued Individual NPDES Permits are inspected annually. The number of AUs by animal type registered with the MPCA feedlot database (November 2014) is summarized in Table 27.

Table 27. NPDES permitted feedlots in the RRW with associated animal type and AUs.

Facility NAME	NPDES Permit #	Bird AU	Bovine AU	Pig AU
Jennie-O Turkey Store - Benson Farm	MNG440036	792		
Jennie-O Turkey Store - Chatfield Farm	MNG440035	1555		
Jennie-O Turkey Store - Fay Farm	MNG440037	1145		
Larson Products Inc Sec 5	MNG440330	340		
Jennie-O Turkey Store - Lingenfelter	MNG440038	984		
Daley Farms of Lewiston LLP	MN0067652		1996	
Johnson Rolling Acres Farm - Sec 21	MNG441129		1960	
Lanesboro Sales Commission	MNG440958		3557	
Schoenfelder Farms LLP - Blue Ridge East	MN0070289		1057	
Wilson Hog Properties LLC	MNG4412130			1080
Mensink Family LLC	MNG441177			1110
Hellickson Swine - Home	MNG440416			1042
Ridgeland Farm - Finisher	MNG440077			1260
Minnesota Family Farms - S2	MNG441059			1026
Minnesota Family Farms - Nursery 1	MNG441059			500
Allan & Kevin Marzolf Farm	MNG440076			1200
CCPC Swine LP	MNG440939			926
Eric Ruen Farm - Sec 11	MNG441292			996
Jon & Glenn Oehlke Farms	MNG440068			1080
Smith Farms of Rushford Inc	MNG440455			1500
Total	**(25,106)**	**4,816**	**8,570**	**11,720**

3.5.1.2 Non-permitted (Non-point Source)

The following text, which provides an overview of nonpoint sources of fecal coliform and *E. coli* bacteria and associated pathogens, is excerpted and adapted from the *Revised Regional Total Maximum Daily Load Evaluation of Fecal Coliform Bacteria Impairments in the Lower Mississippi River Basin in Minnesota* (MPCA 2006) (Note: refer to 2006 report for references in this section). At the time, Minnesota's water quality standard was described in terms of fecal coliform colonies as indicators of fecal pathogens; it has since changed to make use of *E. coli* counts (the water quality standard used in these TMDLs) for the same purpose. While the specific indicator has changed, the discussion of likely pathogen sources at a southeast Minnesota regional scale applies to the RRW; specific source information was inserted where appropriate.

The relationship between land use and fecal coliform concentrations found in streams is complex, involving both pollutant transport and rate of survival in different types of aquatic environments. Intensive sampling at numerous sites in southeastern Minnesota shows a strong positive correlation between stream flow, precipitation, and fecal coliform bacteria concentrations. In the Vermillion River Watershed, storm-event samples often showed concentrations in the thousands of organisms per 100 milliliters, far above non-storm-event samples. A study of the Straight River Watershed divided sources into continuous (failing individual sewage treatment systems, unsewered communities, industrial and institutional sources, WWTPs) and weather-driven (feedlot runoff, manured fields, urban stormwater categories). The study hypothesized that when precipitation and stream flows are high; the influence of continuous sources is overshadowed by weather-driven sources, which generate extremely high fecal coliform concentrations. However, during drought, low-flow conditions continuous sources can generate high concentrations of fecal coliform, the study indicated. Besides precipitation and flow, factors such as temperature, livestock management practices, wildlife activity, fecal deposit age, and channel and bank storage also affect bacterial concentrations in runoff (Baxter-Potter and Gilliland 1988). Fine sediment particles in the streambed can serve as a substrate harboring fecal coliform bacteria. "Extended survival of fecal bacteria in sediment can obscure the source and extent of fecal contamination in agricultural settings," (Howell et. al. 1996). Sadowsky et. al. studied growth and survival of *E. coli* in ditch sediments and water in the Seven Mile Creek Watershed; their work concluded that while cattle are likely major contributors to fecal pollution in the sediments of Seven Mile Creek, it is also likely that some *E. coli* strains grow in the sediments and thus some sites probably contain a mixture of newly acquired and resident strains (Sadowsky et. al. 2010).

Hydrogeologic features in southeastern Minnesota may favor the survival of fecal coliform bacteria. Cold GW, shaded streams, and sinkholes may protect fecal coliform from light, heat, drying, and predation (MPCA 1999). Sampling in the South Branch of the RRW showed concentrations of up to 2,000 organisms/100 ml coming from springs, pointing to a strong connection between surface water and ground water (Fillmore County 1999 and 2000). The presence of fecal coliform bacteria has been detected in private well water in southeastern Minnesota. However, many have been traced to problems of well construction, wellhead management, or flooding, not from widespread contamination of the deeper aquifers used for drinking water. Finally, fecal coliform survival appears to be shortened through exposure to sunlight. This is purported to be the reason why, at several sampling sites downstream of reservoirs, fecal coliform concentrations were markedly lower than at monitoring sites upstream of the reservoirs. This has been demonstrated at Lake Byllesby on the Cannon River and the Silver Creek Reservoir on the South Branch of the Zumbro River in Rochester. Despite the complexity of the relationship between sources and in-stream concentrations of fecal coliform, the following can be considered major source categories.

3.5.1.2.1 Urban and Rural Stormwater

Untreated stormwater from cities, small towns, and rural residential or commercial areas can be a source for many pollutants including fecal coliform bacteria and associated pathogens. Fecal coliform concentrations in urban runoff can be as great as or greater than those found in cropland runoff, and feedlot runoff (EPA 2001). Sources of fecal coliform in urban and residential stormwater include pet and wildlife waste that can be directly conveyed to streams and rivers via impervious surfaces and storm sewer systems. Newer urban development often includes stormwater treatment in the form of such practices as sedimentation basins, infiltration areas, and vegetated filter strips. Smaller communities or even rural residences not covered by municipal separate storm sewer systems (MS4) Permits may be sources of stormwater and associated pollutants. There are no MS4s in the RRW. There are many small communities with unknown impacts to bacteria levels in neighboring streams.

3.5.1.2.2 Non-permitted Livestock Facilities and Manure Application

The vast majority of livestock facilities in the Lower Mississippi River Basin in Minnesota are not CAFOs subject to NPDES or SDS Permit requirements. Nevertheless, they are subject to state feedlot rules, which include provisions for registration, inspection, permitting, and upgrading. Much of this work is accomplished through delegation of authority from the state to county government.

There are 1,532 non-CAFOs listed in the MPCA's database as having a current state registration in the RRW. There are 189 feedlot sites with current feedlot registration that have greater than 300 AUs within the RRW. These 189 sites are subject to more stringent manure management requirements. There are 586 feedlots in the RRW that have open feedlot agreements. From October 2000 to October 2010, livestock producers having open feedlots with fewer than 300 AUs had the option to sign an open lot agreement (OLA) (Minn. R. 7020.2003, subp. 4, and Minn. R. 7050.0305), whereby they committed to correct their open lot runoff problems in exchange for a flexible time schedule for compliance and a conditional waiver from enforcement of penalties for past violations of water quality standards. Interim measures were to be completed by October 1, 2005, and final corrective measures by October 1, 2010. Numbers as of September 2015, in the MPCA database, indicate that 234 sites in the RRW have been verified for OLA site compliance. The remaining 947 sites in the watershed have less than 100 AUs (registered as having between 0.1 and 99.99 AUs). These sites have limited manure management requirements but many have manure management practices in place.

The approximate total AUs in the RRW is slightly under 240,000 (according to the MPCA's Delta and GIS database). About 10% of those AUs are located on NPDES permitted CAFOs (25,106 AUs), while the remaining 90% are located on smaller feedlots permitted by the state of Minnesota (Figure 14). A majority (99%) of the AUs across all feedlots in the RRW are: bovines (68%), pigs (27%) and birds (4%). The other two categories are horses and sheep (Table 28).

Information about dairy and hog waste was obtained through discussion with the Fillmore Soil and Water Conservation District (SWCD) office in 2012. A majority of livestock waste is applied during fall and spring, with varying application rates (Table 29). Between liquid and solid, dairy waste was split 50:50, while hog waste was split 80:20, respectively.

Table 28. Types and numbers of AUs located on feedlots of all sizes in the RRW.

Animal Type	Number of AUs
Dairy	59,472
Beef	98,791
Veal	132
Total Bovine	**158,395**
Total Swine	**63,603**
Chicken	295
Turkey	8442
Total Bird	**8,737**
Total Horse	**2,582**
Total Sheep	**653**
Total AUs	**233,970**

Table 29. Dairy and hog livestock waste land application information.

	Fall:Spring Application	Application Rate	Application Method	General nutrient content N-P-K
Dairy - solid	50:50	14 tons/acre	Broadcast (100%)	11-7-9
Dairy - liquid	50:50	5000 gallons/acre	Knife:Broadcast (70:30)	20-16-24
Hog - solid	50:50	16 tons/acre	Broadcast (100%)	11-7-9
Hog - liquid	70:30	3500 gallons/acre	Knife:Broadcast (70:30)	20-16-24

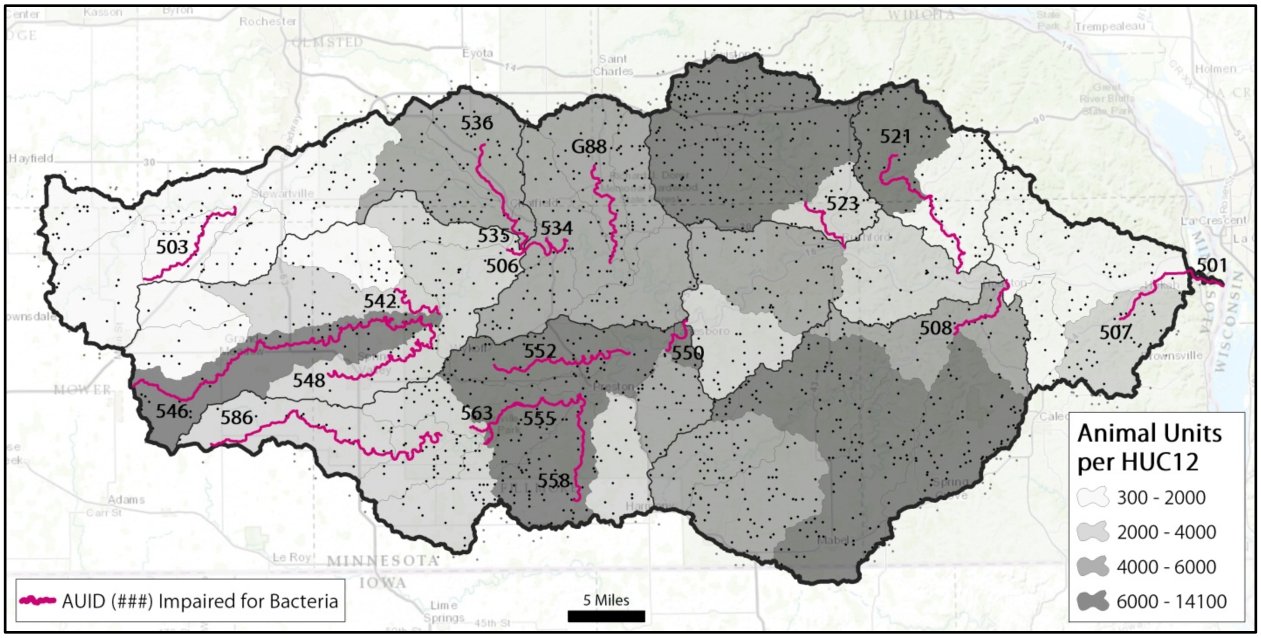


Figure 14. Locations of stream reaches impaired for bacteria, feedlots and AU density in the RRW.

3.5.1.2.3 Subsurface Sewage Treatment Systems (SSTS)

Nonconforming septic systems are an important source of fecal coliform bacteria, particularly during periods of low precipitation and runoff when this continuous source may dominate fecal coliform loads. Unsewered or undersewered communities include older individual systems that are generally failing, and/or collection systems that discharge directly to surface water. This may result in locally high concentrations of wastewater contaminants in surface water, including fecal coliform bacteria, in locations close to population centers where risk of exposure is relatively high.

The court decision leading to the revised Regional TMDL Evaluation of Fecal Coliform Bacteria Impairments in the Lower Mississippi River Basin in Minnesota (MPCA 2006) included the following language related to septic systems that discharge directly to surface waters:

> *"MCEA describes a straight pipe septic system as a system of disposing untreated sewage directly via a pipe to rivers, lakes, drain tiles, or ditches. Such systems are illegal pursuant to Minn. Stat. §§ 115.55 and 115.56."*

The MPCA concurs that these are illegal and un-permitted systems and would expand the definition slightly to include partially treated, as well as untreated, sewage. The majority of these systems likely have some form of rudimentary settling which may provide partial, but inadequate, treatment. The Minn. R. ch. 7080, definition of septic systems posing an imminent threat to public health or safety (ITPHS) includes "surface or surface water discharges and sewage backup into a dwelling or other establishment." Straight pipe septic systems clearly meet this definition.

An estimate of ITPHS in the RRW was based on reported number of Subsurface Sewage Treatment Systems (SSTS) per county (Fillmore, Houston, Mower, Olmsted, Winona, *Dodge was not included). Percentages of each reported numbers of SSTS were accounted for by estimating percent land area of each county that lies within the RRW. Of that estimate, 5% was calculated with a total of 417 estimated as the number of ITPHS in the RRW (MPCA 2014g).

An MPCA evaluation for the Minnesota River Basin suggests that improper SSTS may be responsible for approximately 74 fecal coliform bacteria organisms per 100 milliliter sample within larger rivers (David Morrison, “Contributions from Septic Systems and Undersewered Communities,” presented at Bacteria in the Minnesota River, Mankato, Minnesota, February 16, 1999). However, transport and survival of fecal coliform bacteria are not well understood, particularly as they are affected by the interaction of surface and ground water flows in the karst geology found throughout the Lower Mississippi Basin.

3.5.2 Nitrate

The major source of nitrate in the RRW is leaching loss from row crop acres (MPCA 2014a). The MPCA and MDA monitor nitrate in surface waters. The MPCA uses these data to determine if all water quality standards are being met. In 2011, 15 cold-water streams in Minnesota were listed as not meeting the nitrate water quality standards (listed as impaired). Twelve of the fifteen were located in southeastern Minnesota. Six of those twelve are located in the RRW, specifically in the South Branch Root River.

In a targeted study of southeastern Minnesota private well drinking water nitrate concentrations (Southeast Volunteer Nitrate Monitoring Network), the percent of wells exceeding 10 mg/l nitrate-N ranged between 7.6% and 14.6% during the years 2008 to 2012 (MDA 2015).

Nitrogen Sources

Minnesota recently initiated two state-level efforts related to N in surface waters. The MPCA is developing water quality standards to protect aquatic life from the toxic effects of high nitrate concentrations. The standards development effort, which is required under a 2010 Legislative directive, draws upon recent scientific studies that identify the concentrations of nitrate harmful to fish and other aquatic life (MPCA 2013).

In 2014, the state-level Nutrient Reduction Strategy (NRS), as called for in the 2008 Gulf of Mexico Hypoxia Action Plan, was completed. Minnesota contributes the sixth highest N load to the Gulf nationally and is 1 of 12 member states serving on the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. The cumulative N and phosphorus (P) contributions from several states are largely the cause of a hypoxic (low oxygen) zone in the Gulf of Mexico. This hypoxic zone affects commercial and recreational fishing and the overall health of the Gulf, since fish and other aquatic life cannot survive with low oxygen levels. Minnesota is developing a strategy which will identify how further progress can be made to reduce N and P entering both in-state and downstream waters (MPCA 2013).

The Minnesota Department of Agriculture's updated Nitrogen Fertilizer Management Plan (NFMP) will be implemented in southeast Minnesota (MDA 2015). The NFMP outlines how the Minnesota Department of Agriculture addresses elevated nitrate levels in groundwater from nitrogen fertilizer use. The NFMP has four components: prevention, monitoring, assessment and mitigation. One program within the NFMP is the Township Testing program. The goal of MDA’s Township Testing Program is to monitor nitrate levels in private drinking water wells. The program is focused on townships around the state where groundwater nitrate contamination is more likely to occur. These townships have vulnerable groundwater areas and significant row crop acres. Township testing within Fillmore County is tentatively scheduled for testing in 2017.

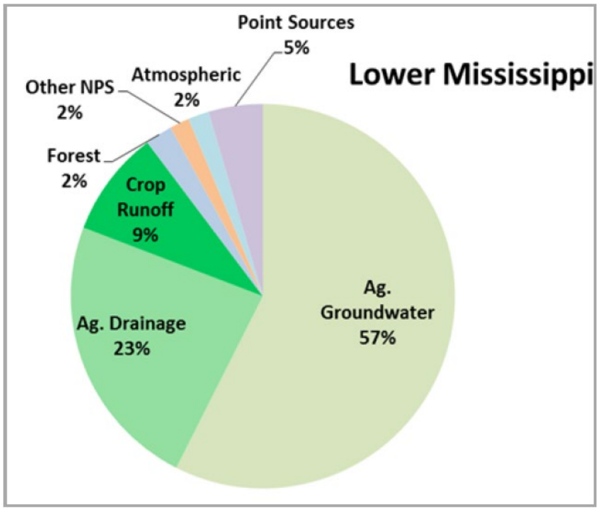


Figure 15. Estimated nitrogen sources to surface waters from the Minnesota contributing areas of the Lower Mississippi River Basin (average precipitation year) (MPCA, 2013).

3.5.2.1 Permitted

According to the Nitrogen in Minnesota Surface Waters (MPCA 2013), point sources only contribute 5% of the nitrogen in the Lower Mississippi River Basin (Figure 15). According to the MPCA document titled *Minnesota NPDES Wastewater Permit Nitrogen Monitoring Implementation Plan* the frequency of nitrogen series monitoring requirements in Minnesota's industrial and municipal wastewater NPDES Permits increased, beginning with permits issued in 2014. This was done in order to develop a more complete understanding of the magnitude and dynamics of nitrogen sources and discharges from wastewater sources. On a statewide scale, it has been determined that a majority of point source nitrogen is from the 10 largest municipal facilities (MPCA 2014f). Only one of the 10 large facilities is within the Lower Mississippi River Basin (Rochester WWTP), and none are in the RRW.

The regulated sources of nitrate within the watersheds of the nitrate impairments addressed in this TMDL study include NPDES permitted WWTP effluent, construction stormwater, and industrial stormwater. Nitrate loads from stormwater runoff were accounted for using the methods described in Section Regulated Wastewater4.1.3.3 below.

<u>Justification for nitrate permit allocations:</u>

For industrial stormwater, some permitted industrial sectors have benchmark monitoring requirements for total nitrogen as nitrite plus nitrate-nitrogen. If one of these industrial sectors is currently in the watershed or comes into the watershed in the future, it would have the potential to be a source of nitrate.

For construction stormwater, nitrate is not currently covered in the construction permit, but if it becomes more prevalent in stormwater it could be. It was included to avoid potential need for transfers in the future. While sediment itself generally is not associated with nitrate, particulate nitrogen can be 30%-40% of total nitrogen loads during urban runoff events. Therefore, indirectly, sediment could transport total nitrogen that could later transform to nitrate.

The WWTPs tend to discharge high concentrations of nitrate which is produced from the conversion of ammonia in waste. Limited discharge monitoring records exist for the WWTPs that discharge to nitrate impaired streams. One WWTP in the RRW already has a permit limit for nitrate: Fountain WWTP (MN0050873). The limit was based on the design flow and current nitrate standard of 10 mg/L. Fountain discharges to a class 1B/2A stream where the 10 mg/L standard applies. Total nitrogen effluent limits may be applicable in the future for wastewater facilities that are found to have a reasonable potential to affect drinking water supplies or to cause or contribute to violations of applicable nitrate water quality standards.

3.5.2.2 Non-permitted

Nitrate loads were estimated for the RRW from 2007-2011 monitoring data as part of the MPCA Watershed Pollutant Load Monitoring Network (Figure 16). Nitrate-nitrite loads in the RRW ranged from 4,321 to 8,567 tons.

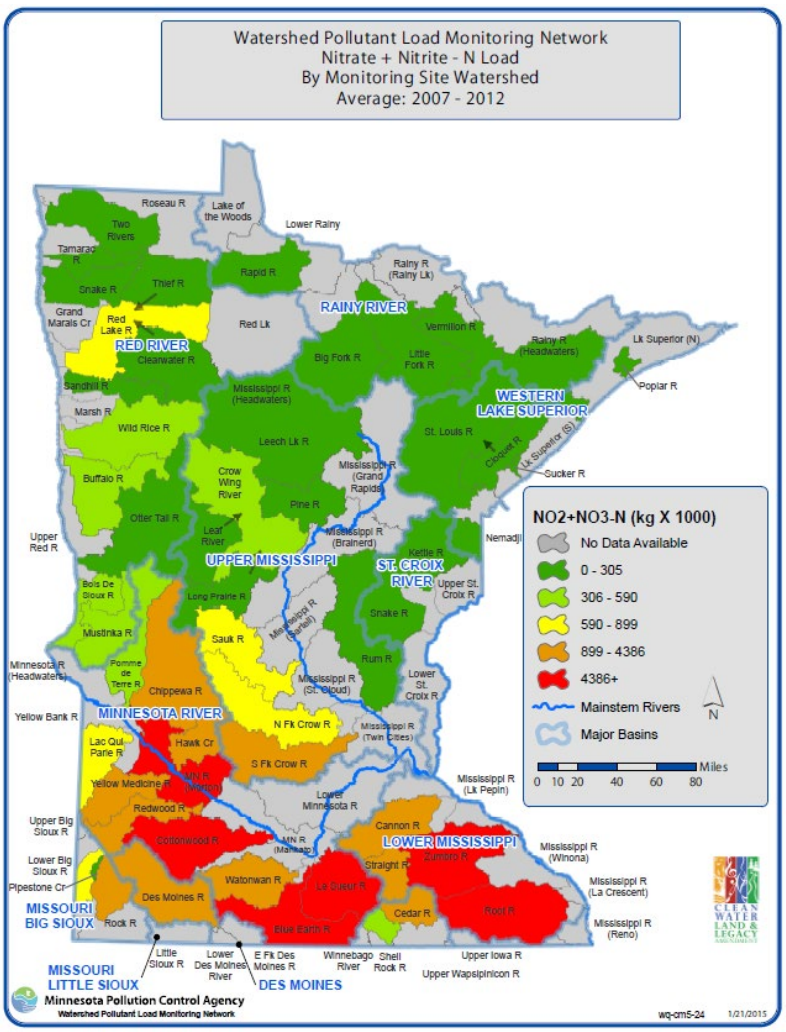
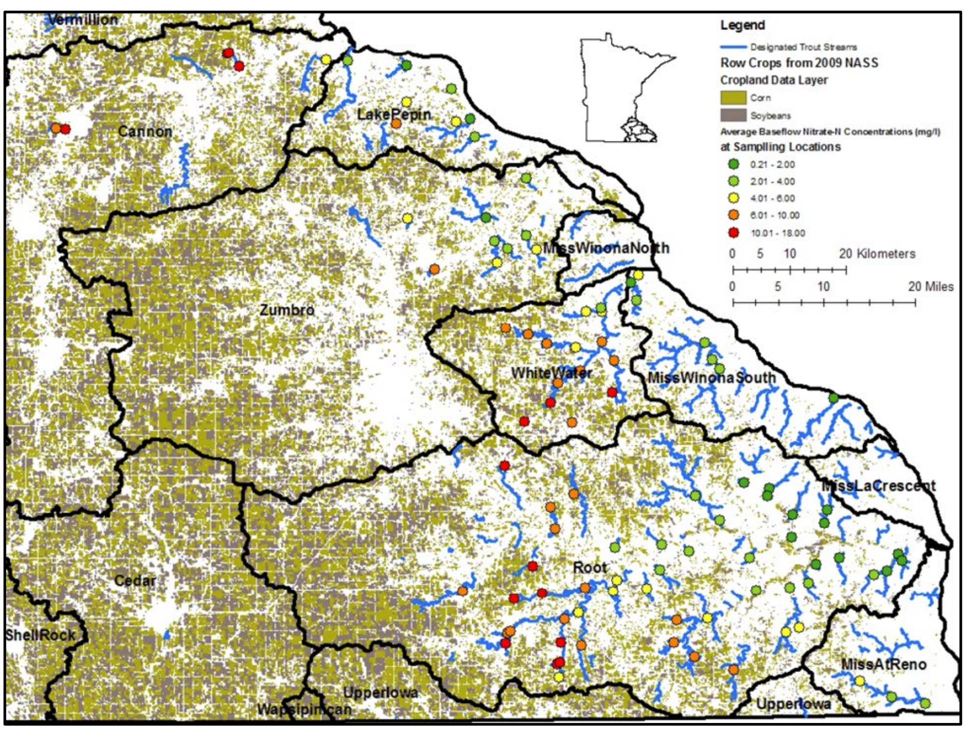


Figure 16. Nitrate-nitrite loads by Minnesota Major Watersheds (HUC 8).

An analysis of the relationship between base flow nitrate concentrations in southeast Minnesota trout streams and percentage of row crop land in the watersheds of these streams produced a statistically significantly regression. The one hundred trout stream sites examined included 51 sites in the RRW (Figure 18). Specific conclusions of this work include:

- Potential Source Linkage: Nitrate concentrations in Southeast Minnesota's trout streams show a strong linear relationship to row crop land use (Figure 17). A linear regression showed a slope of 0.16, suggesting that the average base flow nitrate concentration in the trout stream watersheds of Southeast Minnesota can be approximated by multiplying a watershed's row crop percentage by 0.16 (Figure 18). This regression analysis indicates that a watershed of approximately 60% corn and soybean acres corresponds to exceedances of Minnesota's drinking water nitrate-nitrogen standard of 10 mg/L at the point of sample in the stream (trout streams in Minnesota are protected as drinking water sources) (Watkins, Rasmussen, Streitz et al. 2013). This conclusion is supported by the findings of Nitrogen in Minnesota Surface Waters, which describe similar relationships between nitrogen in surface waters and "leaky soils below row crops," which include areas of shallow depth to bedrock such as the trout stream region of Southeast Minnesota (MPCA 2013). The RRW has approximately 48% land area in corn/soybean acres (USDA 2011).
- Potential Natural Background: The natural background level of nitrate in streams appears to be very low given that the base flow concentrations of streams with undisturbed (very little row crop land use and little or no other human impact) watersheds were less than 1 mg/L. Statistical analysis also suggested that in the absence of human disturbance in a watershed, the base flow nitrate concentration at the point of sample in the stream could approach 0 mg/L (Watkins, Rasmussen, Streitz et al. 2013) (Figure 18). This is in general agreement with recent work by the USGS that concluded that human impacts are the primary reason for elevated nitrogen in United States surface waters; background concentrations of nitrate were 0.24 mg/L in watersheds dominated by non-urban and non-agricultural land uses (Dubrovsky, et al. 2010).

Figure 17. Current baseflow nitrate-nitrogen concentrations from all available data



Given that the primary transport mechanism for loading nitrate to the trout streams of the RRW is leaching loss from agricultural lands to GW, it follows that the response time of nitrate concentrations to changes in land use practices will likely vary in different hydrogeological settings (MGS 2013). Studies outside of southeastern Minnesota have concluded that some hydrogeological systems function in a manner whereby changes in base flow nitrate concentrations lag changes in land use practices by decades (e.g., Tesoriero et al 2013). The most significantly lagged response in southeastern Minnesota should be expected in the deep valleys incised into the Prairie du Chien Plateau, where significant baseflow is derived from deep, siliciclastic-dominated bedrock sources with one or more overlying aquitards (MGS 2013). The RRW WRAPS document will further discuss areas that should be focused on.

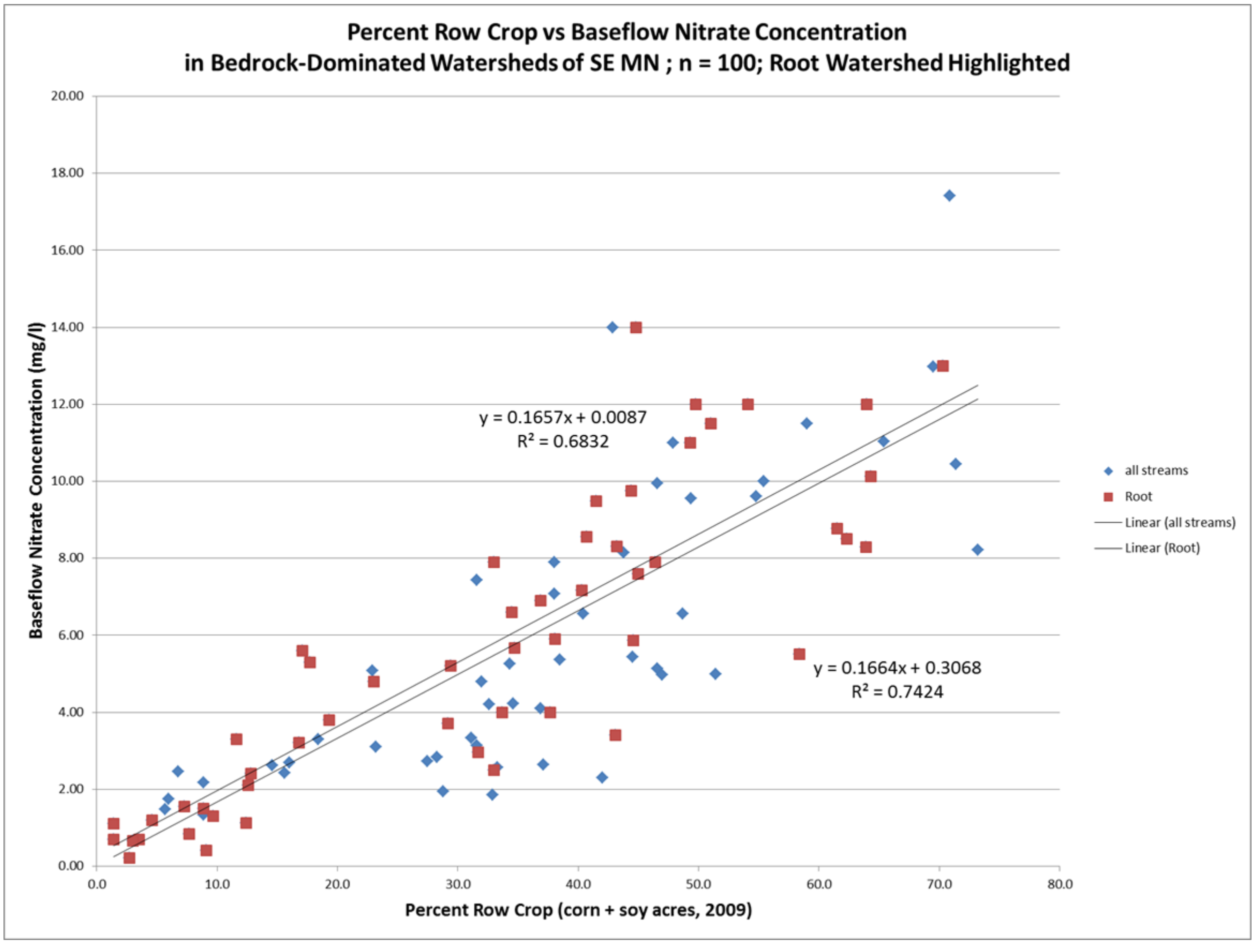


Figure 18. Baseflow nitrate and row crop acres regression (Watkins, Rasmussen, Streitz et al 2013). Root River data points are shown in red.

Atmospheric deposition and Agricultural drainage

The Lower Mississippi River Basin has the highest wet and dry deposition rates of N (12.1-14.6 lb/ac/yr) of all Minnesota Basins (Wall and Pearson 2013). However, atmospheric deposition N loads are relatively small compared to WWTP effluent or agricultural runoff N loads.

Agricultural drainage in the LMRB accounts for 23% of the source of nitrogen (Figure 15). This is an average across the basin and is the most local data analyzed for nitrogen sources. As with the other cited nitrogen sources, further analysis would have to be done to determine watershed specific approximations of contribution.

3.5.3 Sediment (Turbidity/Total Suspended Solids)

3.5.3.1 Permitted Sources

The regulated sources of TSS within the watersheds of the TSS impairments addressed in this TMDL study include the NPDES Permitted WWTP effluent, potential future municipal stormwater, construction stormwater, and industrial stormwater. The TSS loads from wastewater and stormwater runoff were accounted for using the methods described in Section 4.1.1.2 below.

3.5.3.2 Non-permitted Sources

Several investigations related to sediment source apportionment have been conducted within the past 5 to 15 years for watershed areas in southeast Minnesota and in the RRW. These studies have generally involved sediment "fingerprinting" through the geochemical analysis of sediments and the representation of distinct sediment sources within the HSPF models developed for the MPCA (TetraTech 2013). In a literature review conducted in 2013, LimnoTech examined the following:

- Sediment fingerprinting for Lake Pepin and its tributary systems (Kelly and Nater 2000, Schottler et al. 2010);
- Minnesota River HSPF model development and calibration (TetraTech 2009);
- Sediment fingerprinting for the Le Sueur Watershed (Belmont 2012);
- Sediment fingerprinting for source and transport pathways in the Root River (Belmont 2011, Stout 2012); and
- Root River HSPF model development and calibration (TetraTech 2013).

A summary of general findings of the literature review:

- Overall sediment delivery from tributaries to the Upper Mississippi River in southeast Minnesota has increased substantially since European settlement and the onset of agricultural activities in the tributary watersheds;
- The contribution of sediments derived from "field" sheet and rill erosion is typically less than half of the total sediment delivery, and may be as low as ~20% in watersheds where bluff, ravine, and/or stream bank erosion are particularly significant; and
- The relative contributions of "non-field" sources of sediment to the overall watershed sediment yield appears to be increasing over time, with a likely link to the "flashier" hydrology (i.e., rapidly increasing and decreasing flow volumes) resulting from agricultural land use and associated drainage and urban development (LimnoTech 2013).

Sediment Budget

Development of a RRW sediment budget was completed in 2016 as a MDA Clean Water Fund project. Researchers from Utah State University and Winona State University used sediment fingerprinting to identify sediment source contributions. Their main findings were that recent agricultural soil erosion and streambank erosion are prominent sediment sources in the RRW. They found that the Root River has very active river channels with access to easily erodible banks. And, that sediment concentrations increase with river flow at a greater rate in the RRW than almost any other river in Minnesota (Dogwiler and Belmont 2016).

Sediment fingerprinting provides key information regarding the relative contributions of different sources as well as transport pathways through the landscape. Radionuclides were analyzed to apportion sediment sources at five locations in the Root River. Analysis of the geomorphology and hydrology of the watershed in combination with fingerprinting results demonstrated that the three major sediment sources to the Root River are agricultural fields, floodplains and hillslopes. Quantitative source apportionment was found to be more appropriate on the scale of subwatersheds, as opposed to one conclusion that applied to the whole RRW. This is because local source fingerprints could be matched to local suspended sediment concentrations at a subwatershed level, making it a more accurate analysis. It was found that near-channel sources are currently the dominant supplier of excess sediment in the Root River (Stout et al. 2014).

4 TMDL Development

4.1 Watershed TMDLs Overview

This section presents the overall approach to estimating the components of the TMDL. The pollutant sources were first identified and estimated in the pollutant source assessment. The loading capacity (TMDL) of each stream was then estimated using a stream LDC and was divided among the WLAs and LAs. A TMDL for a waterbody that is impaired as the result of excessive loading of a particular pollutant can be described by the following equation:

$$\boxed{\mathbf{TMDL = LC = \sum WLA + \sum LA + MOS + RC}}$$

Where:

Loading capacity (LC): the greatest pollutant load a waterbody can receive without violating water quality standards;

Wasteload allocation (WLA): the pollutant load that is allocated to point sources, including WWTPs, regulated construction stormwater, and regulated industrial stormwater, all covered under NPDES permits for a current or future permitted pollutant source;

Load allocation (LA): the pollutant load that is allocated to sources not requiring NPDES permit coverage, including non-regulated stormwater runoff, atmospheric deposition, and internal loading;

Margin of Safety (MOS): an accounting of uncertainty about the relationship between pollutant loads and receiving water quality;

Reserve Capacity (RC): the portion of the loading capacity attributed to the growth of existing and future load sources.

4.1.1 Loading Capacity

In 2013, Tetra Tech completed development of the HSPF models for the entire RRW (Tetra Tech 2013). The HSPF model was supported by the SWAT (Soil and Water Assessment Tool) models of three subwatersheds within the RRW. Simulated flow data from the HSPF model was used in the development of these TMDLs since actual flow data was not available across the watershed.

The loading capacities for impaired stream reaches receiving a TMDL as a part of this study were determined using the LDCs. Flow duration curves (FDCs) were developed based on data collected in recent years from gaging stations throughout the watershed, or by using the HSPF simulated flows. For the AUIDs that needed to use flow records generated from the RRW HSPF model, the period of 1996 through 2010 were used to develop the FDCs. Stream flow data used to construct the FDCs and estimate bacteria, the TSS, and nitrate loads were recorded at various gaging locations throughout the watershed, or based on the HSPF generated flow records.

The FDCs and LDCs are used to determine the flow conditions (flow regimes) under which exceedances occur. The FDCs provide a visual display of the variation in flow rate for the stream. The x-axis of the plot indicates the percentage of time that a flow exceeds the corresponding flow rate as expressed by the y-axis. The LDCs take the flow distribution information constructed for the stream and factor in pollutant loading to the analysis. A standard curve is developed by applying a particular pollutant standard or criteria to the stream FDCs and is expressed as a load of pollutant per day. The standard curve represents the upper limit of the allowable in-stream pollutant load (loading capacity) at a particular flow. Monitored loads of a pollutant are plotted against this curve to display how they compare to the standard. Monitored values that fall above the curve represent an exceedance of the standard.

4.1.1.1 Bacteria (*E. coli*)

The *E. coli* data were from grab samples collected by the Fillmore SWCD and the MPCA between 2007 and 2009; they represent current conditions in the watershed.

Stream flow data paired with *E. coli* measurements allowed exceedances to be evaluated by flow regime which, in turn, provided insight into potential sources. The loading capacities were determined by applying the *E. coli* water quality standard (126 org/ 100 mL) to the FDC to produce a bacteria standard curve. Loading capacities were calculated as the median value of the *E. coli* load (in billion org/day) along the bacteria standard curve within each flow regime. A TMDL summary table is provided for each impaired AUID Section 4.2.

Baseline: *E. coli* TMDLs are based on data from the period 2007-2009. Any activities implemented during or after 2009 that lead to a reduction in loads or an improvement in an impaired stream water quality may be considered as progress towards meeting a WLA or LA.

4.1.1.2 Turbidity/Total Suspended Solids

The TSS data were from grab samples collected by Fillmore SWCD and the MPCA between 1999 and 2012; they represent current conditions in the watershed.

The loading capacities were determined by applying the TSS water quality standard (10 mg/L for class 2A waters and 65 mg/L for class 2B waters) to the FDC to produce a TSS standard curve. The TSS loading capacities were calculated as the median load (in tons/day) along the TSS standard curve within each flow regime. A TSS TMDL summary table is provided for each impaired AUID Section 4.2.

Baseline: the TSS TMDLs are based on data from the period 1999-2012. Any activities implemented during or after 2012 that lead to a reduction in loads or an improvement in an impaired stream water quality may be considered as progress towards meeting a WLA or LA.

4.1.1.3 Nitrate

Nitrate data were from grab samples collected by Fillmore SWCD and the MPCA between 1999 and 2011; they represent current conditions in the watershed.

Stream flow data paired with nitrate measurements allowed exceedances to be evaluated by flow regime which, in turn, provided insight into potential sources. The loading capacities were determined by applying the nitrate water quality standard (10 mg/L) to the FDC to produce a nitrate standard curve. Loading capacities were calculated as the median value of the nitrate load (in lbs/day) along the nitrate standard curve within each flow regime. A nitrate TMDL summary table is provided for each impaired AUID Section 4.2.

Baseline: the Nitrate TMDLs are based on data from the period 2001-2011. Any activities implemented during or after 2011 that lead to a reduction in loads or an improvement in an impaired stream water quality may be considered as progress towards meeting a WLA or LA.

4.1.2 Load Allocation Methodology

The LAs represent the portion of the loading capacity that is designated for non-regulated sources of pollution. The remainder of the loading capacity after subtraction of the MOS and calculation of the WLA was used to determine the LA for each impaired stream, on an areal basis. The LAs address the following source contributions:

<u>Bacteria</u>

As discussed in detail in Section 3.5.1, sourcing bacteria is complex. Stream flow and precipitation are positively correlated to bacteria concentrations. Also, continuous sources (e.g., failing septics, WWTPs, etc.) are dominant at base and low flow regimes, but weather-driven sources are dominant at high flow regimes. There are three main source categories of bacteria: urban and rural stormwater; livestock facilities and manure application; and SSTSs.

<u>Nitrate</u>

As discussed in detail in Section 3.5.2, Southeastern Minnesota trout streams show a strong linear relationship to row crop land use. Leaching loss from agricultural lands to GW is the primary transport mechanism for loading nitrate to these trout streams of the RRW. Natural background and atmospheric deposition of nitrate are relatively small contributors when compared to other sources.

<u>TSS</u>

As discussed in detail in Section 3.5.3, three major sediment sources were determined using sediment fingerprinting in the RRW: hillslopes, agricultural fields, and floodplains. The dominant supplier of excess sediment was found to be all near-channel sources (Stout et al, 2014). These conclusions agree with a previous study that concluded the relative contribution of non-field sources of sediment appear to be increasing over time (LimnoTech 2013).

4.1.3 Wasteload Allocation Methodology

4.1.3.1 MS4 Regulated Stormwater

Stormwater from an MS4 - a conveyance or system of conveyances (roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, storm drains) - is regulated by the NPDES Permits for all mandatory, designated, or petition MS4s. The one future MS4 in the project area will be a mandatory MS4s, which is based on the U.S. Census definition of an urbanized area: a land area comprising one or more places ("central places") and the adjacent densely settled surrounding area ("urban fringe") that together have a residential population of at least 50,000 and a density of at least 1,000 people per square mile. The definition also includes any other public storm sewer system located fully or partially within an urbanized area.

There are no current regulated MS4 communities located within the drainage area of the impaired streams included in this TMDL report. However, the city of Stewartville (City) was given a future WLA within the applicable bacteria and TSS TMDL calculations because it is possible they will become a MS4 following the 2020 census. This future allocation will avoid the need for a load transfer if they do become regulated. Allocations for this MS4 were determined by the following:

(Total LA per AUID – MOS – NPDES allocation) x % land area MS4 contributes in each AUID where, % land area was calculated using GIS based on a future land use map layer obtained from the city of

Stewartville. Agricultural and open space land use categories were excluded from these calculations. A total of 11 impaired AUIDs receive water from the City (Table 30). In this calculation, the NPDES refers to the WWTP and industrial portions.

Table 30. RRW impaired AUIDs downstream of the city of Stewartville and their future WLAs.

AUID (07040008-)	Area Acres	MS4 applicable acres	MS4 % catchment
717	62387.76	90.87	0.15%
F46	3699.54	302.33	8.17%
716	125459.16	3401.77	2.71%
501	1065382.27	3794.97	0.36%
502	1033375.21	3794.97	0.37%
520	800593.41	3794.97	0.47%
522	748262.80	3794.97	0.51%
527	635204.60	3794.97	0.60%
528	395581.2692	3794.97	0.96%
534	317036.7481	3794.97	1.20%
535	148439.4399	3794.97	2.56%

4.1.3.2 Regulated Construction and Industrial Stormwater

For the TSS and nitrate TMDL calculations, construction stormwater and industrial stormwater were lumped together into a categorical WLA based on an approximation of the land area covered by those activities. To account for these sources, for which the MPCA does not have readily accessible acreage data, as well as reserve capacity (to allow for the potential of higher rates of construction and additional industrial facilities), this TMDL assumes 0.1% of the land area for a combined construction and industrial stormwater category. The allocation to this category is made after the MOS is subtracted from the total loading capacity. That remaining capacity is divided up between construction and industrial stormwater, permitted MS4s, and all of the nonpoint sources (the LA) based on the percent land area covered.

This allocation was not included in bacteria TMDL calculations. The *E. coli* is not a typical pollutant from construction sites. To clarify, this means construction stormwater was not assigned a 0.0, but instead a WLA was not assigned which is an important distinction. The WLAs for regulated industrial stormwater were also not developed. Industrial stormwater must receive a WLA only if the pollutant is part of benchmark monitoring for an industrial site in the watershed of an impaired water body, per the MPCA programmatic requirements. There are no *E. coli* benchmarks associated with the industrial stormwater permit (permit MNR050000).

An additional individual industrial stormwater WLA was given within the TSS TMDL calculations for Pro-Corn POET Biorefining (permit MN0064017). The facility has two outfalls (SD002 and SD003) that were given separate allocations. These allocations were determined by calculating the average annual net precipitation, multiplied by the catchment acreages (13 and 10 acres, respectively) and the average monthly limit of 30 mg/L, and dividing that value by the average operational design number of discharge days per year. The precipitation value of 34 inches was determined as the 1985-2015 average for southeast Minnesota from [NOAA's time series data](). The evaporation value of 27 inches was determined as the 1985 to 2014 average pan evaporation for Waseca of 39 inches, using Minnesota Department of Natural Resources (DNR) online resource of [past climate data](), multiplied by a typical pan coefficient of 0.7, according to [University of Minnesota Technical Bulletin 322](). The average operational design number of discharge days per year was determined as the average of the annual discharge days from 2010 through 2014 (20 and 30 days, respectively), including the months during which the TSS water quality standard does not apply (October through March). It should be noted that these TSS individual WLAs for outfalls SD002 and SD003 were included as permit limits in the 2015 permit reissuance.

4.1.3.3 Regulated Wastewater

An individual WLA was provided for all the NPDES-permitted WWTPs whose surface discharge stations fall within an impaired stream subwatershed. The WLA was calculated as the permitted discharge concentration multiplied by the permitted facility design flow. Continuously discharging municipal WWTP WLAs were calculated based on the average wet weather design flow, equivalent to the wettest 30-days of influent flow expected over the course of a year. Municipal controlled (pond) discharge WWTP WLAs were calculated based on the maximum daily volume that may be discharged in a 24-hour period. There are a total of 20 NPDES permitted WWTPs located with the drainage area of the impaired streams.

In addition to these, a WLA was written for eight industrial facilities. Discharges from these facilities are regulated under the NPDES permitting. The WLA for each facility was calculated as the permitted discharge concentration multiplied by the permitted facility design flow. Municipal and industrial wastewater NPDES permitted facilities and the WLAs for the TSS and bacteria are summarized in Table 31.

Bacteria

An individual WLA was provided for all the NPDES permitted WWTPs that have fecal coliform discharge limits (200 org/100mL, April 1 through October 31) and whose surface discharge stations fall within an impaired stream subwatershed. The WLA was calculated as the pollutant effluent limit multiplied by the permitted facility design flow. Continuously discharging municipal WWTP WLAs were calculated based on the average wet weather design flow, equivalent to the wettest 30-days of influent flow expected over the course of a year. Municipal controlled (pond) discharge WWTP WLAs were calculated based on the maximum daily volume that may be discharged in a 24-hour period.

The WLAs are based on *E. coli* loads even though the facilities' discharge limits are based on fecal coliform. If a discharger is meeting the fecal coliform limits of their permit, it is assumed that they are also meeting the *E. coli* WLA in these TMDLs. Expanding and new dischargers permitted at the fecal coliform limit will be added to the *E. coli* WLA via the NPDES Permit public notice process.

The CAFOs in the RRW were assigned a WLA of 0. Their role as a source of bacteria is discussed in Section 3.6.2.1. By assigning the allowable load to 0, it sets the strictest requirements for CAFOs - i.e., they are not allowed to discharge manure to surface waters, which should not occur if permit language governing them are properly followed.

Nitrate

There are two NPDES permitted WWTPs located within the drainage area of a nitrate impaired stream: Fountain WWTP (MN0050873) and Ostrander WWTP (MN0024449). Both facilities have been given a permit limit of 10 mg/L nitrate-N. Fountain has a WLA of 2.35 kg/day and Ostrander WWTP has a WLA of 1.14 kg/day. The WLA was calculated as the water quality standard for nitrate (10 mg/L) multiplied by the permitted facility design flow. Continuously discharging municipal WWTP WLAs were calculated based on the average wet weather design flow, equivalent to the wettest 30-days of influent flow expected over the course of a year.

TSS

Minnesota's TSS water quality standard is intended to protect aquatic life from the damaging effects of inorganic non-volatile suspended solids (NVSS) to the gills and filter feeding organs of fish and aquatic invertebrates. TSS associated with municipal wastewater discharges are predominantly organic volatile suspended solids (VSS) which do not tend to persist in the environment. The WLAs developed for these TMDLs will be expressed in terms of the TSS. The NPDES Permits for WWTPs may contain water quality based effluent limits that account for the NVSS characteristics of the discharge. Such limits would be consistent with the assumptions and requirements of the TMDLs' WLAs.

Table 31. TSS and bacteria permit limits and WLAs for individual NPDES Permit holders located with the drainage area of impaired streams.

Facility Name	NPDES Permit #	TSS permit limit (mg/L)*	TSS WLA (tons/day)	Bacteria limit	Bacteria WLA (billion orgs/day)
Canton WWTP	MN0023001	30	0.01	126	0.310
Chatfield WWTP	MN0021857	30	0.06	126	2.323
Dexter WWTP	MNG580228	45	0.01	126	1.321
Foremost Farms USA Cooperative	MN0001333	NA	NA	NA	NA
Fountain WWTP	MN0050873	30	0.01	126	0.296
Grand Meadow WWTP	MN0023558	45	0.02	126	4.974
Great River Energy - Pleasant Valley	MN0067717	30	0.015	NA	NA
Haven Hutterian Brethren	MNG580071	45	0.002	126	0.458
Hokah WWTP	MN0021458	30	0.01	126	0.486
Houston WWTP	MN0023736	30	0.03	126	1.192

Facility Name	NPDES Permit #	TSS permit limit (mg/L)*	TSS WLA (tons/day)	Bacteria limit	Bacteria WLA (billion orgs/day)
Lanesboro Public Utilities - Light Plant	MNG255021	NA	NA	NA	NA
Lanesboro WWTP	MN0020044	30	0.01	126	0.525
Lewiston WWTP	MN0023965	30	0.04	126	1.192
Mabel WWTP	MN0020877	30	0.02	126	0.901
DNR Lanesboro State Fish Hatchery	MN0004430	30	1.52	NA	NA
DNR Peterson State Fish Hatchery	MN0061221	30	0.80	NA	NA
Milestone Materials – Panhandle Quarry	MNG490081-SD121	30	0.49	NA	NA
Milestone Materials - Stewartville I-90 Quarry 496	MN0069531 and MNG490081-SD120	30	0.49	NA	NA
MNDOT Enterprise Rest Area	MN0048844	45	0.001	126	0.114
MNDOT High Forest Rest Area	MN0044377	30	0.0004	126	0.016
Ostrander WWTP	MN0024449	30	0.005	126	0.188
Peterson WWTP	MN0024490	30	0.01	126	0.238
Preston WWTP	MN0020745	30	0.04	126	1.869
Pro-Corn LLC dba POET Biorefining - Preston; (Station SD001)	MN0064017	30	0.16	NA	NA
Racine WWTP	MN0024554	45	0.03	126	0.777
Rushford WWTP	MN0024678	30	0.04	126	1.574
Spring Valley WWTP	MN0051934	30	0.11	126	4.464
Stewartville WWTP	MN0020681	30	0.13	126	5.300
Wykoff WWTP	MN0020826	30	0.01	126	0.234

*permit limits are independent of river water quality standards

4.1.4 Margin of Safety

Bacteria

An explicit MOS equal to 10% of the loading capacity was used for the stream TMDLs based on the following considerations:

- Most of the uncertainty in flow is a result of extrapolating flows from the hydrologically-nearest stream gage. The explicit MOS, in part, accounts for this.
- Allocations are a function of flow, which varies from high to low flows. This variability is accounted for through the development of a TMDL for each of five flow regimes.
- With respect to the *E. coli* TMDLs, the load duration analysis does not address bacteria re-growth in sediments, die-off, and natural background levels. The MOS helps to account for the variability associated with these conditions.

Nitrate and TSS

An explicit MOS equal to 10% of the loading capacity was used for the stream TMDLs based on the following considerations:

- Most of the uncertainty in flow is a result of extrapolating flows from the hydrologically-nearest stream gage. The explicit MOS, in part, accounts for this.
- Allocations are a function of flow, which varies from high to low flows. This variability is accounted for through the development of a TMDL for each of five flow regimes.

4.1.5 Seasonal Variation

Bacteria

Use of these water bodies for aquatic recreation occurs from April through October, which includes all or portions of the spring, summer, and fall seasons. The *E. coli* loading varies with the flow regime and season. Spring is associated with large flows from snowmelt, the summer is associated with the growing season as well as periodic storm events and receding streamflows, and the fall brings increasing precipitation and rapidly changing agricultural landscapes.

Critical conditions and seasonal variation are addressed in this TMDL through several mechanisms. The *E. coli* standard applies during the recreational period, and data was collected throughout this period. The water quality analysis conducted on these data evaluated variability in flow through the use of five flow regimes: from high flows, such as flood events, to low flows, such as baseflow. Through the use of the LDCs and monthly summary figures, the *E. coli* loading was evaluated at actual flow conditions at the time of sampling (and by month), and the monthly *E. coli* concentrations were evaluated against precipitation and streamflow.

Nitrate

Critical conditions and seasonal variation are addressed in this TMDL through several mechanisms. The nitrate standard applies year-round, and data was collected throughout this period. The water quality analysis conducted on these data evaluated variability in flow through the use of five flow regimes: from high flows, such as flood events, to low flows, such as baseflow. Through the use of the LDCs and monthly summary figures, nitrate loading was evaluated at actual flow conditions at the time of sampling (and by month), and monthly nitrate concentrations were evaluated against precipitation and streamflow.

TSS

The TSS water quality standard applies for the period April through September, which corresponds to the open water season when aquatic organisms are most active and when the high stream TSS concentrations generally occur. The TSS loading varies with the flow regime and season. Spring is associated with large flows from snowmelt, the summer is associated with the growing season as well as periodic storm events and receding streamflows, and the fall brings increasing precipitation and rapidly changing agricultural landscapes.

Critical conditions and seasonal variation are addressed in this TMDL through several mechanisms. The TSS standard applies during the open water months, and data was collected throughout this period. The water quality analysis conducted on these data evaluated variability in flow through the use of five flow regimes: from high flows, such as flood events, to low flows, such as baseflow. Through the use of the LDCs and monthly summary figures, the TSS loading was evaluated at actual flow conditions at the time of sampling (and by month).

4.1.6 Summary of impairments not addressed with TMDL calculations

As noted elsewhere in this report, there were 26 AUIDs listed on the 2012 303d list with aquatic life as the affected designated use, where a TMDL calculation was not deemed appropriate to calculate and include in this report. Many of these decisions were based on determinations made during the SID Study (MPCA 2014b). Some examples of causal analysis that led to these determinations: 1) nitrate concentrations were determined to be high enough to stress the biotic community, but did not exceed the current water quality standard. This occurred on cold and warm water streams; on warm water streams, there was not a standard to apply. 2) DO and/or temperature were determined as conclusive stressor(s) to the biotic community. In the case of the DO, no pollutant linkages were confirmed while temperature issues need further investigation; additional monitoring was recommended for both. 3) For aquatic life use impairments for which physical habitat and physical connectivity were found to be the stressors and cause of the impairment, a TMDL cannot be calculated because they are non-pollutant stressors. While these types and causes of impairments were not appropriate for TMDL development, they were addressed in the Root River WRAPS report.

4.2 TMDL Summary Tables

All of the summary tables for the RRW are found within this section, organized by 10-HUC. The LDCs that formed the basis of these allocations can be found in Appendix A. A comparison of observed loads and the TMDL loads is provided in Appendix B. Mid-points of the five flow zones on the LDC TMDL continuum were compared to the loads calculated using the 90th percentile water quality value for the respective flow zones. Not all the AUIDs have a rich data set. In cases of only one observed data point, no percent reduction is given (NA placed in table). It should be noted that because the TSS is not a direct or integrative measure of aquatic life use support, it does not follow that a simple comparison of observed to allowable loads translates directly to a management or restoration goal. Rather, the magnitude, frequency and seasonality of exceedances should be considered in a greater context of restoration study and planning. Finally, the standards have different requirements for how often they need to be met, and those are not factored into these percentages (e.g., the TSS standard needs to be met 90% of the time).

4.2.1 Root River (Lower)

The downstream-most HUC-10 of the RRW had three impaired AUIDs, with three pollutants, (one *E.coli* and two TSS), addressed in this report (Table 32, Table 33, Table 34).

Table 32. Root River (Lower) (07040008-501) The TSS TMDL allocations.

Root River AUID 07040008-501 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		tons/day				
TSS Loading Capacity (TMDL)		**521.44**	**256.59**	**191.57**	**155.44**	**120.98**
Wasteload Allocation (WLA) Components	Permitted Municipal and Industrial Wastewater Facilities*	10.85	10.85	10.85	10.85	10.85
	Permitted Industrial Stormwater Facilities*	0.02	0.02	0.02	0.02	0.02
	Construction and Industrial Stormwater	0.47	0.23	0.17	0.14	0.11
	City of Stewartville MS4 (future)	1.63	0.78	0.58	0.46	0.35
	Total WLA	**12.97**	**11.88**	**11.62**	**11.47**	**11.33**
Load Allocation		**456.33**	**219.05**	**160.79**	**128.42**	**97.55**
Margin of Safety		**52.14**	**25.66**	**19.16**	**15.54**	**12.10**

*see Table 62 in Appendix C.

Table 33. Root River (Lower) (07040008-502) The TSS TMDL allocations.

Root River AUID 07040008-502 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		tons/day				
TSS Loading Capacity (TMDL)		**474.53**	**240.93**	**167.66**	**126.28**	**77.52**
Wasteload Allocation (WLA) Components	Permitted Municipal and Industrial Wastewater Facilities*	10.85	10.85	10.85	10.85	10.85
	Permitted Industrial Stormwater Facilities*	0.02	0.02	0.02	0.02	0.02
	Construction and Industrial Stormwater	0.43	0.22	0.15	0.11	0.07
	City of Stewartville MS4 (future)	1.53	0.76	0.51	0.38	0.22
	Total WLA	**12.83**	**11.84**	**11.54**	**11.36**	**11.16**
Load Allocation		**414.25**	**204.99**	**139.36**	**102.29**	**58.61**
Margin of Safety		**47.45**	**24.09**	**16.77**	**12.63**	**7.75**

*see Table 62 in Appendix C.

Table 34. Thompson Creek (07040008-507) *E. coli* TMDL allocations.

Thompson Creek AUID 07040008-507 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		Billions of Organisms/day				
***E. coli* Loading Capacity (TMDL)**		**18.89**	**1.82**	**0.66**	**0.44**	**0.17**
Wasteload Allocation (WLA) Components	NPDES	NA	NA	NA	NA	NA
	Total WLA	**NA**	**NA**	**NA**	**NA**	**NA**
Load Allocation		**17.00**	**1.64**	**0.59**	**0.40**	**0.15**
10% Margin of Safety		**1.89**	**0.18**	**0.07**	**0.04**	**0.02**

4.2.2 City of Rushford Root River

The city of Rushford Root River 10-HUC had three impairments, with three pollutants, all TSS, addressed in this report (Table 35, Table 36, Table 37).

Table 35. Root River (07040008-520) TSS TMDL allocations.

Root River AUID 07040008-520 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		tons/day				
TSS Loading Capacity (TMDL)		**418.40**	**199.61**	**130.27**	**91.57**	**56.58**
Wasteload Allocation (WLA) Components	Permitted Municipal and Industrial Wastewater Facilities*	9.68	9.68	9.68	9.68	9.68
	Permitted Industrial Stormwater Facilities*	0.02	0.02	0.02	0.02	0.02
	Construction and Industrial Stormwater	0.38	0.18	0.12	0.08	0.05
	Stewartville MS4 (future)	1.74	0.81	0.51	0.34	0.20
	Total WLA	**11.82**	**10.69**	**10.33**	**10.13**	**9.95**
Load Allocation		**364.75**	**168.97**	**106.92**	**72.28**	**40.98**
Margin of Safety		**41.84**	**19.96**	**13.03**	**9.16**	**5.66**

*see Table 63 in Appendix C.

Table 36. Root River (07040008-522) TSS TMDL allocations.

Root River AUID 07040008-522 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		tons/day				
TSS Loading Capacity (TMDL)		**409.18**	**190.97**	**123.35**	**85.14**	**51.91**
Wasteload Allocation (WLA) Components	Permitted Municipal and Industrial Wastewater Facilities*	9.65	9.65	9.65	9.65	9.65
	Permitted Industrial Stormwater Facilities*	0.02	0.02	0.02	0.02	0.02
	Construction and Industrial Stormwater	0.37	0.17	0.11	0.08	0.05
	Stewartville MS4 (future)	1.82	0.82	0.51	0.34	0.19
	Total WLA	**11.86**	**10.66**	**10.30**	**10.09**	**9.90**
Load Allocation		**356.41**	**161.21**	**100.72**	**66.54**	**36.82**
Margin of Safety		**40.92**	**19.10**	**12.33**	**8.51**	**5.19**

*see Table 64 in Appendix C.

Table 37. Root River (07040008-527) TSS TMDL allocations.

Root River AUID 07040008-527 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		tons/day				
TSS Loading Capacity (TMDL)		**366.83**	**157.03**	**96.49**	**60.05**	**32.17**
Wasteload Allocation (WLA) Components	Permitted Municipal and Industrial Wastewater Facilities*	9.62	9.62	9.62	9.62	9.62
	Permitted Industrial Stormwater Facilities*	0.02	0.02	0.02	0.02	0.02
	Construction and Industrial Stormwater	0.33	0.14	0.09	0.05	0.03
	Stewartville MS4 (future)	1.91	0.79	0.46	0.27	0.12
	Total WLA	**11.89**	**10.57**	**10.19**	**9.96**	**9.78**
Load Allocation		**318.26**	**130.76**	**76.66**	**44.08**	**19.17**
Margin of Safety		**36.68**	**15.70**	**9.65**	**6.00**	**3.22**

*see Table 65 in Appendix C.

4.2.3 Trout Run Root River

Trout Run Root River 10-HUC had three impairments, with three pollutants, (two *E. coli* and one TSS), addressed in this report (Table 38, Table 39, Table 40).

Table 38. Trout Run Creek (07040008-G88) *E. coli* TMDL allocations.

Trout Run Creek AUID 07040008-G88 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		Billions of Organisms/day				
E. coli Loading Capacity (TMDL)		158.95	122.27	105.96	65.21	52.98
Wasteload Allocation (WLA) Components	Permitted Facilities	NA	NA	NA	NA	NA
	Total WLA	NA	NA	NA	NA	NA
Load Allocation		143.06	110.04	95.36	58.69	47.68
Margin of Safety		15.90	12.23	10.60	6.52	5.30

Table 39. Middle Branch Root River (0704008-528) TSS TMDL allocations.

Root River Middle Branch AUID 07040008-528 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		tons/day				
TSS Loading Capacity (TMDL)		241.57	98.26	58.71	34.11	16.75
Wasteload Allocation (WLA) Components	Permitted Municipal and Industrial Wastewater Facilities*	8.36	8.36	8.36	8.36	8.36
	Permitted Industrial Stormwater Facilities*	NA	NA	NA	NA	NA
	Construction and Industrial Stormwater	0.22	0.09	0.05	0.03	0.02
	Stewartville MS4 (future)	2.01	0.77	0.43	0.21	0.06
	Total WLA	10.58	9.22	8.84	8.61	8.44
Load Allocation		206.83	79.21	44.00	22.10	6.64
Margin of Safety		24.16	9.83	5.87	3.41	1.68

*see Table 66 in Appendix C.

Table 40. Middle Branch Root River (07040008-534) *E. coli* TMDL allocations.

Middle Branch Root River AUID 07040004-534 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		Billions of Organisms/day				
***E. coli* Loading Capacity (TMDL)**		**3405.76**	**1350.05**	**797.85**	**456.95**	**221.36**
Wasteload Allocation (WLA) Components	Permitted Municipal and Industrial Wastewater Facilities*	19.87	19.87	19.87	19.87	19.87
	Permitted Industrial Stormwater Facilities	NA	NA	NA	NA	NA
	Stewartville MS4 (future)	36.45	14.31	8.36	4.68	2.15
	Total WLA	**56.32**	**34.17**	**28.22**	**24.55**	**22.01**
Load Allocation		**3008.86**	**1180.87**	**689.84**	**386.70**	**177.21**
Margin of Safety		**340.58**	**135.01**	**79.79**	**45.70**	**22.14**

*see Table 67 in Appendix C.

4.2.4 Middle Branch Root River

The Middle Branch Root River had four impaired AUIDs with four pollutants, all *E.coli*, addressed in this report (Table 41, Table 42, Table 43, Table 44).

Table 41. Middle Branch Root River (07040008-506) *E. coli* TMDL allocations.

Middle Branch Root River AUID 07040008-506 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		Billions of Organisms/day				
***E. coli* Loading Capacity (TMDL)**		**1708.14**	**712.58**	**439.66**	**264.04**	**139.72**
Wasteload Allocation (WLA) Components	Permitted Municipal and Industrial Wastewater Facilities*	10.45	10.45	10.45	10.45	10.45
	Permitted Industrial Stormwater Facilities	NA	NA	NA	NA	NA
	Total WLA	**10.45**	**10.45**	**10.45**	**10.45**	**10.45**
Load Allocation		**1526.88**	**630.87**	**385.25**	**227.19**	**115.30**
Margin of Safety		**170.81**	**71.26**	**43.97**	**26.40**	**13.97**

*see Table 68 in Appendix C.

Table 42. Bear Creek (07040008-542) *E. coli* TMDL allocations.

Bear Creek AUID 07040008-542 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		Billions of Organisms/day				
E. coli Loading Capacity (TMDL)		734.88	303.56	187.14	111.32	58.98
Wasteload Allocation (WLA) Components	Racine WWTP (MN0024554)	0.78	0.78	0.78	0.78	0.78
	Total WLA	0.78	0.78	0.78	0.78	0.78
Load Allocation		660.61	272.43	167.65	99.41	52.30
Margin of Safety		73.49	30.36	18.71	11.13	5.90

Table 43. Deer Creek (07040008-546) *E. coli* TMDL allocations.

Deer Creek AUID 07040008-546 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		Billions of Organisms/day				
E. coli Loading Capacity (TMDL)		428.87	179.59	111.81	67.07	36.33
Wasteload Allocation (WLA) Components	Grand Meadow WWTP (MN0023558)	4.97	4.97	4.97	4.97	4.97
	Total WLA	4.97	4.97	4.97	4.97	4.97
Load Allocation		381.01	156.66	95.65	55.39	27.72
Margin of Safety		42.89	17.96	11.18	6.71	3.63

Table 44. Spring Valley Creek (07040008-548) *E. coli* TMDL allocations.

Spring Valley Creek AUID 07040008-548 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		Billions of Organisms/day				
E. coli Loading Capacity (TMDL)		224.24	94.01	58.03	35.44	18.64
Wasteload Allocation (WLA) Components	Spring Valley WWTP (MN0051934)	4.46	4.46	4.46	4.46	4.46
	Total WLA	4.46	4.46	4.46	4.46	4.46
Load Allocation		197.35	80.15	47.76	27.43	12.31
Margin of Safety		22.42	9.40	5.80	3.54	1.86

4.2.5 North Branch Root River

The North Branch Root River had four impaired AUIDs and four pollutants (two *E.coli* and two TSS) addressed in this report (Table 45, Table 46, Table 47, Table 48).

Table 45. Root River (07040008-535) *E. coli* TMDL allocations.

Root River AUID 07040008-535 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		Billions of Organisms/day				
***E. coli* Loading Capacity (TMDL)**		**1873.55**	**676**	**346.35**	**177.14**	**75.49**
Wasteload Allocation (WLA) Components	Permitted Municipal and Industrial Wastewater Facilities*	9.42	9.42	9.42	9.42	9.42
	Permitted Industrial Stormwater Facilities*	NA	NA	NA	NA	NA
	Stewartville MS4 (future)	43.11	15.55	7.97	4.08	1.74
	Total WLA	**52.53**	**24.97**	**17.39**	**13.49**	**11.15**
Load Allocation		**1633.67**	**583.43**	**294.33**	**145.93**	**56.79**
10% Margin of Safety		**187.36**	**67.60**	**34.64**	**17.71**	**7.55**

*see Table 69 in Appendix C.

Table 46. Mill Creek (07040008-536) *E. coli* TMDL allocations.

Mill Creek AUID 07040008-536 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		Billions of Organisms/day				
***E. coli* Loading Capacity (TMDL)**		**58.41**	**5.03**	**1.36**	**1.08**	**0.82**
Wasteload Allocation (WLA) Components	Permitted Facilities	NA	NA	NA	NA	NA
	Total WLA	**NA**	**NA**	**NA**	**NA**	**NA**
Load Allocation		**52.57**	**4.53**	**1.22**	**0.97**	**0.74**
10% Margin of Safety		**5.84**	**0.50**	**0.14**	**0.11**	**0.08**

Table 47. North Branch Root River (07040008-716) TSS TMDL allocations.

Root River North Branch AUID 07040008-716 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		tons/day				
TSS Loading Capacity (TMDL)		**126.05**	**38.24**	**22.29**	**13.11**	**7.35**
Wasteload Allocation (WLA) Components	Permitted Municipal and Industrial Wastewater Facilities*	1.29	1.29	1.29	1.29	1.29
	Permitted Industrial Stormwater Facilities*	NA	NA	NA	NA	NA
	Construction and Industrial Stormwater	0.11	0.03	0.02	0.01	0.01
	Stewartville MS4 (future)	3.04	0.90	0.51	0.28	0.14
	Total WLA	**4.44**	**2.22**	**1.82**	**1.59**	**1.44**
Load Allocation		**109.00**	**32.19**	**18.24**	**10.21**	**5.17**
10% Margin of Safety		**12.60**	**3.82**	**2.23**	**1.31**	**0.74**

*see Table 70 in Appendix C.

Table 48. North Branch Root River (07040008-717) TSS TMDL allocations.

Root River North Branch AUID 07040008-717 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		tons/day				
TSS Loading Capacity (TMDL)		**53.24**	**16.17**	**9.42**	**5.54**	**3.11**
Wasteload Allocation (WLA) Components	Permitted Municipal and Industrial Wastewater Facilities*	1.16	1.16	1.16	1.16	1.16
	Permitted Industrial Stormwater Facilities*	NA	NA	NA	NA	NA
	Construction and Industrial Stormwater	0.048	0.015	0.008	0.005	0.003
	Stewartville MS4 (future)	0.068	0.020	0.011	0.006	0.002
	Total WLA	**1.28**	**1.19**	**1.18**	**1.17**	**1.17**
Load Allocation		**46.64**	**13.36**	**7.30**	**3.82**	**1.63**
10% Margin of Safety		**5.32**	**1.62**	**0.94**	**0.55**	**0.31**

*see Table 71 in Appendix C.

4.2.6 Rush Creek

Rush Creek had one impaired AUID and one pollutant, *E. coli*, addressed in this report (Table 49).

Table 49. Rush Creek (07040008-523) *E. coli* TMDL allocations.

Rush Creek AUID 07040008-523 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		Billions of Organisms/day				
***E. coli* Loading Capacity (TMDL)**		**398.97**	**287.83**	**237.81**	**200.64**	**155.14**
Wasteload Allocation (WLA) Components	Permitted Municipal and Industrial Wastewater Facilities*	1.31	1.31	1.31	1.31	1.31
	Permitted Industrial Stormwater Facilities*	NA	NA	NA	NA	NA
	Total WLA	**1.31**	**1.31**	**1.31**	**1.31**	**1.31**
Load Allocation		**357.77**	**257.74**	**212.72**	**179.27**	**138.32**
Margin of Safety		**39.90**	**28.78**	**23.78**	**20.06**	**15.51**

*see Table 72 in Appendix C.

4.2.7 South Branch Root River

The South Branch Root River had nine impaired AUIDs with 14 pollutants (three *E. coli*, six nitrate and five TSS) addressed in this report (Table 50, Table 51, Table 52, Table 53, Table 54, Table 55, Table 56, Table 57, Table 58).

Table 50. South Branch Root River (07040008-550) TSS and *E. coli* TMDL allocations.

Root River South Branch AUID 07040008-550 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		tons/day				
TSS Loading Capacity (TMDL)		**16.09**	**7.26**	**4.49**	**2.83**	**1.54**
Wasteload Allocation (WLA) Components	Permitted Municipal and Industrial Wastewater Facilities*	0.93	0.93	0.93	0.93	0.93
	Permitted Industrial Stormwater Facilities*	0.02	0.02	0.02	0.02	0.02
	Construction and Industrial Stormwater	0.014	0.007	0.004	0.003	0.001
	Total WLA	**0.96**	**0.96**	**0.95**	**0.95**	**0.95**
Load Allocation		**13.52**	**5.58**	**3.09**	**1.60**	**0.44**
Margin of Safety		**1.61**	**0.73**	**0.45**	**0.28**	**0.15**
		Billions of Organisms/day				
***E. coli* Loading Capacity (TMDL)**		**1838.66**	**830.32**	**513.46**	**323.77**	**176.04**
WLA	Permitted Facilities	2.88	2.88	2.88	2.88	2.88
	Total WLA	**2.88**	**2.88**	**2.88**	**2.88**	**2.88**
Load Allocation		**1651.92**	**744.41**	**459.24**	**288.52**	**155.56**
Margin of Safety		**183.87**	**83.03**	**51.35**	**32.38**	**17.60**

*see Table 73 below in Appendix C.

Table 51. Watson Creek (07040008-552) TSS, nitrate, and *E. coli* TMDL allocations.

Watson Creek AUID 07040008-552 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		tons/day				
TSS Loading Capacity (TMDL)		**1.74**	**0.79**	**0.48**	**0.29**	**0.15**
Wasteload Allocation (WLA) Components	Permitted Municipal and Industrial Wastewater Facilities*	0.01	0.01	0.01	0.01	0.01
	Permitted Industrial Stormwater Facilities*	0.02	0.02	0.02	0.02	0.02
	Construction and Industrial Stormwater	0.0016	0.0007	0.0004	0.0003	0.0001
	Total WLA	**0.03**	**0.03**	**0.03**	**0.03**	**0.03**
Load Allocation		**1.53**	**0.68**	**0.40**	**0.23**	**0.10**
Margin of Safety		**0.17**	**0.08**	**0.05**	**0.03**	**0.02**
		lbs/day				
Nitrate Loading Capacity (TMDL)		**3480.70**	**1584.86**	**969.17**	**582.38**	**298.93**
WLA Components	Permitted Municipal and Industrial Wastewater Facilities*	5.18	5.18	5.18	5.18	5.18
	Permitted Industrial Stormwater Facilities*	NA	NA	NA	NA	NA
	Construction and Industrial Stormwater	3.13	1.43	0.87	0.52	0.27
	Total WLA	**8.31**	**6.61**	**6.05**	**5.70**	**5.45**
Load Allocation		**3124.32**	**1419.77**	**866.20**	**518.44**	**263.59**
Margin of Safety		**348.07**	**158.49**	**96.92**	**58.24**	**29.89**
		Billions of Organisms/day				
***E. coli* Loading Capacity (TMDL)**		**198.93**	**90.58**	**55.39**	**33.28**	**17.08**
WLA Components	Permitted Municipal and Industrial Wastewater Facilities*	0.30	0.30	0.30	0.30	0.30
	Permitted Industrial Stormwater Facilities*	NA	NA	NA	NA	NA
	Total WLA	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**
Load Allocation		**178.74**	**81.23**	**49.56**	**29.66**	**15.08**
Margin of Safety		**19.89**	**9.06**	**5.54**	**3.33**	**1.71**

*see Table 74 in Appendix C.

Table 52. South Branch Root River (07040008-554) TSS TMDL allocations.

Root River South Branch AUID 07040008-554 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		tons/day				
TSS Loading Capacity (TMDL)		15.88	5.99	3.79	2.57	1.42
Wasteload Allocation (WLA) Components	Permitted Municipal and Industrial Wastewater Facilities*	0.05	0.05	0.05	0.05	0.05
	Permitted Industrial Stormwater Facilities*	NA	NA	NA	NA	NA
	Construction and Industrial Stormwater	0.014	0.005	0.003	0.002	0.001
	Total WLA	0.06	0.06	0.05	0.05	0.05
Load Allocation		14.23	5.33	3.36	2.26	1.23
Margin of Safety		1.59	0.60	0.38	0.26	0.14

*see Table 75 in Appendix C.

Table 53. South Branch Root River (07040008-555) TSS and nitrate TMDL allocations.

Root River South Branch AUID 07040008-555 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		tons/day				
TSS Loading Capacity (TMDL)		7.41	3.23	1.9	1.14	0.6
Wasteload Allocation (WLA) Components	Ostrander WWTP (MN0024449)	0.004	0.004	0.004	0.004	0.004
	Construction and Industrial Stormwater	0.0067	0.0029	0.0017	0.0010	0.0005
	Total WLA	0.011	0.007	0.006	0.005	0.005
Load Allocation		6.66	2.90	1.70	1.02	0.53
Margin of Safety		0.74	0.32	0.19	0.11	0.06
		lbs/day				
Nitrate Loading Capacity (TMDL)		14823.14	6456.09	3803.16	2275.14	1196.37
WLA	Ostrander WWTP (MN0024449)	2.51	2.51	2.51	2.51	2.51
	Construction and Industrial Stormwater	13.34	5.81	3.42	2.05	1.08
	Total WLA	15.85	8.32	5.94	4.56	3.59
Load Allocation		13324.97	5802.16	3416.91	2043.07	1073.14
Margin of Safety		1482.31	645.61	380.32	227.51	119.64

Table 54. South Branch Root River (07040008-556) TSS TMDL allocations.

Root River South Branch AUID 07040008-556 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		tons/day				
TSS Loading Capacity (TMDL)		**3.84**	**1.7**	**0.97**	**0.59**	**0.3**
Wasteload Allocation (WLA) Components	Ostrander WWTP (MN0024449)	0.004	0.004	0.004	0.004	0.004
	Construction and Industrial Stormwater	0.0035	0.0015	0.0009	0.0005	0.0003
	Total WLA	**0.008**	**0.006**	**0.005**	**0.005**	**0.005**
Load Allocation		**3.45**	**1.52**	**0.87**	**0.53**	**0.27**
Margin of Safety		**0.38**	**0.17**	**0.10**	**0.06**	**0.03**

Table 55. Canfield Creek (07040008-557) nitrate TMDL allocations.

Canfield Creek AUID 07040008-557 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		lbs/day				
Nitrate Loading Capacity (TMDL)		**3629.49**	**1605.74**	**984.6**	**594.75**	**311.44**
Wasteload Allocation (WLA) Components	Permitted Facilities	NA	NA	NA	NA	NA
	Construction and Industrial Stormwater	3.27	1.45	0.89	0.54	0.28
	Total WLA	**3.27**	**1.45**	**0.89**	**0.54**	**0.28**
Load Allocation		**3263.27**	**1443.72**	**885.25**	**534.74**	**280.02**
Margin of Safety		**362.95**	**160.57**	**98.46**	**59.48**	**31.14**

Table 56. Willow Creek (07040008-558) nitrate and *E. coli* TMDL allocations.

Willow Creek AUID 07040004-558 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		lbs/day				
Nitrate Loading Capacity (TMDL)		**4645.8**	**2073.19**	**1289.76**	**775.46**	**399.85**
Wasteload Allocation (WLA) Components	Permitted Facilities	NA	NA	NA	NA	NA
	Construction and Industrial Stormwater	4.18	1.87	1.16	0.70	0.36
	Total WLA	**4.18**	**1.87**	**1.16**	**0.70**	**0.36**
Load Allocation		**4177.04**	**1864.01**	**1159.62**	**697.22**	**359.51**
Margin of Safety		**464.58**	**207.32**	**128.98**	**77.55**	**39.99**
		Billions of Organisms/day				
***E. coli* Loading Capacity (TMDL)**		**265.52**	**118.49**	**73.71**	**44.32**	**22.85**
WLA	NPDES	NA	NA	NA	NA	NA
	Total WLA	**NA**	**NA**	**NA**	**NA**	**NA**
Load Allocation		**238.97**	**106.64**	**66.34**	**39.89**	**20.57**
Margin of Safety		**26.55**	**11.85**	**7.37**	**4.43**	**2.29**

Table 57. Etna Creek (07040008-562) nitrate TMDL allocations.

Etna Creek AUID 07040008-562 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		lbs/day				
Nitrate Loading Capacity (TMDL)		**752.45**	**332.84**	**191.05**	**114.65**	**59.71**
Wasteload Allocation (WLA) Components	Permitted Facilities	NA	NA	NA	NA	NA
	Construction and Industrial Stormwater	0.68	0.30	0.17	0.10	0.05
	Total WLA	**0.68**	**0.30**	**0.17**	**0.10**	**0.05**
Load Allocation		**676.53**	**299.26**	**171.77**	**103.08**	**53.69**
Margin of Safety		**75.25**	**33.28**	**19.11**	**11.47**	**5.97**

Table 58. Forestville Creek (07040008-563) nitrate and E.coli TMDL allocations

Forestville Creek AUID 07040008-563 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		lbs/day				
Nitrate Loading Capacity (TMDL)		**1852.41**	**780.07**	**473.74**	**282.99**	**148.38**
Wasteload Allocation (WLA) Components	Permitted Facilities	NA	NA	NA	NA	NA
	Construction and Industrial Stormwater	1.67	0.70	0.43	0.25	0.13
	Total WLA	**1.67**	**0.70**	**0.43**	**0.25**	**0.13**
Load Allocation		**1665.50**	**701.36**	**425.94**	**254.44**	**133.41**
Margin of Safety		**185.24**	**78.01**	**47.37**	**28.30**	**14.84**
		Billions of Organisms/day				
***E. coli* Loading Capacity (TMDL)**		**105.87**	**44.58**	**27.08**	**16.17**	**8.48**
WLA	NPDES	NA	NA	NA	NA	NA
	Total WLA	**NA**	**NA**	**NA**	**NA**	**NA**
Load Allocation		**95.28**	**40.12**	**24.37**	**14.55**	**7.63**
Margin of Safety		**10.59**	**4.46**	**2.71**	**1.62**	**0.85**

4.2.8 South Fork Root River

The South Fork Root River had three impaired AUIDs with four pollutants (one *E. coli* and three TSS) addressed in this TMDL report (Table 59, Table 60, Table 61).

Table 59. South Fork Root River (07040008-508) TSS and *E. coli* TMDL allocations

Root River South Fork AUID 07040008-508 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		tons/day				
TSS Loading Capacity (TMDL)		**53.09**	**37.40**	**31.12**	**25.40**	**14.88**
Wasteload Allocation (WLA) Components	Canton WWTP (MN0023001), Mabel WWTP (MN0020877)	0.03	0.03	0.03	0.03	0.03
	Permitted Industrial Stormwater Facilities*	NA	NA	NA	NA	NA
	Construction and Industrial Stormwater	0.048	0.034	0.028	0.023	0.013
	Total WLA	**0.078**	**0.064**	**0.058**	**0.053**	**0.043**
Load Allocation		**47.75**	**33.63**	**27.97**	**22.83**	**13.36**
Margin of Safety		**5.31**	**3.74**	**3.11**	**2.54**	**1.49**
		Billions of Organisms/day				
***E. coli* Loading Capacity (TMDL)**		**933.61**	**657.65**	**547.18**	**446.69**	**261.62**

Root River South Fork AUID 07040008-508 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		tons/day				
WLA	Canton WWTP (MN0023001), Mabel WWTP (MN0020877)	1.21	1.21	1.21	1.21	1.21
	Permitted Industrial Stormwater Facilities*	NA	NA	NA	NA	NA
	Total WLA	**1.21**	**1.21**	**1.21**	**1.21**	**1.21**
Load Allocation		**839.04**	**590.67**	**491.25**	**400.81**	**234.25**
Margin of Safety		**93.36**	**65.77**	**54.72**	**44.67**	**26.16**

*see Table 76 in Appendix C.

Table 60. South Fork Root River (07040008-509) TSS TMDL allocations.

Root River South Fork AUID 07040008-509 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		tons/day				
TSS Loading Capacity (TMDL)		**53.09**	**37.40**	**31.12**	**25.40**	**14.88**
Wasteload Allocation (WLA) Components	Canton WWTP (MN0023001), Mabel WWTP (MN0020877)	0.03	0.03	0.03	0.03	0.03
	Permitted Industrial Stormwater Facilities*	NA	NA	NA	NA	NA
	Construction and Industrial Stormwater	0.048	0.034	0.028	0.023	0.013
	Total WLA	**0.08**	**0.06**	**0.06**	**0.05**	**0.04**
Load Allocation		**47.70**	**33.60**	**27.95**	**22.81**	**13.35**
Margin of Safety		**5.31**	**3.74**	**3.11**	**2.54**	**1.49**

*see Table 77 in Appendix C.

Table 61. South Fork Root River (07040008-573) TSS TMDL allocations.

Root River South Fork AUID 07040008-573 TMDL summary.		Flow Regime				
		VHigh	High	Mod	Low	VLow
		tons/day				
TSS Loading Capacity (TMDL)		**5.36**	**1.32**	**0.53**	**0.21**	**0.02**
Wasteload Allocation (WLA) Components	Permitted Facilities	NA	NA	NA	NA	NA
	Construction and Industrial Stormwater	0.00482	0.00119	0.00048	0.00019	0.00002
	Total WLA	**0.00482**	**0.00119**	**0.00048**	**0.00019**	**0.00002**
Load Allocation		**4.82**	**1.19**	**0.47**	**0.19**	**0.02**
Margin of Safety		**0.536**	**0.132**	**0.053**	**0.021**	**0.002**

5 Future Growth

Potential changes in population and land use over time in the RRW could result in changing sources of pollutants. The city of Rochester is growing (population increased by 24.4% from 2000 through 2010 according to the U.S. Census Bureau), but it is not anticipated that the boundary of the city will enter the boundary of the RRW within the next 10 years. The number of registered feedlots is decreasing while the number of AUs per feedlot is increasing, which may result in additional NPDES permitted facilities in the watershed. Possible changes and how they may or may not impact the TMDL allocations are discussed below.

The city of Stewartville is currently not a MS4 community, but it is anticipated that it will be within the next 10 years. Therefore, it was given an allocation in the WLA of this TMDL.

5.1 New or Expanding Permitted MS4 WLA Transfer Process

Future transfer of watershed runoff loads in this TMDL may be necessary if any of the following scenarios occur within the project watershed boundaries:

1. New development occurs within a regulated MS4. The RRW does not currently have any MS4s. But, any newly developed areas must be transferred from the LA to the WLA to account for the growth. The city of Stewartville was given a MS4 future allocation in anticipation of it becoming a MS4 within the next 10 years.
2. One regulated MS4 acquires land from another regulated MS4. Examples include annexation or highway expansions. In these cases, the transfer is WLA to WLA.
3. One or more non-regulated MS4s become regulated. If this has not been accounted for in the WLA, then a transfer must occur from the LA.
4. Expansion of a U.S. Census Bureau Urban Area encompasses new regulated areas for existing permittees. An example is existing state highways that were outside an Urban Area at the time the TMDL was completed, but are now inside a newly expanded Urban Area. This will require either a WLA to WLA transfer or a LA to WLA transfer.
5. A new MS4 or other stormwater-related point source is identified and is covered under a NPDES Permit. In this situation, a transfer must occur from the LA.

Load transfers will be based on methods consistent with those used in setting the allocations in this TMDL. One transfer rate was defined for each impaired stream as the total watershed runoff LA (kg/day, tons/day or billion org/day) divided by the watershed area downstream of any upstream impaired waterbody (acres). In the case of a load transfer, the amount transferred from LA to WLA will be based on the area (acres) of land coming under permit coverage multiplied by the transfer rate (kg/ac-day or billion org/ac-day). The MPCA will make these allocation shifts. In cases where WLA is transferred from or to a regulated MS4, the permittees will be notified of the transfer and have an opportunity to comment.

5.2 New or Expanding Wastewater (TSS and *E. coli* TMDLs only)

The MPCA, in coordination with the EPA Region 5, has developed a streamlined process for setting or revising WLAs for new or expanding wastewater discharges to waterbodies with an EPA approved TMDL (MPCA 2012). This procedure will be used to update WLAs in approved TMDLs for new or expanding wastewater dischargers whose permitted effluent limits are at or below the instream target and will ensure that the effluent concentrations will not exceed applicable water quality standards or surrogate measures. The process for modifying any and all WLAs will be handled by the MPCA, with input and involvement by the EPA, once a permit request or reissuance is submitted. The overall process will use the permitting public notice process to allow for the public and EPA to comment on the permit changes based on the proposed WLA modification(s). Once any comments or concerns are addressed, and the MPCA determines that the new or expanded wastewater discharge is consistent with the applicable water quality standards, the permit will be issued and any updates to the TMDL WLA(s) will be made.

For more information on the overall process visit the MPCA's TMDL Policy and Guidance webpage.

6 Reasonable Assurance

Several federal, state and local agencies have been working and continue to work toward the goal of reducing pollutant loads in the RRW. Strong partnerships that were strengthened during the WRAPS process such as those between the counties, SWCDs, Natural Resource Conservation Service (NRCS), DNR, and U.S. Fish and Wildlife Service have and will continue to lead to watershed wide implementation of conservation practices. Civic engagement efforts initiated during the WRAPS will strengthen the relationship between the RRW peoples and the agencies which provide technical assistance and incentives to attain water quality improvements.

6.1 Non-Regulatory

Reasonable assurance that the water quality of the RRW will be improved is formulated on the following points:

- Availability of reliable means of addressing pollutant loads (i.e., the BMPs, NPDES Permits);
- A means of prioritizing and focusing management;
- Development of a strategy for implementation;
- Availability of funding to execute projects;
- A system of tracking progress and monitoring water quality response.

Accordingly, the following summary provides reasonable assurance that implementation will occur and result in phosphorus load reductions in the RRW.

- The BMPs outlined in the implementation plan for the *Revised Regional Total Maximum Daily Load Evaluation of Fecal Coliform Bacteria Impairments in the Lower Mississippi River Basin in Minnesota* have all been demonstrated to be effective in reducing transport of pathogens to surface water. This suite of practices is supported by the basic programs administered by the SWCDs and the NRCS. Local resource managers are well-trained in promoting, placing and installing these BMPs. Some watershed counties have shown significant levels of adoption of these practices. Thus, these BMPs constitute the standard means of addressing nonpoint source pollutant loads in the RRW.

- Since 2006, the Southeast Minnesota Water Resources Board (SEMNWRB) has led many efforts that were noted in the implementation plan to address bacteria reductions, including multiple projects utilizing Federal Clean Water Act Section 319 dollars. Rotational grazing incentives, feedlot improvements and unsewered community fixes are a few examples of projects completed. Efforts are still underway utilizing state and federal dollars to continue to address feedlots and unsewered/undersewered communities. The collaborative approach to funding these projects through the SEMNWRB has been a key to success. It has relieved the competitive nature that comes from applying for limited grant funds and instead promotes water resource partners in southeastern Minnesota to work together to address common problems. Discussions are taking place between these same partners to address other common problems such as the need for more technical support staff to carry out key programs, or one regional staff person that could provide GIS support to all counties in southeastern Minnesota. The SEMNWRB will ensure planning continues along these collaborative lines to help achieve goals in other aspects of water quality issues such as excess sediment and nitrogen.

- Various projects and tools provide means for identifying priority pollutant sources and focusing implementation work in the watershed:
  - Counties and SWCDs within the watershed are key partners in improving water quality. Below are links to the SWCD offices located in the Root River. Click on the links to explore what each is doing to improve water quality.
    - Fillmore SWCD: http://www.fillmoreswcd.org/staff.html
    - Mower SWCD: http://www.mowerswcd.org/index.html
    - Olmsted SWCD: http://www.co.olmsted.mn.us/pw/oswcd/Pages/default.aspx
    - Root River SWCD: http://www.co.houston.mn.us/RRSWCD/RRSWCD.aspx
    - Winona County SWCD: http://www.winonaswcd.org/
  - The state of Minnesota funded a shoreland mapping project to inventory land use in riparian areas in southeast Minnesota. The project is complete, and the information will be used in the implementation planning process to examine riparian land use in the RRW, and prioritize potential BMP installation.
  - Light Detection and Ranging (LIDAR) data are available for all of southeast Minnesota, and being increasingly used by local government units (LGU) to examine landscapes, understand water flow and dynamics, and accordingly prioritize BMP targeting.
  - Intensive Watershed Monitoring (IWM) was initiated in the RRW in 2008. Inherent in its design is geographic prioritization and focus. Encompassing site placement across the watershed allows for a full examination of designated use support, which will be the foundation for subsequent steps, ultimately leading to focused management efforts.
  - The state of Minnesota (Clean Water Fund) funded development of a WRAPS for the RRW. This effort is in its final stages as of the writing of this TMDL report and constitutes a foundational planning piece that supports and informs local government plans (e.g. local water plans). The document includes strategies and tools specific to the watersheds. It will be revised and maintained as further prioritization and understanding of pollutant dynamics are made available.
  - The Minnesota Board of Water and Soil Resources (BWSR) is piloting a One Watershed, One Plan (1W1P) approach in the RRW at the time of this TMDL report. One of the program's guiding principles is that it "will result in plans with prioritized, targeted, and measurable implementation actions that meet or exceed current water plan content standards." The RRW 1W1P is set to be completed in June of 2016.
  - On November 4, 2008, Minnesota voters approved the Clean Water, Land and Legacy Amendment to the constitution to:
    - protect drinking water sources;
    - protect, enhance, and restore wetlands, prairies, forests, and fish, game, and wildlife habitat;
    - preserve arts and cultural heritage;
    - support parks and trails;
    - and protect, enhance, and restore lakes, rivers, streams, and GW.

This is a secure funding mechanism with the explicit purpose of supporting water quality improvement projects.

In response to this funding, several state agencies have strengthened their partnerships by coming together to focus high level water planning in order to best utilize these funds. The interagency Minnesota Water Quality Framework (Figure 19) as applied to Minnesota's 80 major watersheds clearly illustrates the cycle of assessment, watershed planning and implementation activities, and informs an adaptive management approach to watershed restoration and protection. Since the majority of the pollutant reductions activities will rely on voluntary adoption of BMPs, civic engagement is important. Citizenry of the RRW were engaged throughout the TMDL and WRAPS process. They gave input to the strategies defined in the WRAPS to address restoration of impaired waters as well as strategies to protect waters.

All agencies involved in the process have and continue to pursue the implementation of BMPs in the watershed through the use of funds including those administered by the BWSR, Federal Clean Water Act Section 319 program, and the Environmental Quality Incentives Program (EQIP).

Watershed technical staff maintains contact with landowners interested in installing water quality improvement projects in the watershed and keep them regularly updated on funding as it becomes available. Over the long term, active participation will help build and sustain local civic infrastructure and leadership for watershed stewardship initiatives.

- Monitoring components in the RRW are diverse and constitute a foundational means for focusing work, tracking progress and supporting adaptive management. In addition to condition monitoring, research will continue to further understanding of pathogens in surface water, thereby supporting both future TMDL studies and implementation efforts.

Further, preliminary results of the MPCA trend analysis have documented the decreasing TSS and total phosphorus concentrations at numerous milestone monitoring sites across southeast Minnesota. This provides reasonable assurance in that it suggests that long-term, enduring efforts to decrease nonpoint source pollutant loading (including pathogen loading, which is typically delivered via transport mechanisms similar to those for sediment and phosphorus) to surface waters have the potential for positive impacts.

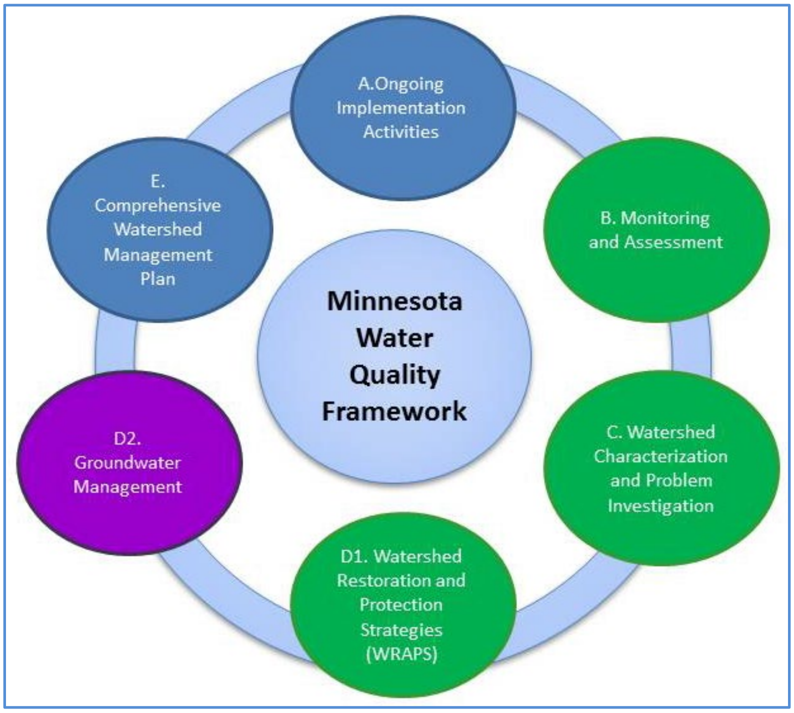


Figure 19. The Minnesota Water Quality Framework was developed to help achieve cleaner water via comprehensive watershed management using regulatory and non-regulatory means.

6.2 Regulatory

6.2.1 Regulated Construction Stormwater

State implementation of the TMDL will be through action on the NPDES Permits for regulated construction stormwater. To meet the WLA for construction stormwater, construction stormwater activities are required to meet the conditions of the Construction General Permit under the NPDES program and properly select, install, and maintain all the BMPs required under the permit, including any applicable additional BMPs required in Appendix A of the Construction General Permit for discharges to impaired waters, or meet local construction stormwater requirements if they are more restrictive than requirements of the State General Permit.

6.2.2 Regulated Industrial Stormwater

To meet the WLA for industrial stormwater, industrial stormwater activities are required to meet the conditions of the industrial stormwater general permit or Nonmetallic Mining & Associated Activities General Permit (MNG49) under the NPDES program and properly select, install and maintain all the BMPs required under the permit.

6.2.3 Municipal Separate Storm Sewer System (MS4) Permits

Stormwater discharges associated with the MS4s are regulated through the NPDES/SDS Permits. The Stormwater Program for the MS4s is designed to reduce the amount of sediment and pollution that enters surface and ground water from storm sewer systems to the Maximum Extent Practicable (MEP). The MS4 Permits require the implementation of the BMPs to address the WLAs. In addition, the owner or operator is required to develop a Stormwater Pollution Prevention Plan (SWPPP) that incorporates the BMPs applicable to their MS4. The SWPPP must cover six minimum control measures:

- Public education and outreach;
- Public participation/involvement;
- Illicit discharge, detection and elimination;
- Construction site runoff control;
- Post-construction site runoff control; and
- Pollution prevention/good housekeeping.

6.1.4 Wastewater & State Disposal System (SDS) Permits

The MPCA issues permits for WWTPs that discharge into waters of the state. The permits have site specific limits on bacteria that are based on water quality standards. Permits regulate discharges with the goals of 1) protecting public health and aquatic life, and 2) assuring that every facility treats wastewater. In addition, the SDS permits set limits and establish controls for land application of sewage.

6.1.5 Subsurface Sewage Treatment Systems Program

The SSTS, commonly known as septic systems, are regulated by Minn. Stat. §§ 115.55 and 115.56 and by Minn. R. ch. 7020., Minn. Stat. § 115.55, subd. 2 and Minn. R. 7082.0040, subp. 2, requires Minnesota counties to adopt and implement SSTS ordinances and Minn. R. 7080.0700, outlines the inspection requirements county programs must have, so the LGUs have authority to conduct inspections. Minn. R. 7082.0700 subp. 2, details the information required to be collected during the inspection of new construction replacement and existing systems. Minn. R. 7082.0700, subp. 4(B) requires that the inspection report form developed by the MPCA be used for relevant parts of the county's inspection of existing systems. Minn. Stat. § 115.55, subd. 11, requires that "An inspection who discovers the existence of a straight-pipe system shall issue a noncompliance notice to the owner of the straight-pipe system and forward a copy of the notice to the agency." Minn. Stat. § 115.55, subd. 5a, identifies straight-pipes as an ITPHS and must be upgraded, replaced, or its use discontinued within 10 months of the receipt of the notice of noncompliance.

Minnesota LGUs identify straight-pipes through many triggers identified in their ordinances. These triggers include, but are not limited to building permit applications, variances, and property transfer. As straight-pipes are identified they are placed on a ten-month update. Those that do not update within the timeframe are addressed through the process outlined in Minn. Stat. § 115.55, subd. 11, that states if the owner does not replace or discontinue the use of the straight-pipe system within 10 months after the notice was received, the owner of the straight-pipe system shall be subject to an administrative penalty of $500 per month of noncompliance beyond the ten-month period. While the majority of inspections and replacements are handled by Minnesota LGUs, the MPCA still retains authority to conduct inspections. The MPCA has the NPDES and SSTS compliance and enforcement staff located in offices across the state.

6.1.6 Feedlot Rules

The MPCA regulates the collection, transportation, storage, processing, and disposal of animal manure and other livestock operation wastes. The MPCA Feedlot Program implements rules governing these activities, and provides assistance to counties and the livestock industry. The feedlot rules apply to most aspects of livestock waste management including the location, design, construction, operation, and management of feedlots and manure handling facilities.

There are two primary concerns about feedlots in protecting water:

- Ensuring that manure on a feedlot or manure storage area does not run into water;
- Ensuring that manure is applied to cropland at a rate, time and method that prevents bacteria and other possible contaminants from entering streams, lakes and ground water.

7 Monitoring Plan

Watershed Approach Framework:

Future monitoring in the RRW will be according to the Watershed Approach Framework. The IWM strategy utilizes a nested watershed design allowing the aggregation of watersheds from coarse to fine scale. The foundation of this comprehensive approach is the 80 major watersheds within Minnesota. Streams are segmented by HUC. Sampling occurs in each major watershed once every 10 years (MPCA 2012). The RRW Monitoring and Assessment Report provides detailed discussion of the IWM and how it will be applied going forward (it will be repeated in the RRW in 2018). Monitoring will continue on assessment units noted in this document (see Table 1); this will provide trend information at intervals.

Watershed Pollutant Load Monitoring Network:

In addition to the Watershed Approach based monitoring, the MPCA will also conduct sampling through their Watershed Pollutant Load Monitoring Program (WPLMN). The WPLMN is designed to obtain spatial and temporal pollutant load information from Minnesota's rivers and streams and track water quality trends. Site-specific stream flow data from United States Geological Survey and the DNR is combined with water quality data collected by the MPCA, local units of government, state universities, nonprofit organizations, and Metropolitan Council Environmental Services to compute annual pollutant loads at river monitoring sites across Minnesota.

Monitoring sites span three ranges of scale:

- Basin — major river main stem sites along the Mississippi, Minnesota, Rainy, Red, Des Moines, and St. Croix Rivers
- Major Watershed — tributaries draining to major rivers with an average drainage area of 1,350 square miles (8 digit HUC scale)
- Subwatershed — major branches or nodes within major watersheds with average drainage areas of approximately 300-500 square miles

Establishment of basin and major watershed monitoring sites within the network began in 2007, following the passage of Minnesota's Clean Water Legacy Act with subsequent funding from the Clean Water Fund of the Minnesota Clean Water, Land and Legacy Amendment. Establishment of subwatershed monitoring sites began in 2011, with all sites operational by 2015.

In the RRW, there is one major watershed site, and four subwatershed sites (South Branch, South Fork, North Branch and Middle Branch), all established between 2009 and 2013.

More detail is available on the WPLMN.

Bacteria Impairments

Specific to bacterial, aquatic recreation impairments, the *Revised Regional Total Maximum Daily Load Evaluation of Fecal Coliform Bacteria Impairments in the Lower Mississippi River Basin in Minnesota* includes a monitoring section that describes activities and responsibilities pertaining to the greater regional examination of pathogens in surface water, of which the RRW is a part.

Focused Monitoring and Research Needs:

In addition to monitoring for both assessment and effectiveness purposes, there are research needs pertaining to pathogens in surface water. The *Revised Regional TMDL Evaluation of Fecal Coliform Bacteria Impairments In the Lower Mississippi River Basin in Minnesota Implementation Plan* notes that these points of need include, but are not limited to:

- Study of sources of pathogens in cities and urban areas;
- Better understanding of load reduction capabilities for applicable structural and non- structural BMPs;
- Models to evaluate loading sources and track load reductions;
- Methods to evaluate pollutant migration pathways and delivery mechanisms from pathogen sources to surface waters;
- DNA “fingerprinting” to identify pathogen sources.

Such research would further the understanding of pathogens in surface water, and greatly support both future TMDL studies and implementation efforts by allowing for more quantified approaches to both.

8 Implementation Strategy Summary

8.1 Permitted Sources

8.1.1 Construction Stormwater

The WLA for stormwater discharges from sites where there is construction activity reflects the number of construction sites greater than one acre expected to be active in the watershed at any one time, and the BMPs and other stormwater control measures that should be implemented at the sites to limit the discharge of pollutants of concern. The BMPs and other stormwater control measures that should be implemented at construction sites are defined in the State's NPDES/SDS General Stormwater Permit for Construction Activity (MNR100001). If a construction site owner/operator obtains coverage under the NPDES/SDS General Stormwater Permit and properly selects, installs and maintains all the BMPs required under the permit, including those related to impaired waters discharges and any applicable additional requirements found in Appendix A of the Construction General Permit, the stormwater discharges would be expected to be consistent with the WLA in this TMDL. All local construction stormwater requirements must also be met.

8.1.2 Industrial Stormwater

The WLA for stormwater discharges from sites where there is industrial activity reflects the number of sites in the watershed for which the NPDES Industrial Stormwater Permit coverage is required, and the BMPs and other stormwater control measures that should be implemented at the sites to limit the discharge of pollutants of concern. The BMPs and other stormwater control measures that should be implemented at the industrial sites are defined in the State's NPDES/SDS Industrial Stormwater Multi-Sector General Permit (MNR050000) or the NPDES/SDS General Permit for Construction Sand & Gravel, Rock Quarrying and Hot Mix Asphalt Production facilities (MNG490000). If a facility owner/operator obtains stormwater coverage under the appropriate NPDES/SDS Permit and properly selects, installs and maintains all the BMPs required under the permit, the stormwater discharges would be expected to be consistent with the WLA in this TMDL. All local stormwater management requirements must also be met.

8.1.3 Wastewater

The MPCA issues permits for WWTPs that discharge into waters of the state. The permits have site specific limits that are based on water quality standards. Permits regulate discharges with the goals of 1) protecting public health and aquatic life, and 2) assuring that every facility treats wastewater. In addition, SDS Permits set limits and establish controls for land application of sewage.

8.2 Non-Permitted Sources

8.2.1 Best Management Practices

A variety of the BMPs to restore and protect the lakes and streams within the RRW were outlined and prioritized in the WRAPS report, set for completed in 2016.

8.2.2 Education and Outreach

A crucial part in the success of the WRAPS report that will be designed to clean up the impaired streams and protect the non-impaired water bodies will be participation from local citizens. In order to gain support from these citizens, education and civic engagement opportunities will be necessary. A variety of educational avenues can and will be used throughout the watershed (see Public Participation section). These include (but are not limited to): press releases, meetings, workshops, focus groups, trainings, websites, etc. Local staff (SWCD, county, etc.) and board members work to educate the residents of the watersheds about ways to clean up their streams on a regular basis. Education and engagement will continue throughout the watershed.

An example of how education and outreach has already worked in the RRW was seen in Fillmore County. The County led a pilot study from 2004 through 2009 to help citizens learn about the benefits of maintaining functional septic systems, while at the same time protecting the GW from ITPHS. The grant they received for this study allowed them to hold educational classes and inspect 3,765 systems, 571 of which were found to be Imminent Public Health Threats (IPHT). As of August 2009, 49 IPHT systems still needed to be replaced. Other counties within the RRW, including Olmsted and Winona, have completed inspections in portions of their counties.

A regional effort to address unsewered communities has been underway for over a decade in the Lower Mississippi River Basin. Since 2001, the Southeast Minnesota Wastewater Initiative (SMWI), and two related community educators have worked with unsewered communities to help them successfully install a functional system. During this time, 21 communities have completed the process for achieving adequate sewage treatment. Those communities span 13 counties in southeast Minnesota (two in the RRW) and have reduced the load of raw sewage by 106 million gallons a year. The catalyst for this innovative approach was the Lower Mississippi Regional TMDL for Fecal Coliform, which identified strategies to address point sources through wastewater treatment and nonpoint sources through feedlot fixes and manure management. Those efforts are working to reduce bacteria levels in regional rivers across southeast Minnesota. The SMWI won an award in 2014 from the Bush Foundation for community innovation.

8.2.3 Technical Assistance

The counties and the SWCDs within the watershed provide assistance to landowners for a variety of projects that benefit water quality. Assistance provided to landowners varies from agricultural to rural to urban BMPs. This technical assistance includes education and one-on-one training. It is important that outreach opportunities for watershed residents continue. Marketing is necessary to motivate landowners to participate in voluntary cost-share assistance programs.

Programs such as state cost share, Clean Water Legacy funding, EQIP, and Conservation Reserve Program (CRP) are available to help implement the best conservation practices that each parcel of land is eligible for to target the best conservation practices per site. Conservation practices may include, but are not limited to: stormwater bioretention, septic system upgrades, feedlot improvements, invasive species control, wastewater treatment practices, as well as agricultural and rural BMPs. More information about types of practices and implementation of BMPs will be discussed in the Root River WRAPS Report.

8.2.4 Partnerships

Partnerships with counties, cities, townships, citizens, businesses, and Friends of the Root River non-profit group are one mechanism through which watershed partners will protect and improve water quality. Strong partnerships with state and local government to protect and improve water resources and to bring waters within the RRW into compliance with state standards will continue. A partnership with the LGUs and regulatory agencies such as cities, townships and counties may be formed to develop and update ordinances to protect the area's water resources.

8.3 Cost

The Clean Water Legacy Act requires that a TMDL include an overall approximation of the cost to implement a TMDL (Minn. Stat. § 114D.25 2007).

8.3.1 Bacteria

The cost estimate for bacteria load reduction is based on unit costs for the two major sources of bacteria: livestock and imminent threat to public health septic systems. The unit cost for bringing the AUs under manure management plans and feedlot lot runoff controls is $350/AU. This value is based on the USDA EQIP payment history and includes buffers, livestock access control, manure management plans, waste storage structures, and clean water diversions. Repair or replacement of the ITPHS was estimated at $7,500/system (EPA 2011). Multiplying those unit costs by an estimated 417 ITPHS and 233,970 AU in the RRW provides a total cost of approximately $85.02 million.

8.3.2 Nitrate

The Minnesota NRS set a statewide goal of 20% nitrate reduction by the year 2025 to help achieve the nutrient reduction goals for the Gulf of Mexico, and a (45% reduction by 2040) (MPCA 2014). Through a separate, related study, Nitrogen in Minnesota Surface Waters (MPCA 2013), the University of Minnesota developed a tool to evaluate the expected N reductions to Minnesota waters from individual or collective BMPs adopted on lands well-suited for the practices (Lazurus et al. 2014). The tool, called "Nitrogen BMP watershed planning tool" (NBMP), enables planners to gauge the potential for reducing N loads to surface waters from watershed croplands, and to assess the potential costs (and savings) of achieving various N reduction goals. The tool also enables the user to identify which combinations of BMPs will be most cost-effective for achieving N reductions at a HUC8 watershed or statewide scale.

Nitrate impaired subwatersheds in the RRW (AUIDs 07040008-552, -555, -557, -558, -562, -563; Table 2) cover 135,872 acres, or 13% of the total watershed area of approximately 1,062,000 acres. Focus will be placed on these impaired subwatersheds for nitrate BMP implementation. By taking 13% of the $19.54 million per year cost estimated using one NBMP tool scenario (Figure 20), it is estimated it will cost $2.54 million per year to address nitrate issues in the impaired subwatersheds.

Figure 20. The RRW scenario from the NBMP tool illustrating a potential strategy to achieve the 20% nitrate reduction interim goal.

1.062 million acres in watershed or state

Watershed: Root River

52	% suitable	% adoption	% treated	% treated, combined	acres treated (000), combined
Corn acres receiving target N rate, no inhibitor or timing shift	29.0%	60%	17.4%	15.8%	167.84
Fall N target rate acres receiving N inhibitor	2.3%	55%	1.2%	1.2%	12.38
Fall N applications switched to spring, % of fall-app. acres	2.3%	45%	1.0%	0.4%	4.56
Fall N switch to split spring/sidedressing, % of fall acres	2.3%	45%	1.0%	0.4%	4.56
Restored wetlands	1.8%	50%	0.9%	0.9%	9.45
Tile line bioreactors	1.1%	20%	0.2%	0.0%	0.00
Controlled drainage	1.1%	50%	0.5%	0.3%	2.81
Saturated buffers	1.1%	50%	0.5%	0.5%	5.61
Riparian buffers	2.8%	90%	2.5%	2.5%	26.06
Corn grain &soybean acres planted w/cereal rye cover crop	42.6%	55%	23.5%	22.0%	233.27
Short season crops planted to a cereal rye cover crop	2.5%	50%	1.8%	1.2%	12.53
Perennial crop % of corn & soybean area (marginal only)	3.0%	10%	0.3%	0.3%	3.07

Weather scenario: Wet year- 30% of preplant N is lost, yield reduced — Load default data

For wet spring scenario 2, fertilizer & manure N lost: 30%

Sidedressing is done after the rains. The average-year rate of sidedressed N is applied.

N load reduction with these adoption rates: 19.7% of all nonpoint source load

20.5% of cultivated ag land source load

More results===>

Treatment cost before fertilizer cost savings & corn yield impacts	$22.97	million/year
N fertilizer cost savings & corn yield impacts	-$3.44	
Net BMP treatment cost	$19.54	million/year

8.3.3 TSS

Utilizing numbers developed by the *Group of 16* (G16) (State of Minnesota, 2004), an interagency work group (BWSR, MDA, MPCA, Minnesota Association of SWCDs, Minnesota Association of Watershed Districts, etc.) who assessed restoration costs for several TMDLs, it was determined that implementing the RRW TSS TMDLs will cost approximately $195 million over 10 years. This was based on total area of the watershed (1,664 square miles) multiplied by the cost estimate of $117,000/square mile for a watershed based treatment approach.

8.4 Adaptive Management

This list of implementation elements and the more detailed RRW WRAPS report prepared concurrently with this TMDL focuses on adaptive management. Continued monitoring and "course corrections" responding to monitoring results are the most appropriate strategy for attaining the water quality goals established in this TMDL. Management activities will be changed or refined to efficiently meet the TMDL and lay the groundwork for de-listing the impaired water bodies.

9 Public Participation

Public participation for this TMDL was enveloped in the previous efforts of the turbidity TMDL and more recent efforts of the Root River WRAPS and local water planner led 1W1P documents, both part of the watershed approach. Before Minnesota adopted the watershed approach, a TMDL project was started in 2008 that was set to address 11 turbidity impairments in the RRW. By the time the turbidity TMDL report was nearing completion, the watershed approach had started. Instead of finalizing the turbidity-only TMDL, that work was put on hold and later enveloped in the current TMDL report.

Root River Technical Advisory Group and Stakeholder Advisory Group:

During the turbidity TMDL that occurred from March 2008 through June 2011 both a Technical Advisory Group (TAG) and Stakeholder Advisory Group (SAG) were formed. These groups were kept informed of turbidity TMDL report related developments and asked for input on a regular basis. As the work shifted to a watershed approach, TAG meetings continued, and the group was kept informed of impairments and implementation strategies being developed as part of the WRAPS. The TAG in the RRW has developed into a group of water professionals sharing information about all activities occurring in the watershed.

Root River TAG members represented the following groups:

1. Board of Water and Soil Resources (BWSR)
2. Fillmore County Planning and Zoning
3. Fillmore County NRCS
4. Fillmore County SWCD
5. Hiawatha Valley RC & D
6. Houston County Planning and Zoning
7. Houston County (Root River) SWCD
8. Trout Unlimited
9. DNR
10. Mower County NRCS
11. Mower County SWCD
12. MPCA
13. Olmsted County NRCS
14. Olmsted County SWCD
15. Southeast Minnesota Water Resources Board
16. The Nature Conservancy
17. United States Fish and Wildlife Service (USFWS)
18. Winona County Planning and Zoning
19. Winona County SWCD
20. Minnesota Department of Agriculture (MDA)
21. Fillmore and Houston County Extension
22. Minnesota Trout Association
23. Winona State University

Root River SAG members represented the following groups:

1. Citizen Stream Monitoring Program (CSMP)
2. Minnesota Corn Growers Association
3. Corn Promotion Council
4. Chatfield WWTP
5. Fillmore County Commissioner
6. Local Farmers

Public participation/outreach included the following:

- September 26, 2008 – TAG meeting in Preston
- October 30, 2008 – Kingsland High School presentation
- November 20, 2008 – Public kickoff meeting and open house in Preston
- November 20, 2008 – Root River Turbidity TMDL poster was on display for open house and meeting
- November 20, 2008 – Minnesota Public Radio broadcast information regarding the turbidity impairments in the Root River, and advertised the public kickoff meeting
- November 20, 2008 – KAAL-TV6 broadcast information regarding the turbidity impairments in the Root River, and advertised the public kickoff meeting
- December 2008 – Article in the Fillmore County SWCD Conservation Chronicles
- December 2008 – Article in the Bluff Country Reader
- December/January 2008/2009 – Sent out thank you letters to people who attended the kickoff meeting, and summary letters to people who didn't attend. Both letters also asked for participation in the SAG.
- March 12, 2009 – TAG meeting in Preston
- April 7, 2009 – Presentation at the Annual Township meeting in Preston
- April 25, 2009 – Lanesboro Earth Day Celebration, TMDL poster was on display
- June 4, 2009 – SAG meeting in Chatfield
- August 26, 2009 – Presented during the BWSR Flood Tour
- October 20, 2009 – TAG meeting in Preston
- December 2009 – Article in the Fillmore County SWCD Conservation Chronicles
- December 2009 – Sent out Root River Turbidity TMDL Newsletter to SAG
- July 2009 and 2010 – TMDL posters on display at the Fillmore County Fair
- February 18, 2010 – Poster presentation at the "Nutrients in Our Environment Conference" in Mankato
- April 6, 2010 – Presentation at the Annual Township meeting in Preston
- May 17, 2010 – TAG meeting
- October 6, 2010 – TAG meeting
- January 2011 – Article in the Fillmore County SWCD Conservation Chronicles (Fillmore County Journal insert)
- February 5, 2011 – Two posters (TMDL and Sediment Fingerprinting) were on display at the "Dinner on the Bluff" at Eagle Bluff
- Winter 2011 – 2nd edition of the Root River Turbidity TMDL Newsletter was sent to the SAG
- June 2011 – Article in the Fillmore County SWCD Conservation Chronicles (new online format)
- June 9, 2011 – TAG meeting

- Updates and information about the Turbidity TMDL were located on the Fillmore SWCD website and the MPCA website
- Continuous updates were given to the Fillmore County Local Water Management Citizens' Advisory and Technical Committees (Root River Turbidity TMDL topics were on the Technical agenda 8 times, and the Citizens' agenda 9 times)
- April 23, 2012 – TAG meeting
- November 25, 2013 – TAG meeting
- April 8, 2015 – Root River 1W1P kick-off meeting (TMDL information was shared with 85 citizens from the watershed that were in attendance)

Root River Citizen Advisory Group

The purpose of formation of this group was two-fold: 1) provide input into strategies to raise public awareness of water resource issues in the watershed and 2) to encourage adoption of BMPs for water quality restoration and protection. To fulfill these purposes, Citizen Advisory Group (CAG) members were not only informed of water quality conditions in their watershed, but were also trained to be community leaders. Fillmore SWCD (FSWCD) partnered with University of Minnesota-Extension (UM-E) to lead the group and provide this training so that CAG members felt comfortable leading citizen conversations about the watersheds in their respective communities.

In May of 2012, the CAG met for the first time. In the first year, members were:

- oriented to their roles and responsibilities and the game plan for the next meetings
- provided with water quality information on the Root River
- asked to respond to the question "What has to happen to keep you involved?"
- training in civic engagement skills and processes/methods for doing effective civic engagement, identifying stakeholders, and dealing with difficult people. This was done to prepare them to lead citizen conversations.

The CAG met 14 times from May 2012 through June 2014 when the contract funding their activities (mileage was reimbursed) ended. Since June 2014, the CAG has continued to meet each month, on average, to discuss their future. In 2015, they went through the process of and became a 501c3 non-profit organization called "Friends of the Root River" (FORR). The mission of the group and other information can be found on their website.

CAG meeting dates (before formation of FORR):

- May 1, 2012
- August 7, 2012
- September 4, 2012
- October 2, 2012
- November 15, 2012
- December 4, 2012
- January 8, 2013
- February 5, 2013
- March 13, 2013
- May 7, 2013
- June 4, 2013

- September 30, 2013
- January 29, 2014
- April 24, 2014
- August 26, 2014
- November 18, 2014
- December 18, 2014
- January 22, 2015

Root River Citizen Conversations (Conversations)

From March 25 through May 8, 2013, seven Conversations were held across the RRW. The purpose of these Conversations was to gather citizen input for developing implementation strategies for the RRW that will reduce concentrations of sediment, bacteria and nitrates. Background information about impairments in the watershed was given as context for the discussion. A total of 148 people attended the seven events. The events lasted 2.5 hours; however, many stayed later to discuss issues further.

In June of 2014, five follow-up Conversations were convened and attended by a total of 39 citizens. These Conversations were held to inform people of the land use practices proposed to address water quality impairments and to identify local resources and assets that can help to implement the practices. More information about the Conversations can be found in the Root River WRAPS document (MPCA 2016).

Public Notice

The RRW TMDLs and WRAPS were public noticed from April 18 to May 17, 2016

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GIS Maps and Data:

Reasonable effort has been made to ensure the accuracy of the data on which this analysis is based. However, the Minnesota Pollution Control Agency does not warrant the accuracy, completeness, or suitability for any implied uses of these data. For more information refer to the MPCA website policies and disclaimers.

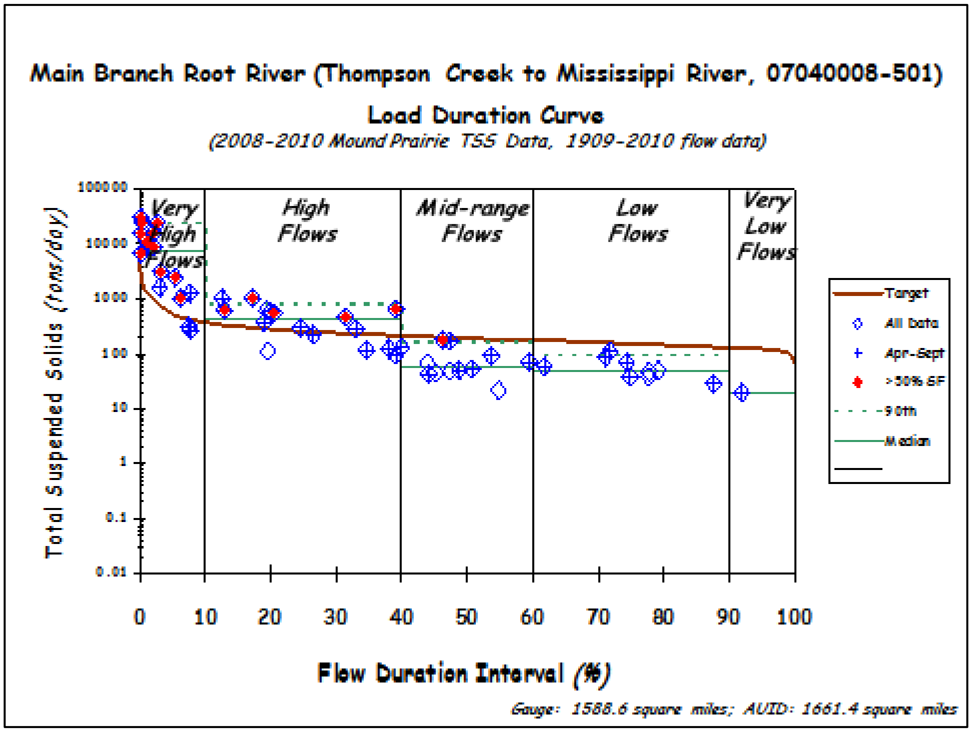
Service Layer Credits for the Basemap used in figures (1, 5-14) are as follows: Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Appendices

Appendix A. LDCs used in TMDL calculations, listed in numerical order by last three digits.

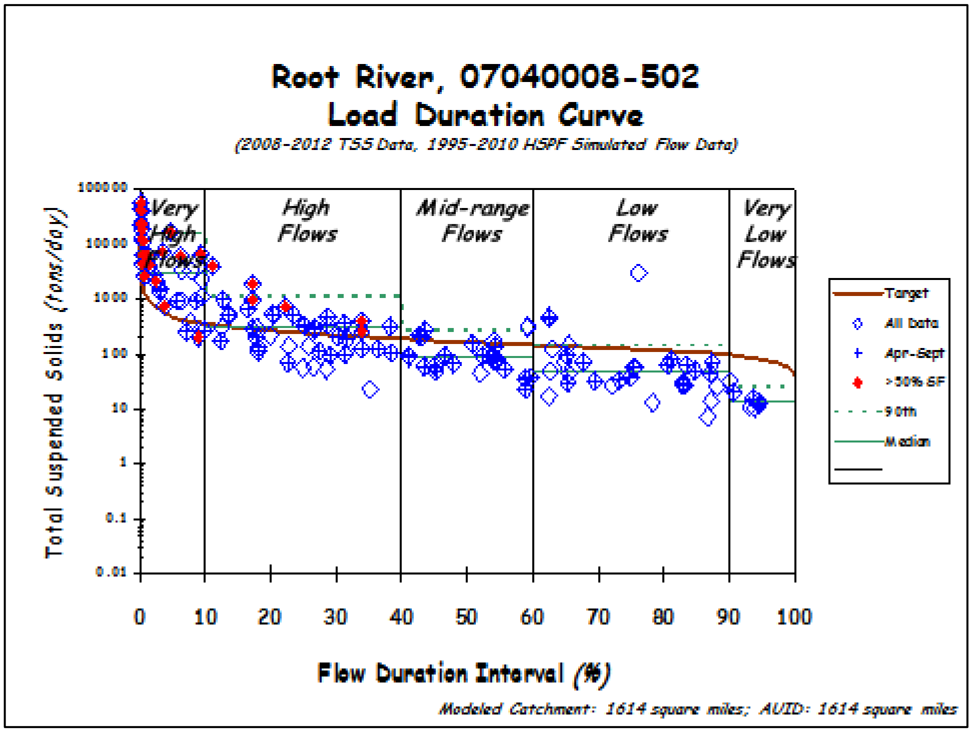
A1. 07040008-501

a. Total Suspended Solids:



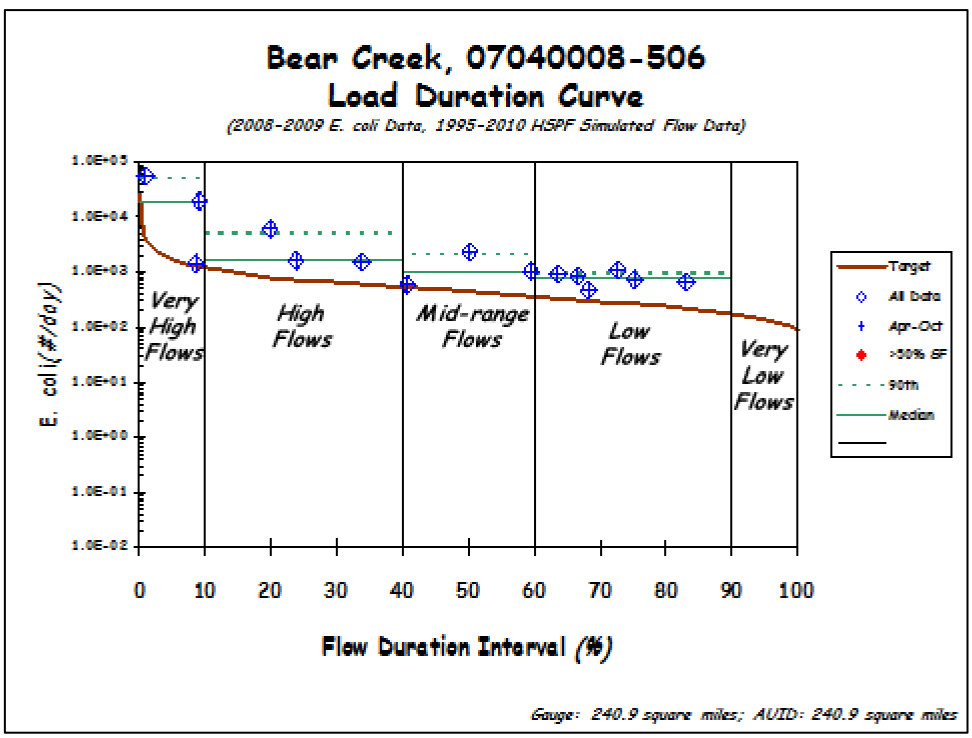
A2. 07040008-502

a. Total Suspended Solids:



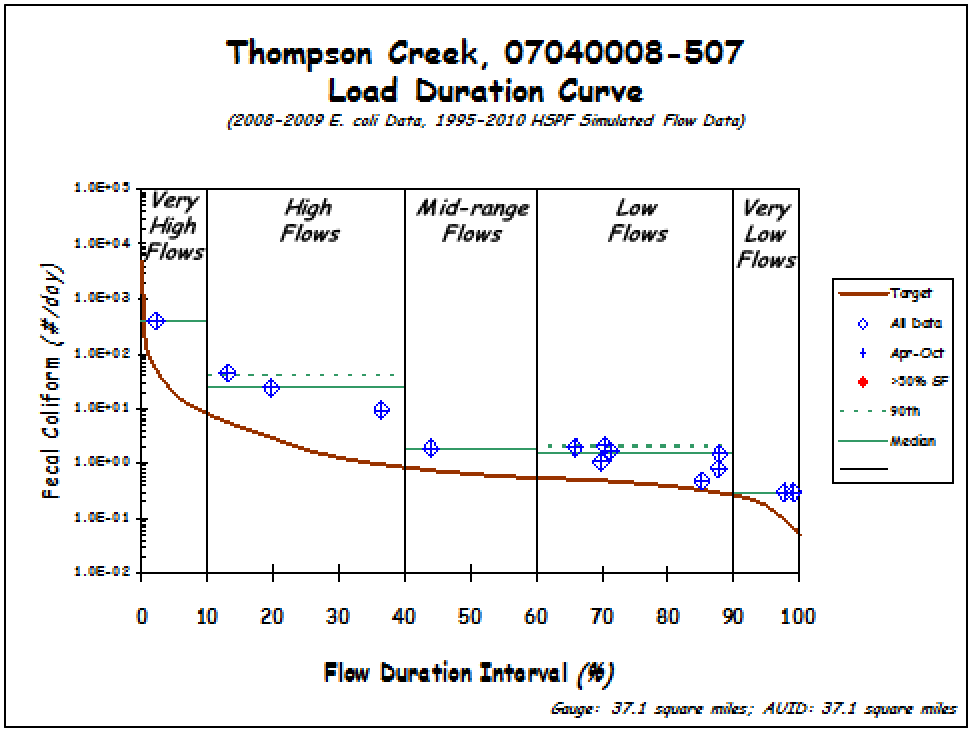
A3. 07040008-506

a. *E. coli*:



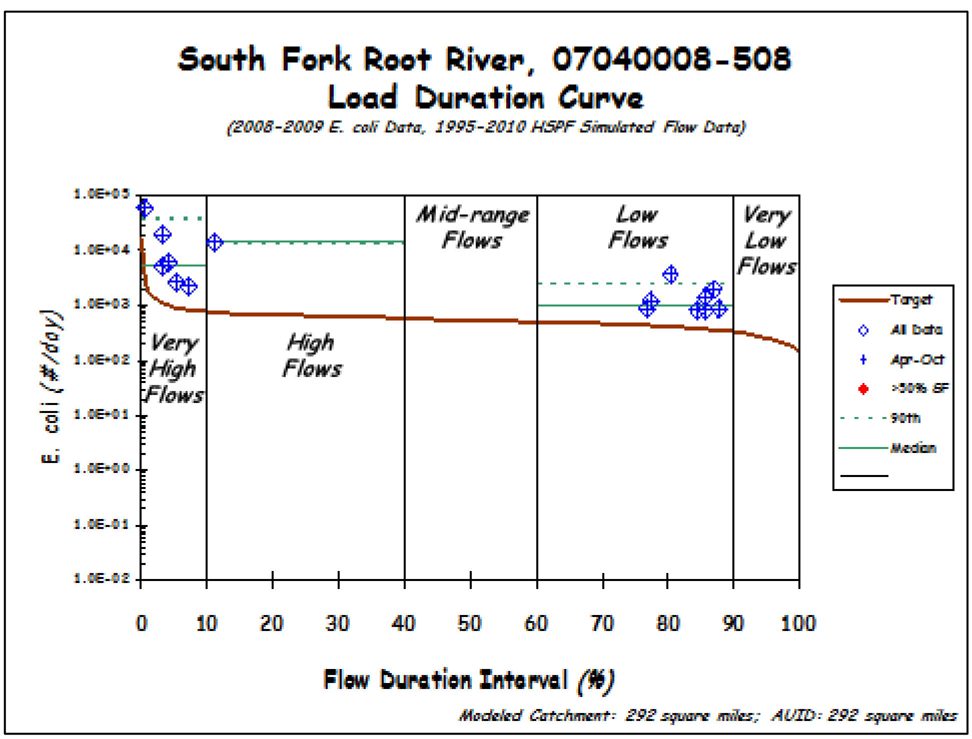
A4. 07040008-507

a. Fecal coliform:

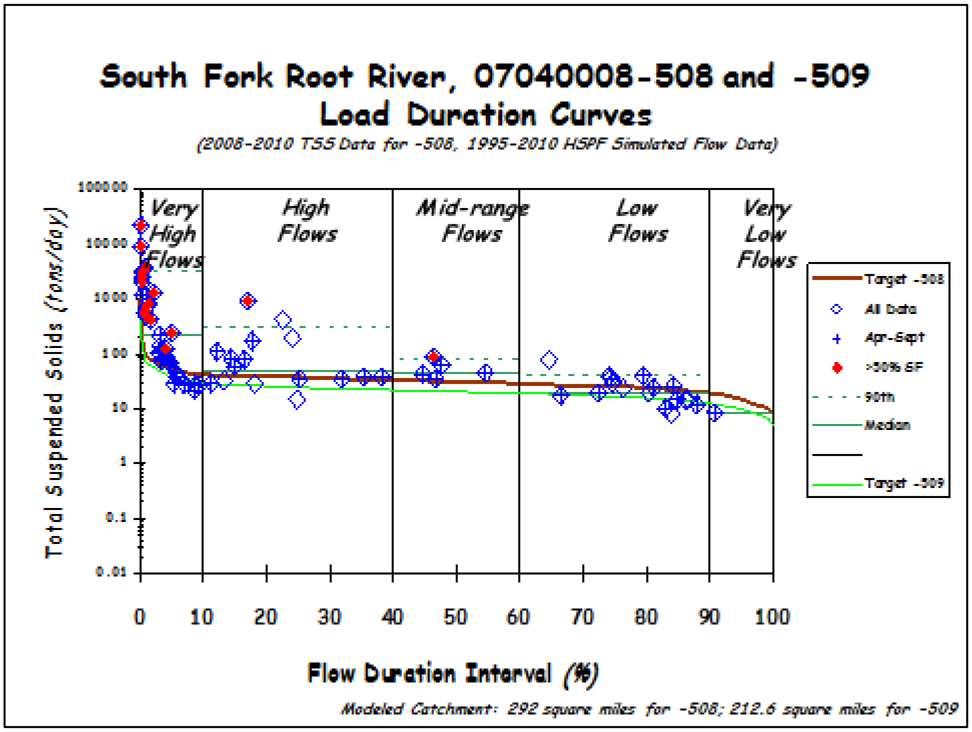


A5. 07040008-508

a. *E. coli*:

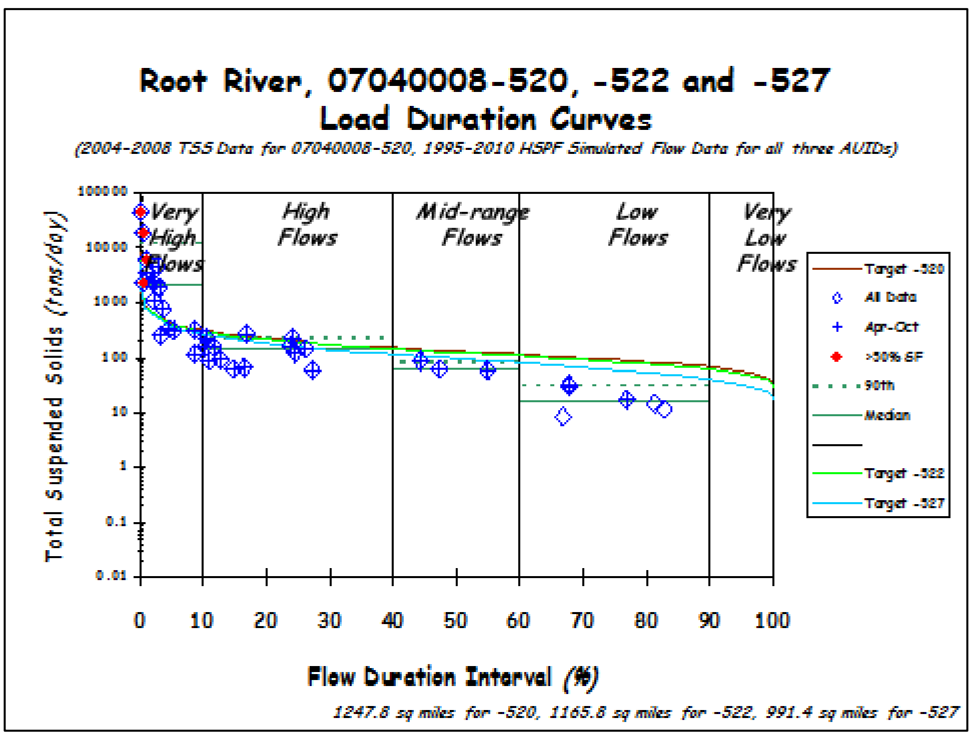


b. Total Suspended Solids (-508 and -509):



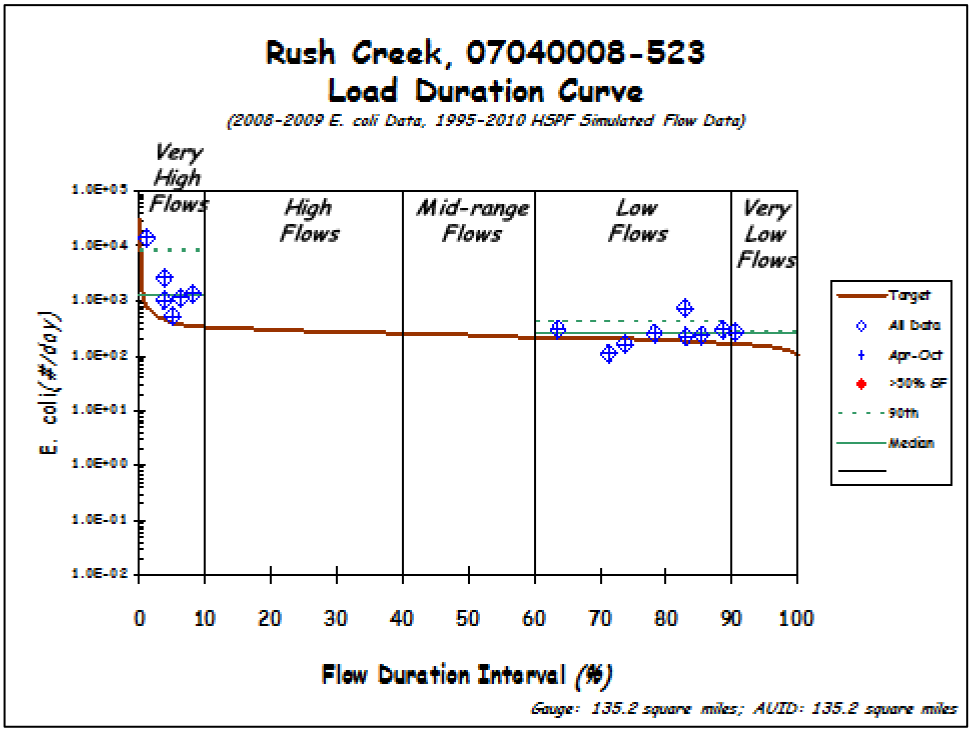
A6. 07040008-520, -522, -527

a. Total Suspended Solids:



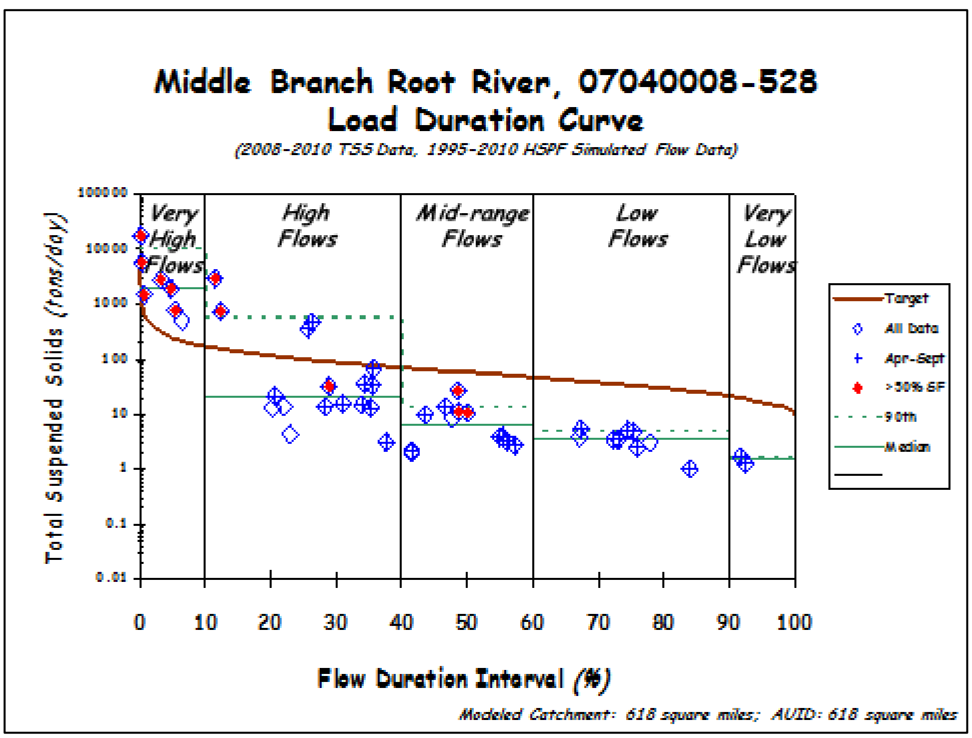
A7. 07040008-523

a. *E. coli*:



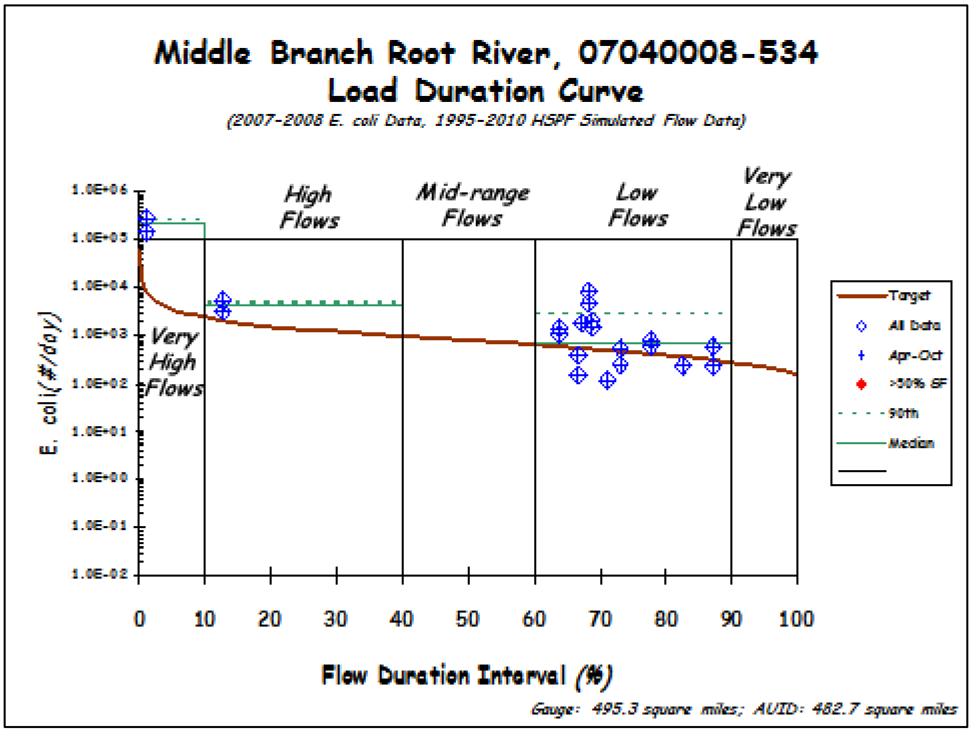
A8. 07040008-528

a. Total Suspended Solids:



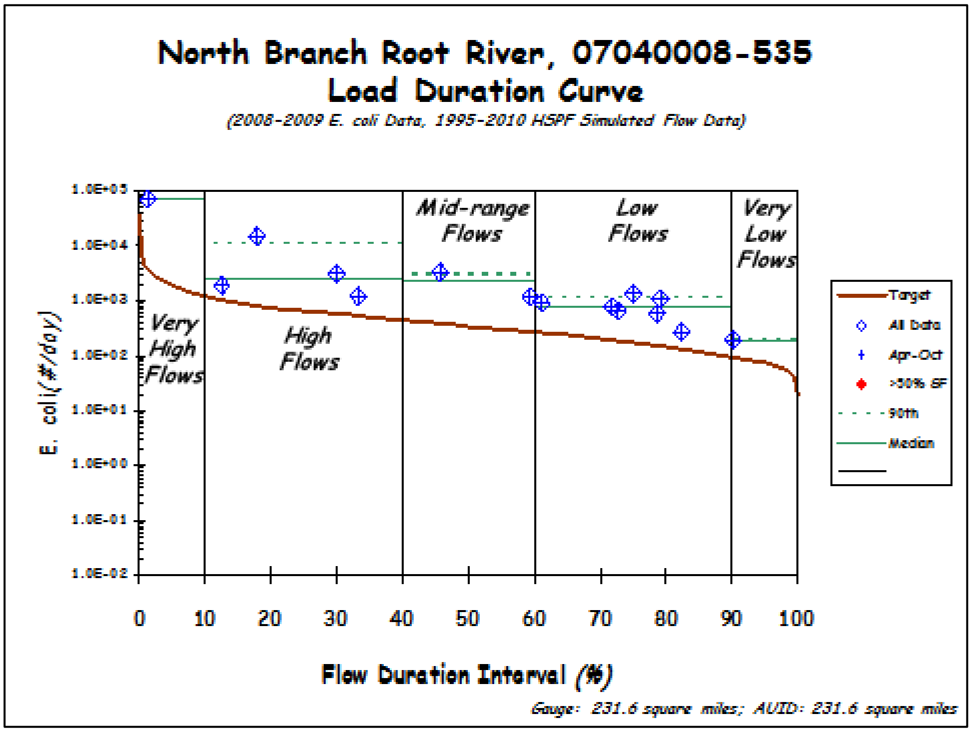
A9. 07040008-534

a. *E. coli*:



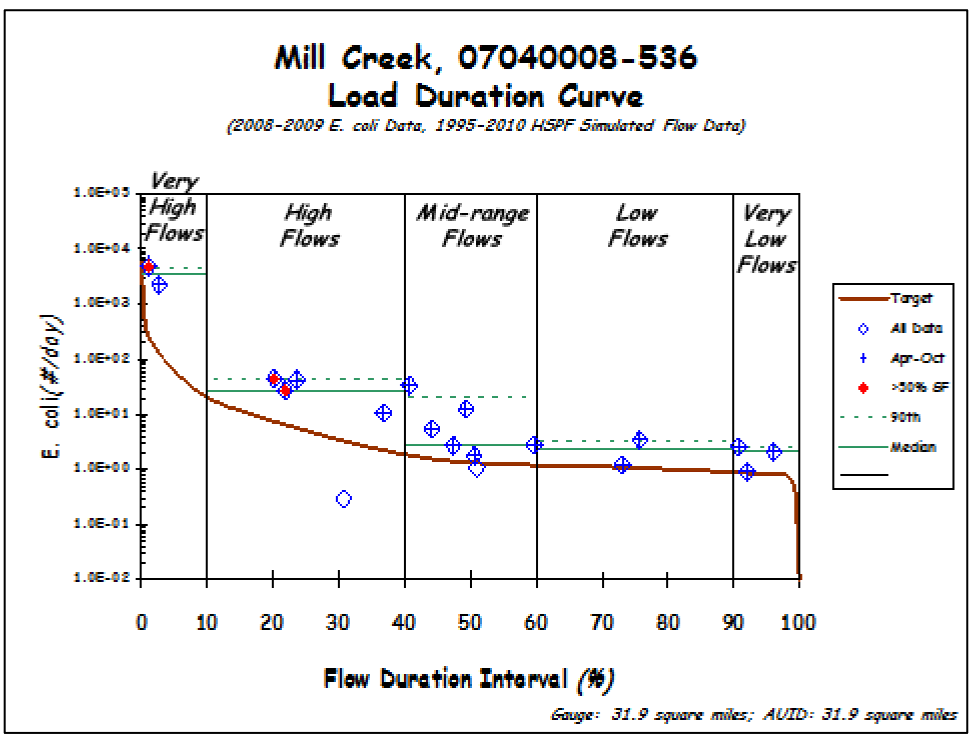
A10. 07040008-535

a. *E.coli*:



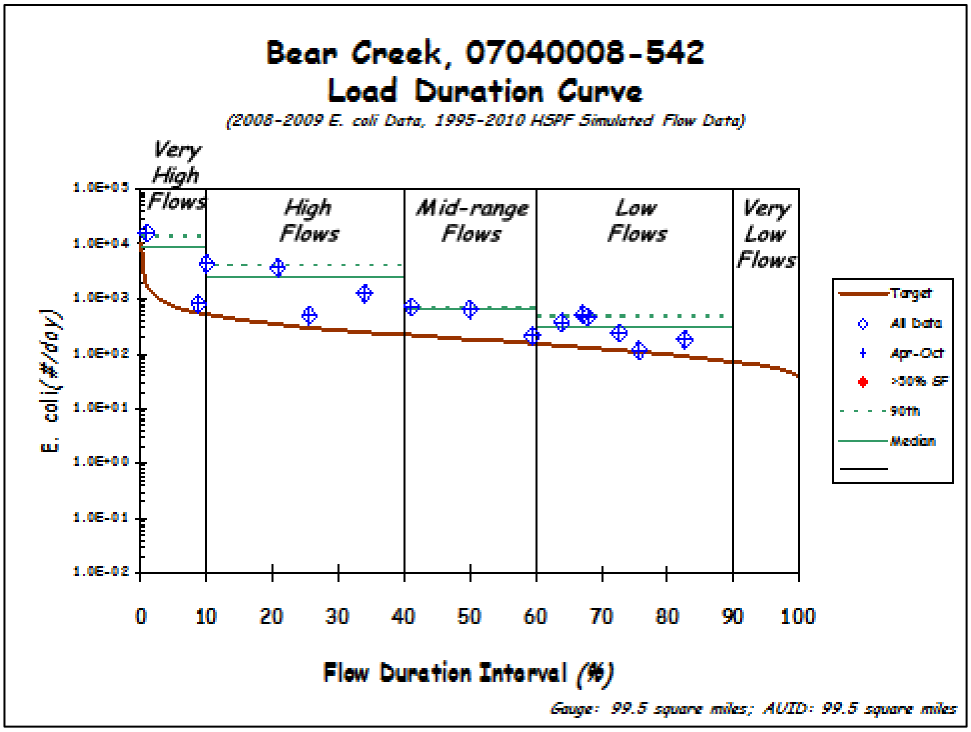
A11. 07040008-536

a. *E. coli*:



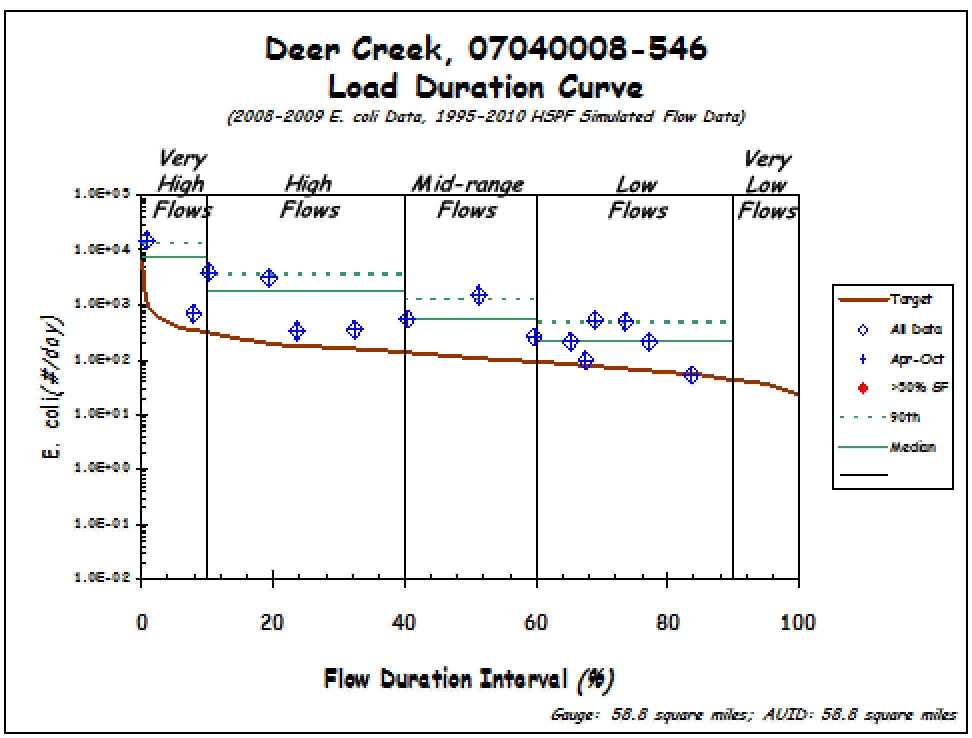
A12. 07040008-542

a. *E. coli*:



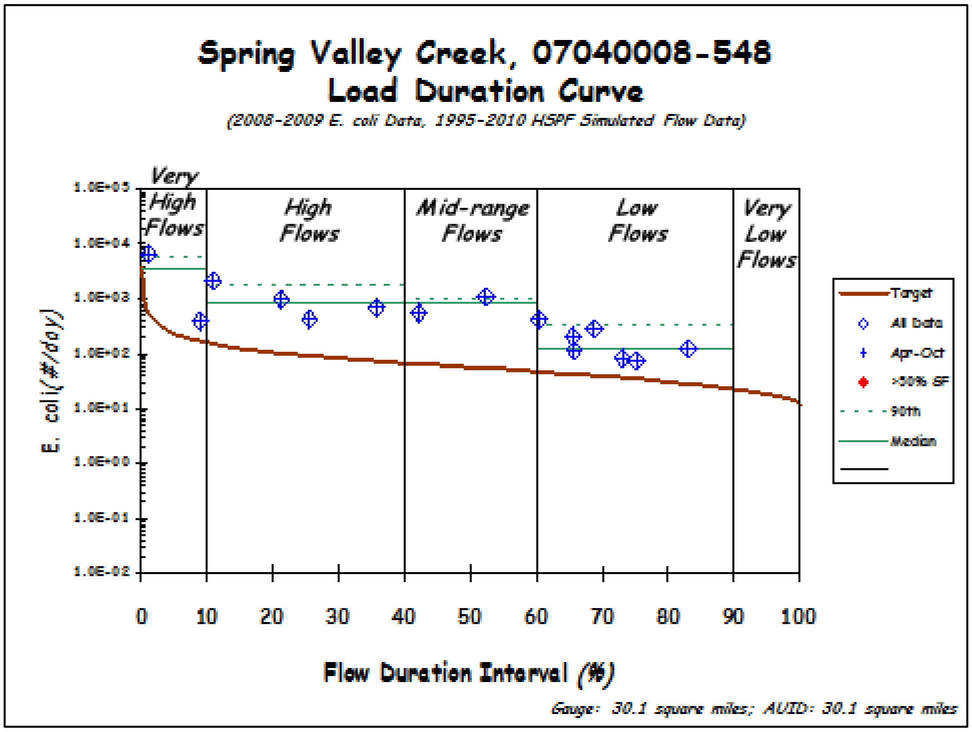
A13. 07040008-546

a. *E. coli*:



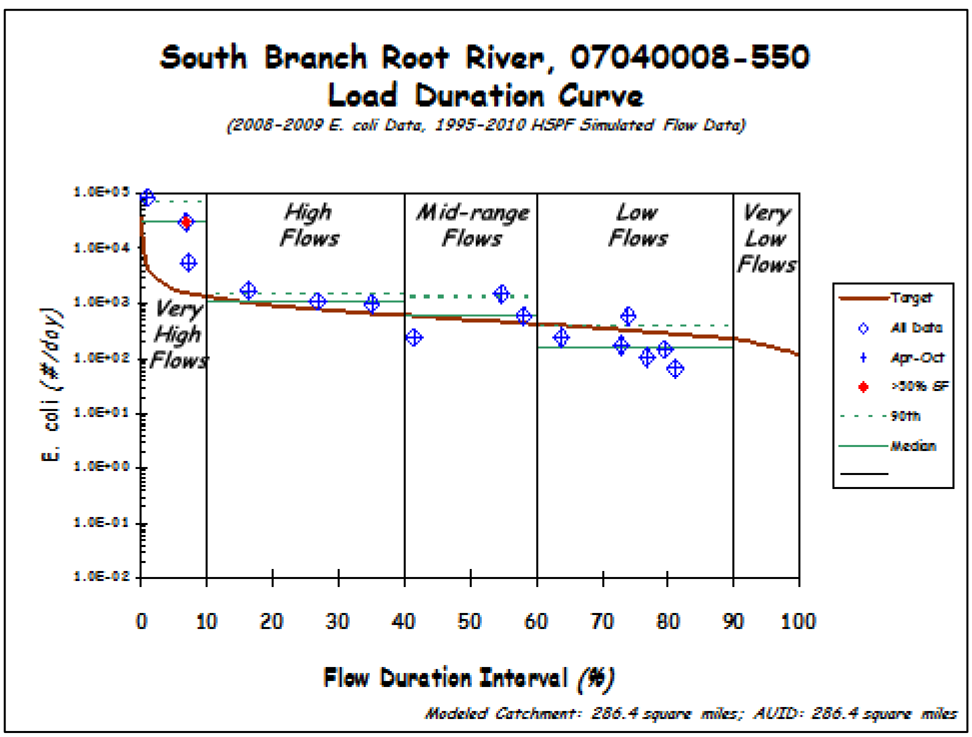
A14.07040008-548

a. ***E. coli*:**

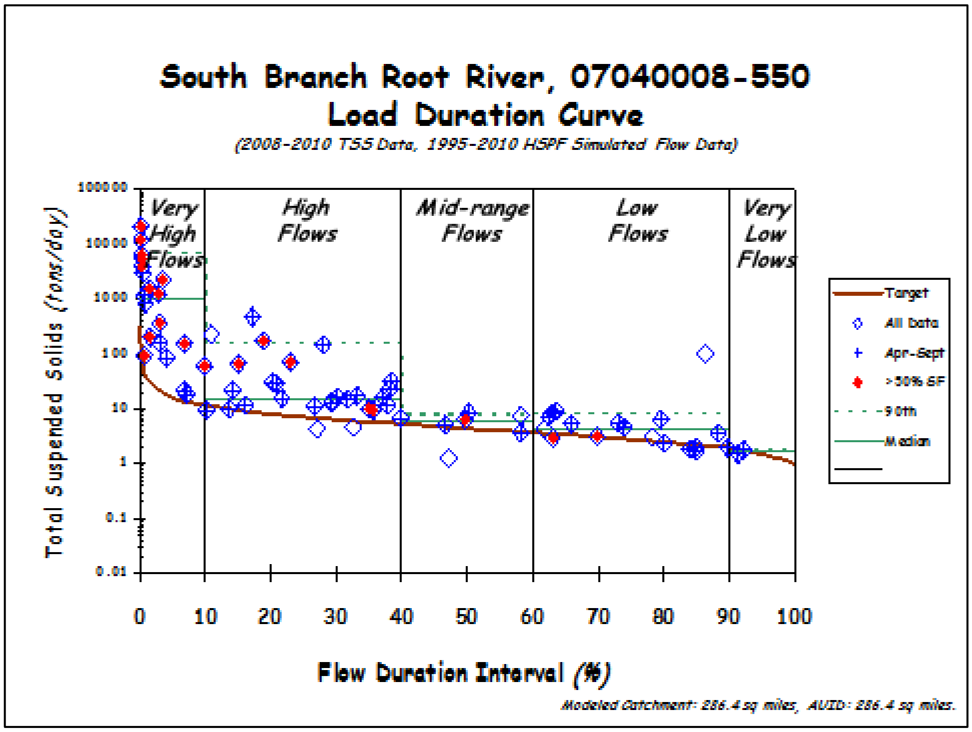


A15. 07040008-550

a. ***E. coli*:**

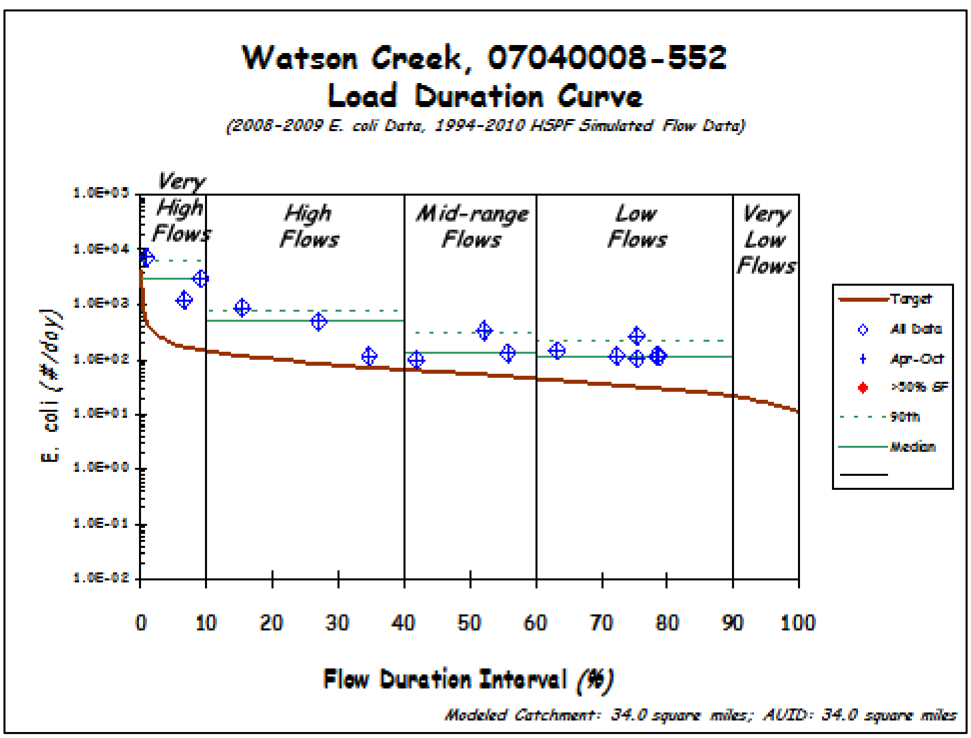


b. Total Suspended Solids:

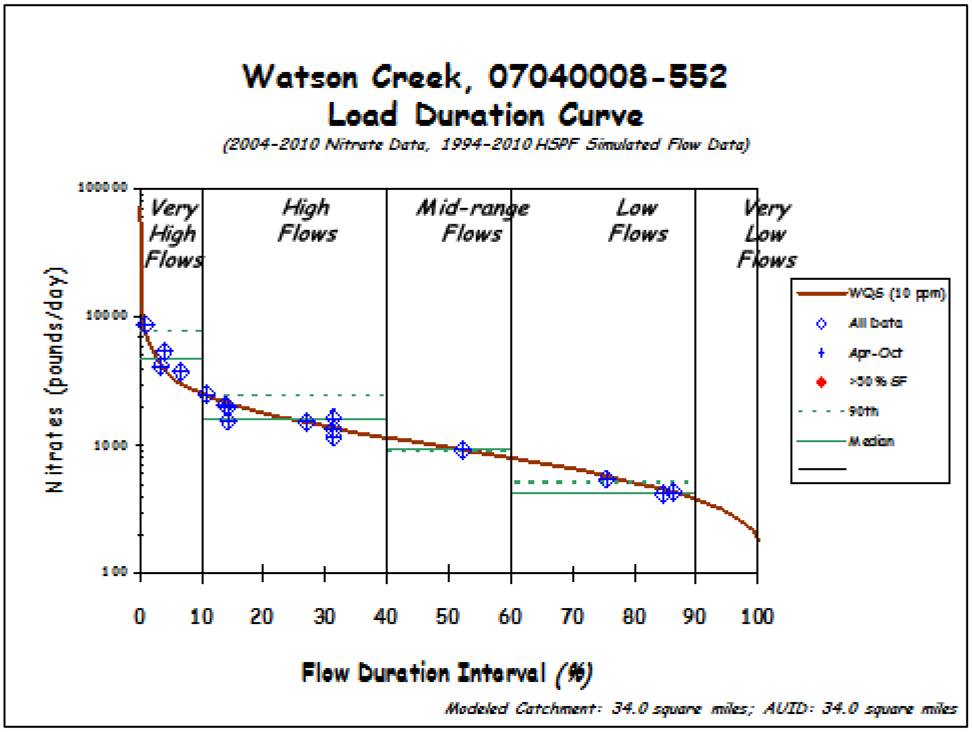


A16. 07040008-552

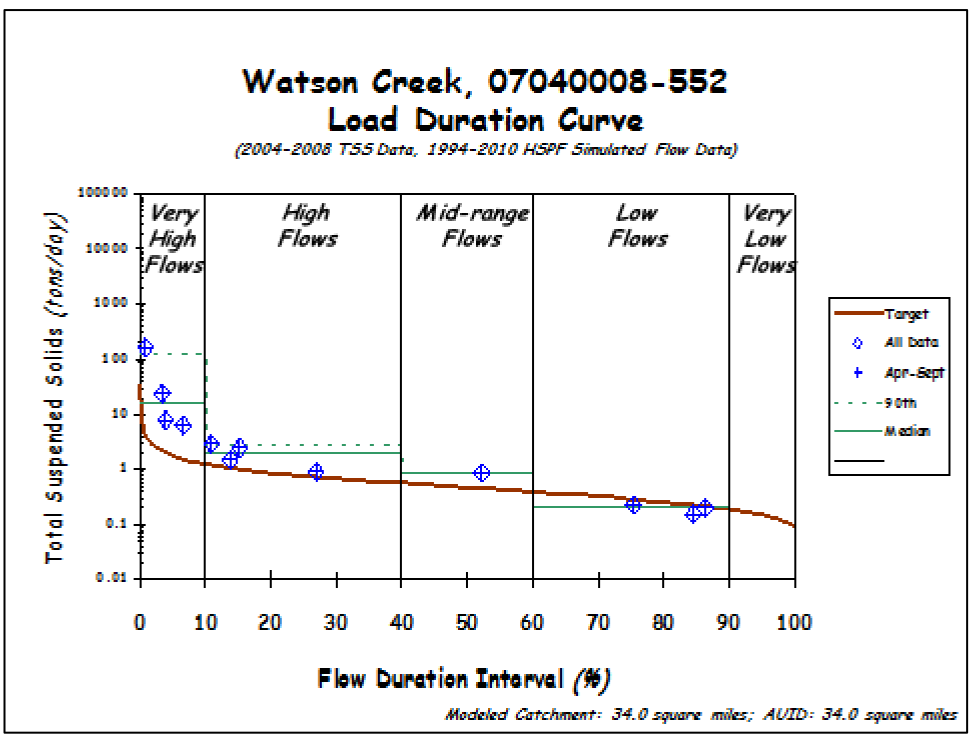
a. *E.coli*:



b. Nitrate:

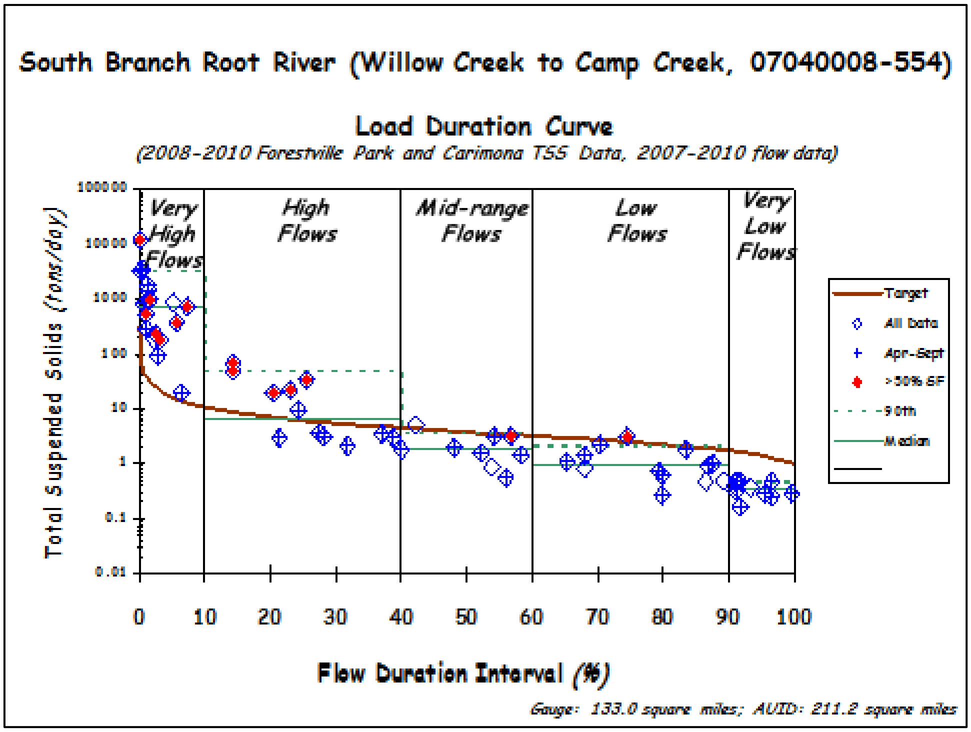


c. Total suspended solids:



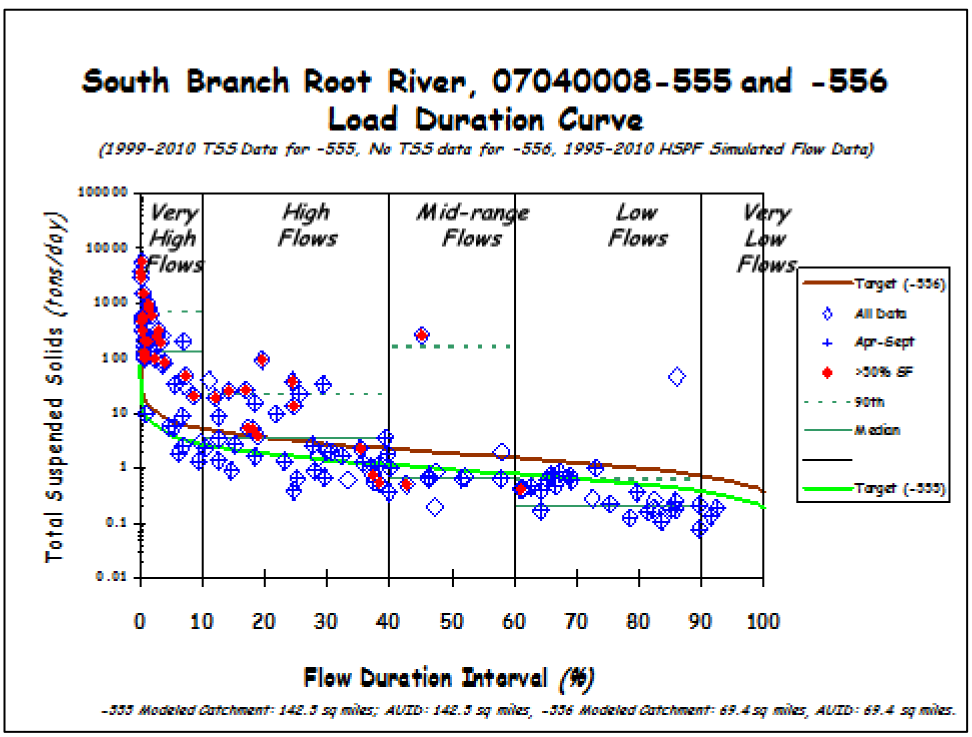
A17. 07040008-554

a. Total suspended solids:



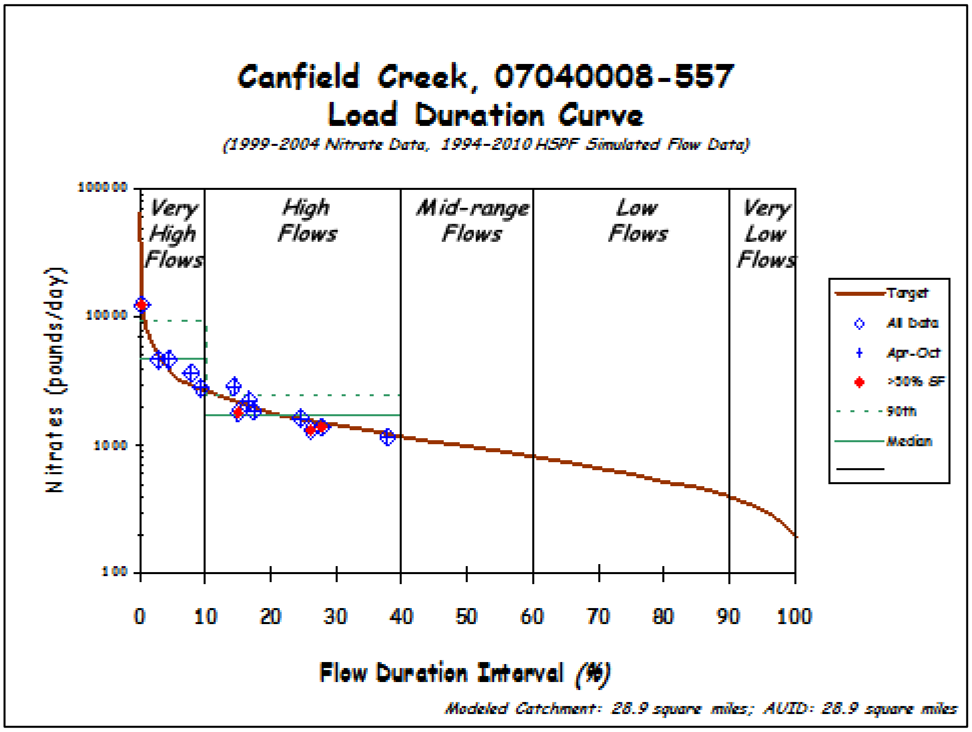
A18. 07040008-555, -556

a. Total suspended solids:



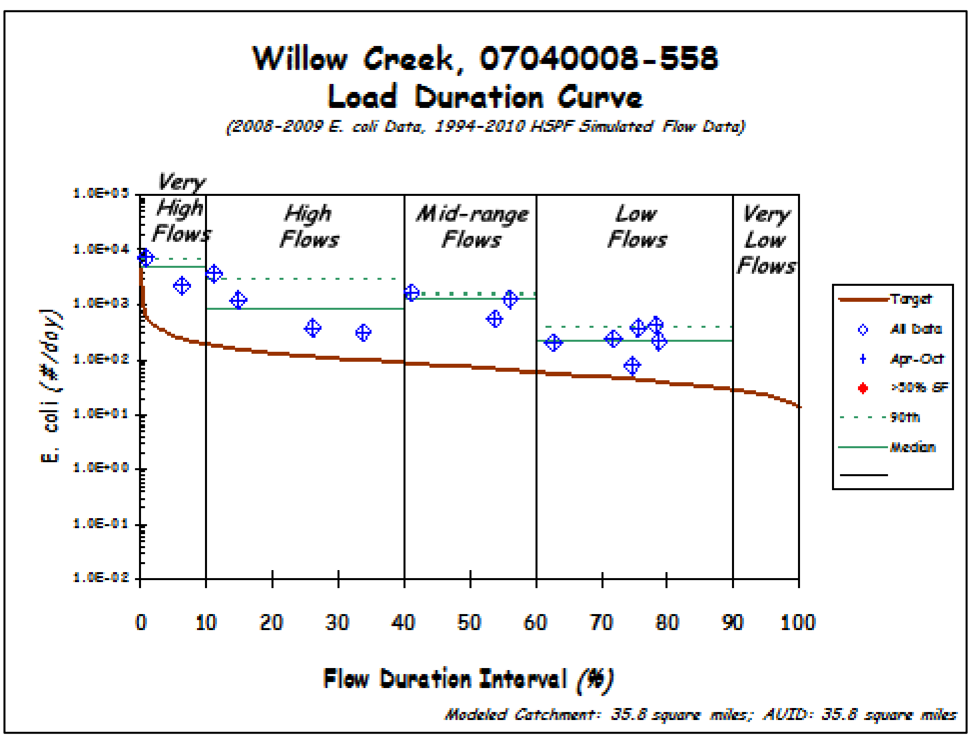
A19: 07040008-557

a. Nitrate:

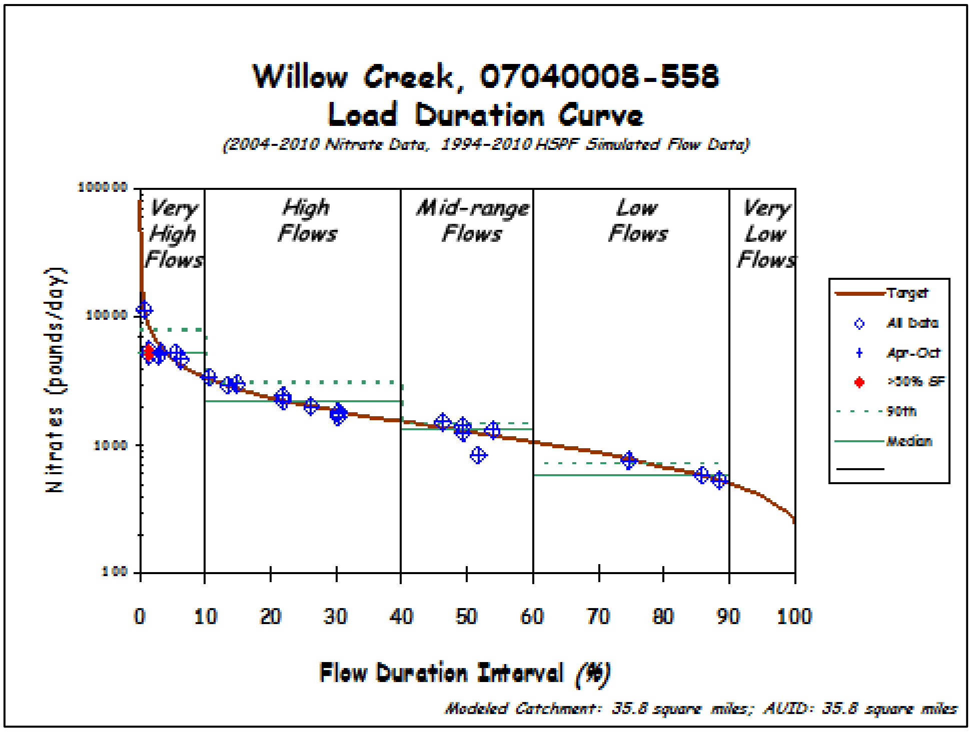


A20. 07040008-558

a. *E.coli*:

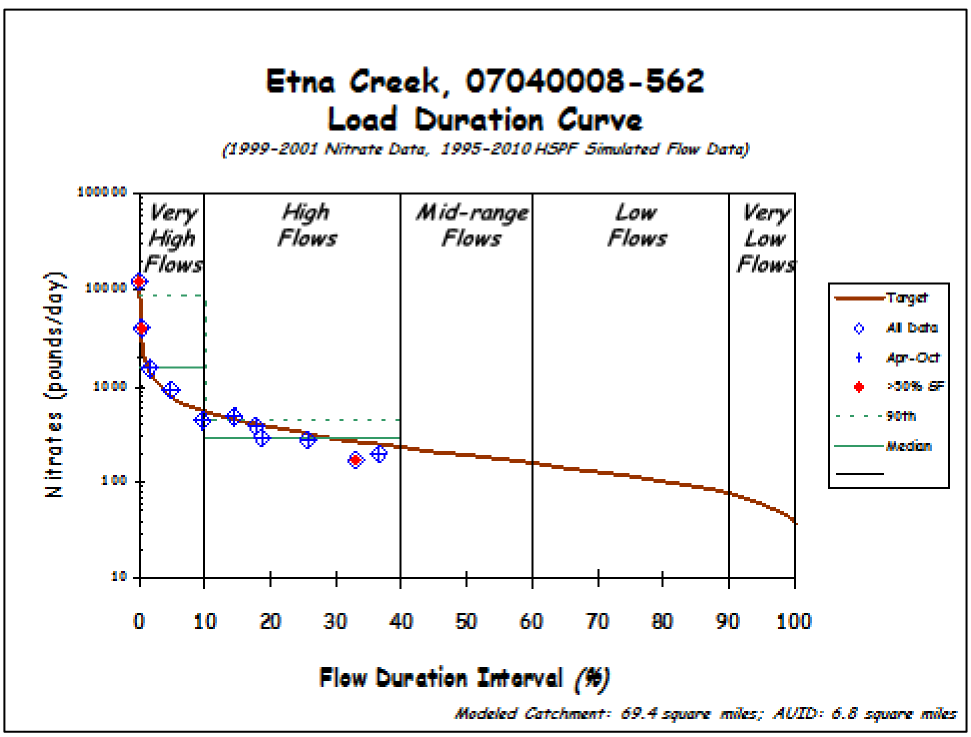


b. Nitrates:



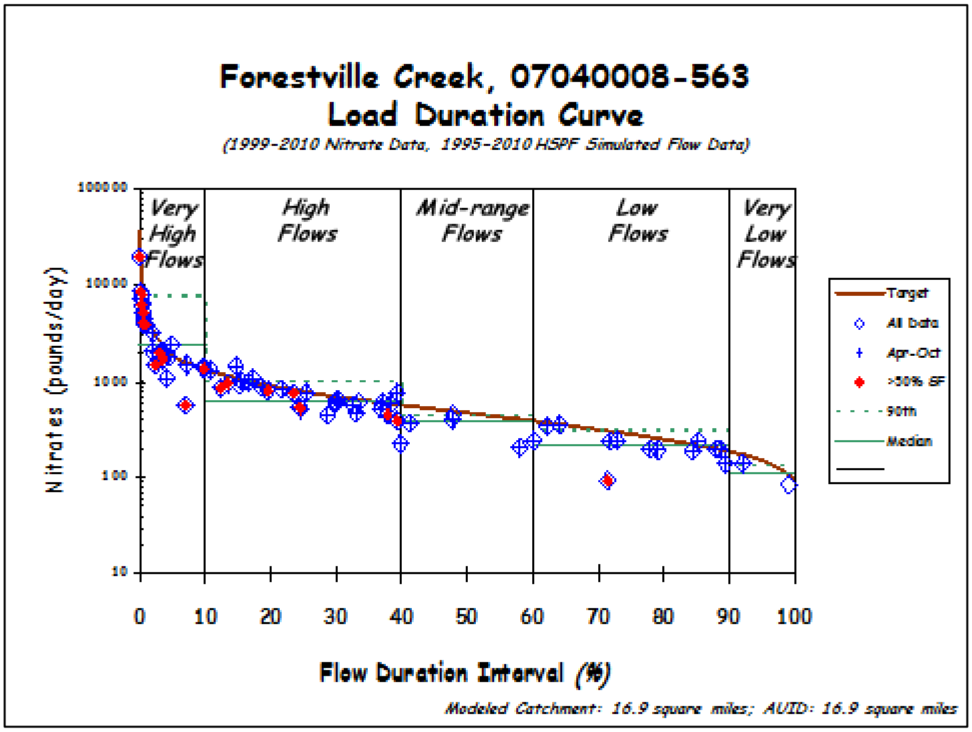
A21. 07040008-562

a. Nitrates:



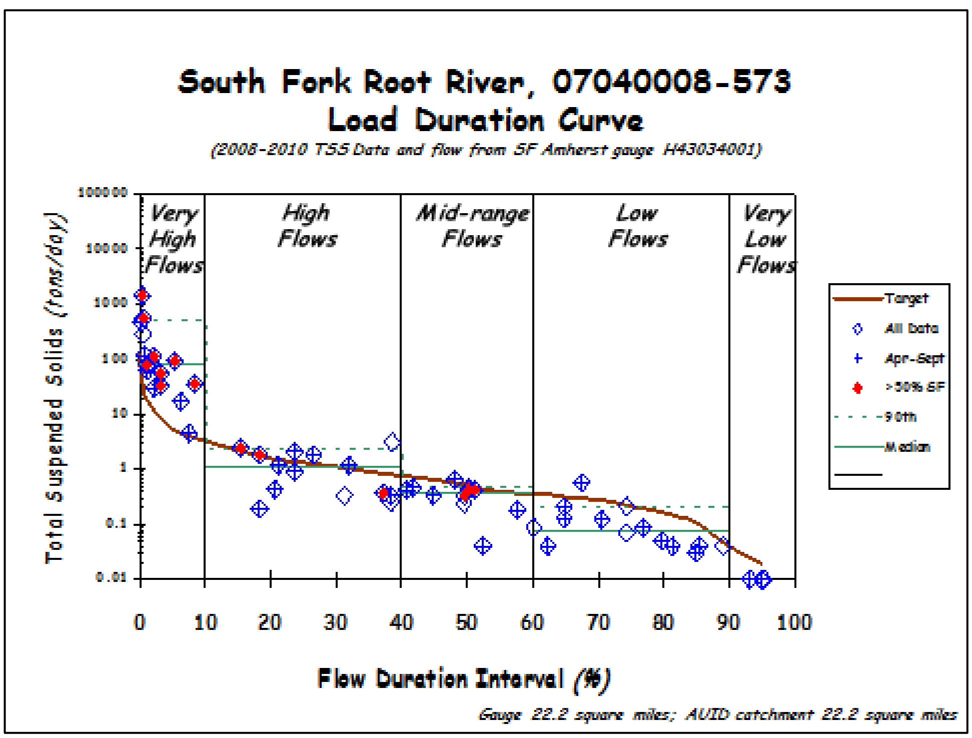
A22. 07040008-563

a. Nitrates:



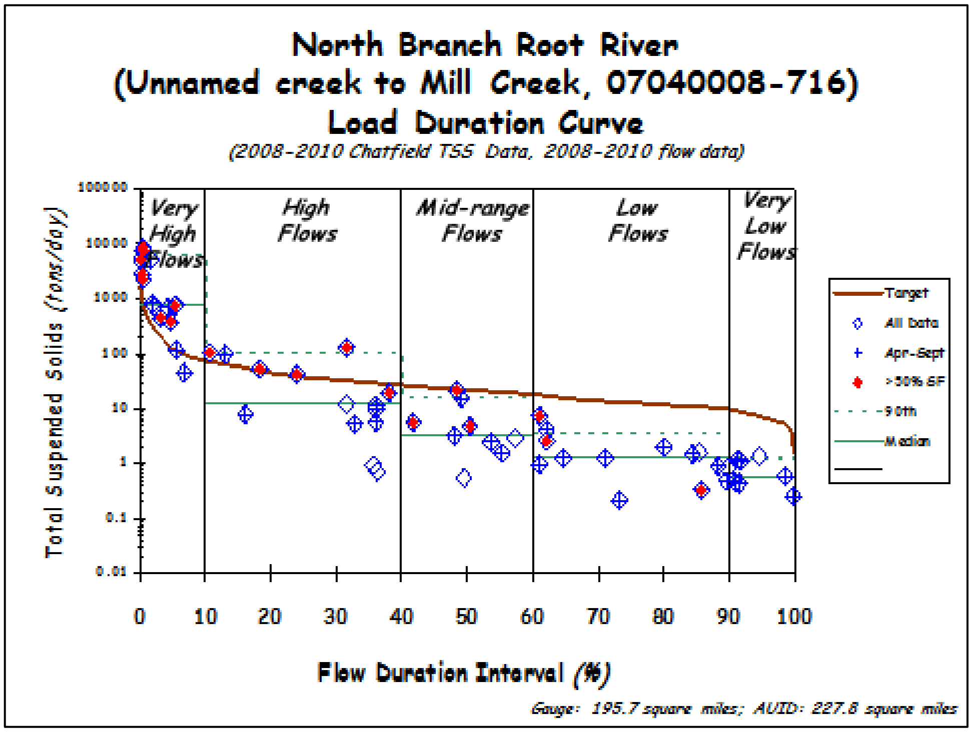
A23. 07040008-573

a. Total suspended solids:



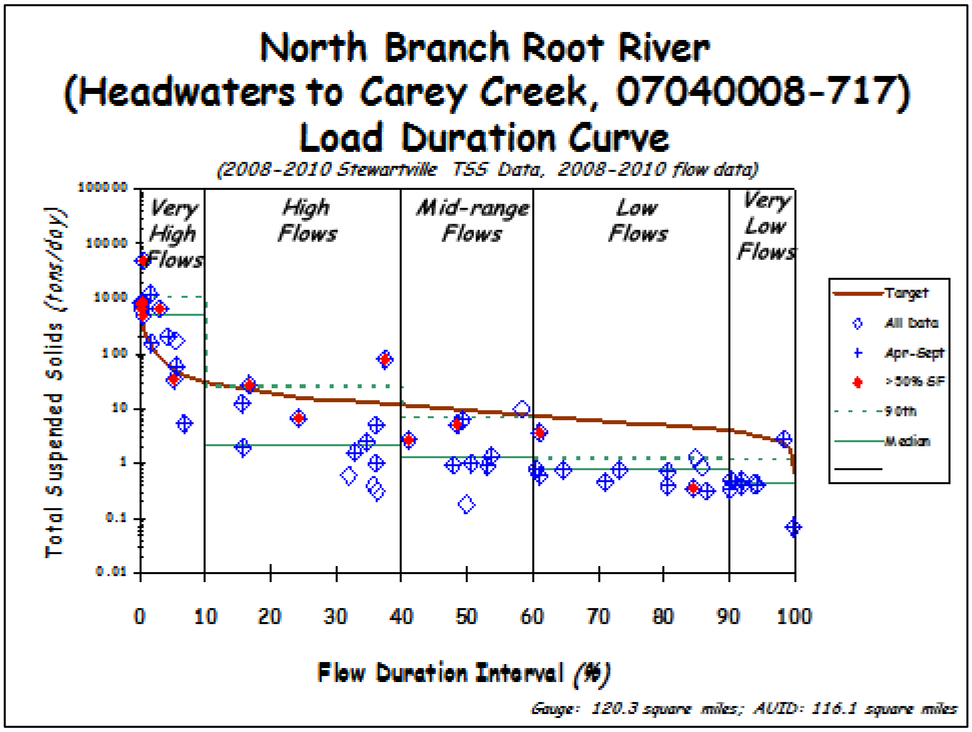
A24. 07040008-716

a. Total suspended solids:



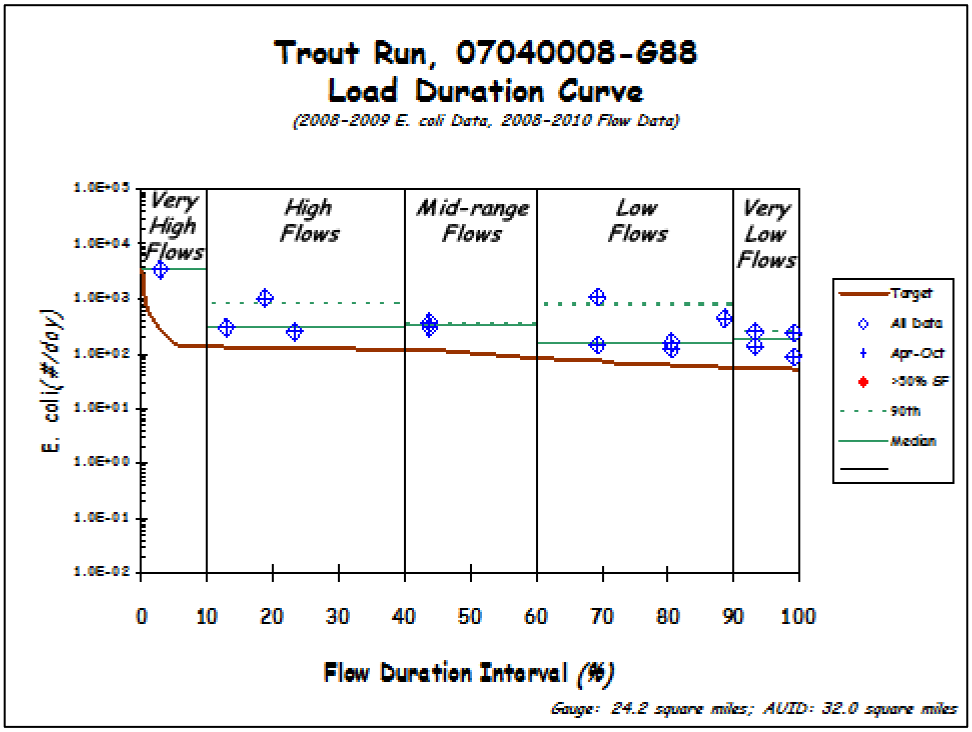
A25. 07040008-717

a. Total suspended solids:



A26. 07040008-G88

a. *E. coli*:



Appendix B. Percent reductions to standards based on LDCs and 90th percentile water quality values in each flow zone.

Root River (Lower)	Flow Regime				
	Vhigh	High	Mod	Low	Vlow
AUID -501					
TSS % exceedance	97.9	69.4	none	none	none
AUID -502					
TSS % exceedance	97.1	79.1	38.2	14.5	none
AUID -507					
Bacteria % exceedance	95.2	95.6	65.1	78.5	47.9
City of Rushford-Root River	Flow Regime				
	Vhigh	High	Mod	Low	Vlow
AUIDs -520,-522,-527					
TSS % exceedance	96.7	14.3	none	none	NA
Trout Run-Root River	Flow Regime				
	Vhigh	High	Mod	Low	Vlow
AUID -528					
TSS % exceedance	97.7	83.0	none	none	none
AUID -534					
Bacteria % exceedance	99.0	73.9	NA	84.4	NA
AUID -G88					
Bacteria % exceedance	95.5	86.0	71.9	92.0	79.4
Middle Branch Root River	Flow Regime				
	Vhigh	High	Mod	Low	Vlow
AUID -506					
Bacteria % exceedance	96.6	86.4	79.2	73.5	NA
AUID -542					
Bacteria % exceedance	94.9	92.8	74.3	78.1	NA
AUID -546					

Bacteria % exceedance	96.8	95.1	91.5	86.9	NA
AUID -548					
Bacteria % exceedance	96.2	94.8	94.3	89.5	NA
North Branch Root River	Flow Regime				
	Vhigh	High	Mod	Low	Vlow
AUID -535					
Bacteria % exceedance	97.4	94.2	88.9	85.4	61.8
AUID -536					
Bacteria % exceedance	98.7	88.7	93.5	67.0	67.8
AUID -716					
TSS % exceedance	98.1	62.7	none	none	none
AUID -717					
TSS % exceedance	95.2	36.9	none	none	none
Rush Creek	Flow Regime				
	Vhigh	High	Mod	Low	Vlow
AUID -523					
Bacteria % exceedance	95.3	NA	NA	54.9	44.1
South Branch Root River	Flow Regime				
	Vhigh	High	Mod	Low	Vlow
AUID -550					
TSS % exceedance	99.8	95.3	44.9	67.2	13.6
Bacteria % exceedance	97.5	46.74	62.3	20.4	NA
AUID -552					
TSS % exceedance	98.6	72.2	45.4	none	NA
Bacteria % exceedance	96.9	88.4	81.8	84.2	NA
Nitrate % exceedance	64.3	48.8	17	10.5	NA
AUID -554					
TSS % exceedance	99.5	87.4	none	none	none
AUID -555					

TSS % exceedance	99.0	86.5	98.8	none	NA
Nitrate % exceedance	49.3	29.1	7.2	9.7	NA
AUID -556					
TSS % exceedance	99	86.5	98.8	none	none
AUID -557					
Nitrate % exceedance	61.0	34.1	none	none	none
AUID -558					
Bacteria % exceedance	96.2	96.0	95.4	89.1	none
Nitrate % exceedance	40.9	33.9	13.1	none	none
AUID -562					
Nitrate % exceedance	91.5	25.0	none	none	none
AUID -563					
Bacteria % exceedance	100.0	95.3	63.1	none	none
Nitrate % exceedance	76.5	23.2	none	10.5	none
South Fork Root River	Flow Regime				
	Vhigh	High	Mod	Low	Vlow
AUID -508					
TSS % exceedance	98.4	87.9	60.3	36.6	none
Bacteria % exceedance	97.6	95.5	NA	82.3	NA
AUID -509					
TSS % exceedance	98.9	92	73.9	58.1	none
AUID -511					
TSS % exceedance	99.9	90.3	94.6	88	64.1
AUID -573					
TSS % exceedance	99	44.5	none	1.6	none

note: NA indicates only one data point was available; a target load and therefore % exceedance could not be calculated. None indicates no reduction is needed in that flow zone.

Appendix C. NPDES permitted facilities included in WLAs on impaired AUIDs receiving TMDLs in this report.

1. Root River (Lower)

Table 62. NPDES permitted facilities included for the Root River (07040008 -501, and -502)

Facility	Permit Number	Design or Maximum Flow (MGD)	TSS limit (mg/L)	TSS WLA (tons/day)
Municipal/Industrial Wastewater				
Canton WWTP	**MN0023001**	0.065	30	0.01
Chatfield WWTP	**MN0021857**	0.487	30	0.06
Dexter WWTP	**MNG580228**	0.0454	45	0.01
Foremost Farms USA Cooperative	**MN0001333**	0.225	NA	NA
Fountain WWTP	**MN0050873**	0.062	30	0.01
Grand Meadow WWTP	**MN0023558**	0.12	45	0.196
Great River Energy - Pleasant Valley	**MN0067717**	0.12*	30	0.015
Haven Hutterian Brethren	**MNG580071**	0.01125	45	0.002
Hokah WWTP	**MN0021458**	0.102	30	0.01
Houston WWTP	**MN0023736**	0.25	30	0.03
Lanesboro Public Utilities - Light Plant	**MNG255021**	0.1	NA	NA
Lanesboro WWTP	**MN0020044**	0.11	30	0.01
Lewiston WWTP	**MN0023965**	0.35	30	0.04
Mabel WWTP	**MN0020877**	0.189	30	0.02
MDNR Lanesboro State Fish Hatchery	**MN0004430**	13.4	30	1.52
MDNR Peterson State Fish Hatchery	**MN0061221**	7.056	30	0.80
Milestone Materials - Panhandle Quarry	**MNG490081 (Station 121)**	4.32	30	0.54
Milestone Materials - Stewartville I-90 Quarry 496	**MNG490081 (Station 120)**	4.32	30	0.54
MNDOT Enterprise Rest Area	**MN0048844**	0.0058	45	0.001
MNDOT High Forest Rest Area	**MN0044377**	0.0033	30	0.0004
Ostrander WWTP	**MN0024449**	0.0394	30	0.005
Peterson WWTP	**MN0024490**	0.0507	30	0.01
Preston WWTP	**MN0020745**	0.392	30	0.04
Racine WWTP	**MN0024554**	0.039	45	0.03
Rushford WWTP	**MN0024678**	0.33	30	0.04
Spring Valley WWTP	**MN0051934**	0.936	30	0.11
Stewartville WWTP	**MN0020681**	1.1114	30	0.13
Ulland Brothers - Aggregate	**MNG490069**	58.89	30	6.69
Wykoff WWTP	**MN0020826**	0.049	30	0.01
TOTAL				**10.85**
Industrial Stormwater**				
Pro-Corn LLC dba POET Biorefining - Preston; Stations SD002	**MN0064017**	NA	30	0.01

Pro-Corn LLC dba POET Biorefining - Preston; Stations SD003	**MN0064017**	NA	30	0.01
TOTAL				**0.02**

*The MGD used to calculate the WLA reflects the maximum discharge flow value from the facility's most recent permit application.
**Industrial Stormwater permittees were given individual WLAs if they had both a limit and a design flow. All other stormwater is covered under the categorical construction and industrial stormwater allocation.

2. City of Rushford Root River

Table 63. NPDES permitted facilities included for the Root River (07040008-520).

Facility	Permit Number	Design Flow	TSS limit (mg/L)	TSS WLA (tons/day)
Municipal/Industrial Wastewater				
Chatfield WWTP	**MN0021857**	0.487	30	0.06
Dexter WWTP	**MNG580228**	0.0454	45	0.05
Foremost Farms USA Cooperative	**MN0001333**	0.225	NA	NA
Fountain WWTP	**MN0050873**	0.062	30	0.01
Grand Meadow WWTP	**MN0023558**	0.12	45	0.196
Great River Energy - Pleasant Valley	**MN0067717**	0.12*	30	0.015
Haven Hutterian Brethren	**MNG580071**	0.01125	45	0.02
Houston WWTP	**MN0023736**	0.25	30	0.03
Lanesboro Public Utilities - Light Plant	**MNG255021**	0.1	NA	NA
Lanesboro WWTP	**MN0020044**	0.11	30	0.01
Lewiston WWTP	**MN0023965**	0.35	30	0.03
MDNR Lanesboro State Fish Hatchery	**MN0004430**	13.4	30	0.86
MDNR Peterson State Fish Hatchery	**MN0061221**	7.056	30	0.28
Milestone Materials - Panhandle Quarry	**MNG490081 (Station 121)**	4.32	30	0.54
Milestone Materials - Stewartville I-90 Quarry 496	**MNG490081 (Station 120)**	4.32	30	0.54
MNDOT Enterprise Rest Area	**MN0048844**	0.0058	45	0.004
MNDOT High Forest Rest Area	**MN0044377**	0.0033	30	0.0004
Ostrander WWTP	**MN0024449**	0.0394	30	0.005
Peterson WWTP	**MN0024490**	0.0507	30	0.01
Preston WWTP	**MN0020745**	0.392	30	0.04
Racine WWTP	**MN0024554**	0.039	45	0.03
Rushford WWTP	**MN0024678**	0.33	30	0.04
Spring Valley WWTP	**MN0051934**	0.936	30	0.11
Stewartville WWTP	**MN0020681**	1.1114	30	0.13
Ulland Brothers - Aggregate	**MNG490069**	58.89	30	6.69
Wykoff WWTP	**MN0020826**	0.049	30	0.01
TOTAL				**9.68**
Industrial Stormwater**				

Pro-Corn LLC dba POET Biorefining - Preston; Stations SD002	**MN0064017**	30	0.01
Pro-Corn LLC dba POET Biorefining - Preston; Stations SD003	**MN0064017**	30	0.01
TOTAL			**0.02**

*The MGD used to calculate the WLA reflects the maximum discharge flow value from the facility's most recent permit application.
**Industrial Stormwater permittees were given individual WLAs if they had both a limit and a design flow. All other stormwater is covered under the categorical construction and industrial stormwater allocation.

Facility	Permit Number	Design Flow	TSS limit (mg/L)	TSS WLA (tons/day)
Municipal/Industrial Wastewater				
Chatfield WWTP	**MN0021857**	0.487	30	0.06
Dexter WWTP	**MNG580228**	0.0454	45	0.05
Foremost Farms USA Cooperative	**MN0001333**	0.225	NA	NA
Fountain WWTP	**MN0050873**	0.062	30	0.01
Grand Meadow WWTP	**MN0023558**	0.12	45	0.196
Great River Energy - Pleasant Valley	**MN0067717**	0.12*	30	0.015
Haven Hutterian Brethren	**MNG580071**	0.01125	45	0.02
Houston WWTP	**MN0023736**	0.25	30	0.03
Lanesboro Public Utilities - Light Plant	**MNG255021**	0.1	NA	NA
Lanesboro WWTP	**MN0020044**	0.11	30	0.01
Lewiston WWTP	**MN0023965**	0.35	30	0.03
MDNR Lanesboro State Fish Hatchery	**MN0004430**	13.4	30	0.86
MDNR Peterson State Fish Hatchery	**MN0061221**	7.056	30	0.28
Milestone Materials - Panhandle Quarry	**MNG490081 (Station 121)**	4.32	30	0.54
Milestone Materials - Stewartville I-90 Quarry 496	**MNG490081 (Station 120)**	4.32	30	0.54
MNDOT Enterprise Rest Area	**MN0048844**	0.0058	45	0.004
MNDOT High Forest Rest Area	**MN0044377**	0.0033	30	0.0004
Ostrander WWTP	**MN0024449**	0.0394	30	0.005
Peterson WWTP	**MN0024490**	0.0507	30	0.01
Preston WWTP	**MN0020745**	0.392	30	0.04
Racine WWTP	**MN0024554**	0.039	45	0.03
Rushford WWTP	**MN0024678**	0.33	30	0.04
Spring Valley WWTP	**MN0051934**	0.936	30	0.11
Stewartville WWTP	**MN0020681**	1.1114	30	0.13
Ulland Brothers - Aggregate	**MNG490069**	58.89	30	6.69
Wykoff WWTP	**MN0020826**	0.049	30	0.01
TOTAL				**9.68**
Industrial Stormwater**				

Pro-Corn LLC dba POET Biorefining - Preston; Stations SD002	**MN0064017**	30	0.01
Pro-Corn LLC dba POET Biorefining - Preston; Stations SD003	**MN0064017**	30	0.01
TOTAL			**0.02**

*The MGD used to calculate the WLA reflects the maximum discharge flow value from the facility's most recent permit application.
**Industrial Stormwater permittees were given individual WLAs if they had both a limit and a design flow. All other stormwater is covered under the categorical construction and industrial stormwater allocation.

Table 64. NPDES permitted facilities included for the Root River (07040008-522).

Facility	Permit Number	Design Flow	TSS limit (mg/L)	TSS WLA (tons/day)
Municipal/Industrial Wastewater				
Chatfield WWTP	**MN0021857**	0.487	30	0.06
Dexter WWTP	**MNG580228**	0.0454	45	0.05
Foremost Farms USA Cooperative	**MN0001333**	0.225	NA	NA
Fountain WWTP	**MN0050873**	0.062	30	0.01
Grand Meadow WWTP	**MN0023558**	0.196	45	0.196
Great River Energy - Pleasant Valley	**MN0067717**	0.12*	30	0.015
Haven Hutterian Brethren	**MNG580071**	0.01125	45	0.02
Lanesboro Public Utilities - Light Plant	**MNG255021**	0.1	NA	NA
Lanesboro WWTP	**MN0020044**	0.11	30	0.01
Lewiston WWTP	**MN0023965**	0.35	30	0.03
MDNR Lanesboro State Fish Hatchery	**MN0004430**	13.4	30	0.86
MDNR Peterson State Fish Hatchery	**MN0061221**	7.056	30	0.28
Milestone Materials - Panhandle Quarry	**MNG490081 (Station 121)**	4.32	30	0.54
Milestone Materials - Stewartville I-90 Quarry 496	**MNG490081 (Station 120)**	4.32	30	0.54
MNDOT Enterprise Rest Area	**MN0048844**	0.0058	45	0.004
MNDOT High Forest Rest Area	**MN0044377**	0.0033	30	0.0004
Ostrander WWTP	**MN0024449**	0.0394	30	0.005
Peterson WWTP	**MN0024490**	0.0507	30	0.01
Preston WWTP	**MN0020745**	0.392	30	0.04
Racine WWTP	**MN0024554**	0.039	45	0.03
Rushford WWTP	**MN0024678**	0.33	30	0.04
Spring Valley WWTP	**MN0051934**	0.936	30	0.11
Stewartville WWTP	**MN0020681**	1.1114	30	0.13
Ulland Brothers - Aggregate	**MNG490069**	58.89	30	6.69
Wykoff WWTP	**MN0020826**	0.049	30	0.01
TOTAL				**9.65**
Industrial Stormwater**				

Pro-Corn LLC dba POET Biorefining - Preston; Stations SD002	**MN0064017**	30	0.01
Pro-Corn LLC dba POET Biorefining - Preston; Stations SD003	**MN0064017**	30	0.01
TOTAL			**0.02**

*The MGD used to calculate the WLA reflects the maximum discharge flow value from the facility's most recent permit application.
**Industrial Stormwater permittees were given individual WLAs if they had both a limit and a design flow. All other stormwater is covered under the categorical construction and industrial stormwater allocation.

Facility	Permit Number	Design Flow	TSS limit (mg/L)	TSS WLA (tons/day)
Municipal/Industrial Wastewater				
Chatfield WWTP	**MN0021857**	0.487	30	0.06
Dexter WWTP	**MNG580228**	0.0454	45	0.05
Foremost Farms USA Cooperative	**MN0001333**	0.225	NA	NA
Fountain WWTP	**MN0050873**	0.062	30	0.01
Grand Meadow WWTP	**MN0023558**	0.196	45	0.196
Great River Energy - Pleasant Valley	**MN0067717**	0.12*	30	0.015
Haven Hutterian Brethren	**MNG580071**	0.01125	45	0.02
Lanesboro Public Utilities - Light Plant	**MNG255021**	0.1	NA	NA
Lanesboro WWTP	**MN0020044**	0.11	30	0.01
Lewiston WWTP	**MN0023965**	0.35	30	0.03
MDNR Lanesboro State Fish Hatchery	**MN0004430**	13.4	30	0.86
MDNR Peterson State Fish Hatchery	**MN0061221**	7.056	30	0.28
Milestone Materials - Panhandle Quarry	**MNG490081 (Station 121)**	4.32	30	0.54
Milestone Materials - Stewartville I-90 Quarry 496	**MNG490081 (Station 120)**	4.32	30	0.54
MNDOT Enterprise Rest Area	**MN0048844**	0.0058	45	0.004
MNDOT High Forest Rest Area	**MN0044377**	0.0033	30	0.0004
Ostrander WWTP	**MN0024449**	0.0394	30	0.005
Peterson WWTP	**MN0024490**	0.0507	30	0.01
Preston WWTP	**MN0020745**	0.392	30	0.04
Racine WWTP	**MN0024554**	0.039	45	0.03
Rushford WWTP	**MN0024678**	0.33	30	0.04
Spring Valley WWTP	**MN0051934**	0.936	30	0.11
Stewartville WWTP	**MN0020681**	1.1114	30	0.13
Ulland Brothers - Aggregate	**MNG490069**	58.89	30	6.69
Wykoff WWTP	**MN0020826**	0.049	30	0.01
TOTAL				**9.65**
Industrial Stormwater**				
Pro-Corn LLC dba POET Biorefining - Preston; Stations SD002	**MN0064017**		30	0.01

Pro-Corn LLC dba POET Biorefining - Preston; Stations SD003	**MN0064017**		30	0.01
TOTAL				**0.02**

*The MGD used to calculate the WLA reflects the maximum discharge flow value from the facility's most recent permit application.
**Industrial Stormwater permittees were given individual WLAs if they had both a limit and a design flow. All other stormwater is covered under the categorical construction and industrial stormwater allocation.

Table 65. NPDES permitted facilities included for the Root River (07040008-527).

Facility	Permit Number	Design Flow	TSS limit (mg/L)	TSS WLA (tons/day)
Municipal/Industrial Wastewater				
Chatfield WWTP	**MN0021857**	0.487	30	0.06
Dexter WWTP	**MNG580228**	0.0454	45	0.05
Foremost Farms USA Cooperative	**MN0001333**	0.225	NA	NA
Fountain WWTP	**MN0050873**	0.062	30	0.01
Grand Meadow WWTP	**MN0023558**	0.196	45	0.196
Great River Energy - Pleasant Valley	**MN0067717**	0.12*	30	0.015
Haven Hutterian Brethren	**MNG580071**	0.01125	45	0.02
Lanesboro Public Utilities - Light Plant	**MNG255021**	0.1	NA	NA
Lanesboro WWTP	**MN0020044**	0.11	30	0.01
MDNR Lanesboro State Fish Hatchery	**MN0004430**	13.4	30	0.86
MDNR Peterson State Fish Hatchery	**MN0061221**	7.056	30	0.28
Milestone Materials - Panhandle Quarry	**MNG490081 (Station 121)**	4.32	30	0.54
Milestone Materials - Stewartville I-90 Quarry 496	**MNG490081 (Station 120)**	4.32	30	0.54
MNDOT High Forest Rest Area	**MN0044377**	0.0033	30	0.0004
Ostrander WWTP	**MN0024449**	0.0394	30	0.005
Peterson WWTP	**MN0024490**	0.0507	30	0.006
Preston WWTP	**MN0020745**	0.392	30	0.04
Racine WWTP	**MN0024554**	0.039	45	0.03
Rushford WWTP	**MN0024678**	0.33	30	0.04
Spring Valley WWTP	**MN0051934**	0.936	30	0.11
Stewartville WWTP	**MN0020681**	1.1114	30	0.13
Ulland Brothers - Aggregate	**MNG490069**	58.89	30	6.69
Wykoff WWTP	**MN0020826**	0.049	30	0.006
TOTAL				**9.62**
Industrial Stormwater**				
Pro-Corn LLC dba POET Biorefining - Preston; Stations SD002	**MN0064017**		30	0.01
Pro-Corn LLC dba POET Biorefining - Preston; Stations SD003	**MN0064017**		30	0.01
TOTAL				**0.02**

*The MGD used to calculate the WLA reflects the maximum discharge flow value from the facility's most recent permit application.
**Industrial Stormwater permittees were given individual WLAs if they had both a limit and a design flow. All other stormwater is covered under the categorical construction and industrial stormwater allocation.

3. Trout Run Creek

Table 66. NPDES permitted facilities included for the Middle Branch Root River (07040008-528).

Facility	Permit Number	Design Flow	TSS limit (mg/L)	TSS WLA (tons/day)
Municipal/Industrial Wastewater				
Chatfield WWTP	**MN0021857**	0.487	30	0.06
Dexter WWTP	**MNG580228**	0.0454	45	0.05
Grand Meadow WWTP	**MN0023558**	0.12	45	0.196
Great River Energy - Pleasant Valley	**MN0067717**	0.12*	30	0.015
Haven Hutterian Brethren	**MNG580071**	0.01125	45	0.02
Milestone Materials - Panhandle Quarry	**MNG490081 (Station 121)**	4.32	30	0.54
Milestone Materials - Stewartville I-90 Quarry 496	**MNG490081 (Station 120)**	4.32	30	0.54
MNDOT High Forest Rest Area	**MN0044377**	0.0033	30	0.00
Racine WWTP	**MN0024554**	0.039	45	0.03
Spring Valley WWTP	**MN0051934**	0.936	30	0.11
Stewartville WWTP	**MN0020681**	1.1114	30	0.13
Ulland Brothers - Aggregate	**MNG490069**	58.89	30	6.69
Wykoff WWTP	**MN0020826**	0.049	30	0.01
TOTAL				**8.36**

*The MGD used to calculate the WLA reflects the maximum discharge flow value from the facility's most recent permit application.

Table 67. NPDES permitted facilities included for the Middle Branch Root River (07040008-534).

Facility	Permit Number	Design Flow	*E. coli* limit	*E. coli* WLA
Municipal/Industrial Wastewater				
Chatfield WWTP	**MN0021857**	0.49	126	2.32
Dexter WWTP	**MNG580228**	0.05	126	1.32
Grand Meadow WWTP	**MN0023558**	0.12	126	4.97
Great River Energy - Pleasant Valley	**MN0067717**	0.12*	30	0.015
Haven Hutterian Brethren	**MNG580071**	0.01	126	0.46
Milestone Materials - Panhandle Quarry	**MNG490081 (Station 121)**	4.32	30	0.54
Milestone Materials - Stewartville I-90 Quarry 496	**MNG490081 (Station 120)**	4.32	30	0.54
MNDOT High Forest Rest Area	**MN0044377**	0.00	126	0.02
Racine WWTP	**MN0024554**	0.04	126	0.78
Spring Valley WWTP	**MN0051934**	0.94	126	4.46
Stewartville WWTP	**MN0020681**	1.11	126	5.30
Wykoff WWTP	**MN0020826**	0.05	126	0.23
TOTAL				**20.96**

*The MGD used to calculate the WLA reflects the maximum discharge flow value from the facility's most recent permit application.

4. Middle Branch

Table 68. NPDES permitted facilities included for the Middle Branch Root River (07040008-506).

Facility	Permit Number	Design Flow	*E. coli* limit	*E. coli* WLA
Municipal/Industrial Wastewater				
Grand Meadow WWTP	**MN0023558**	0.12	126	4.97
Racine WWTP	**MN0024554**	0.039	126	0.78
Spring Valley WWTP	**MN0051934**	0.936	126	4.46
Wykoff WWTP	**MN0020826**	0.049	126	0.23
TOTAL				**10.45**

5. North Branch

Table 69. NPDES permitted facilities included for the Root River (07040008-535).

Facility	Permit Number	Design Flow	*E. coli* limit	*E. coli* WLA
Chatfield WWTP	**MN0021857**	0.49	126	2.32
Dexter WWTP	**MNG580228**	0.05	126	1.32
Great River Energy - Pleasant Valley	**MN0067717**	0.12*	30	0.015
Haven Hutterian Brethren	**MNG580071**	0.01	126	0.46
Milestone Materials - Panhandle Quarry	**MNG490081 (Station 121)**	4.32	30	0.54
Milestone Materials - Stewartville I-90 Quarry 496	**MNG490081 (Station 120)**	4.32	30	0.54
MNDOT High Forest Rest Area	**MN0044377**	0.003	126	0.02
Stewartville WWTP	**MN0020681**	1.11	126	5.30
TOTAL				**10.51**

*The MGD used to calculate the WLA reflects the maximum discharge flow value from the facility's most recent permit application.

Table 70. NPDES permitted facilities included for the North Branch Root River (07040008-716).

Facility	Permit Number	Design Flow	TSS limit (mg/L)	TSS WLA (tons/day)
Municipal/Industrial Wastewater				
Dexter WWTP	**MNG580228**	0.05	45	0.05
Great River Energy - Pleasant Valley	**MN0067717**	0.12*	30	0.015
Haven Hutterian Brethren	**MNG580071**	0.01	45	0.02
Milestone Materials - Panhandle Quarry	**MNG490081 (Station 121)**	4.32	30	0.54
Milestone Materials - Stewartville I-90 Quarry 496	**MNG490081 (Station 120)**	4.32	30	0.54
MNDOT High Forest Rest Area	**MN0044377**	0.003	30	0.00
Stewartville WWTP	**MN0020681**	1.11	30	0.13
TOTAL				**1.29**

*The MGD used to calculate the WLA reflects the maximum discharge flow value from the facility's most recent permit application.

Table 71. NPDES permitted facilities included for the North Branch Root River (07040008-717).

Facility	Permit Number	Design Flow	TSS limit (mg/L)	TSS WLA (tons/day)
Municipal/Industrial Wastewater				
Dexter WWTP	**MNG580228**	0.05	45	0.05
Great River Energy - Pleasant Valley	**MN0067717**	0.12*	30	0.015
Haven Hutterian Brethren	**MNG580071**	0.01	45	0.02
Milestone Materials - Panhandle Quarry	**MNG490081 (Station 121)**	4.32	30	0.54
Milestone Materials - Stewartville I-90 Quarry 496	**MNG490081 (Station 120)**	4.32	30	0.54
TOTAL				**1.16**

*The MGD used to calculate the WLA reflects the maximum discharge flow value from the facility's most recent permit application.

6. Rush Creek

Table 72. NPDES permitted facilities included for Rush Creek (07040008-523)

Facility	Permit Number	Design Flow	*E. coli* limit	*E. coli* WLA
Lewiston WWTP	**MN0023965**	0.35	126	1.19
MNDOT Enterprise Rest Area	**MN0048844**	0.006	126	0.11
TOTAL				**1.31**

7. South Branch

Table 73. NPDES permitted facilities included for the South Branch Root River (07040008-550).

Facility	Permit Number	Design Flow	TSS limit (mg/L)	TSS WLA (tons/day)	*E. coli* limit	*E. coli* WLA
Municipal/Industrial Wastewater						
Foremost Farms USA Cooperative	**MN0001333**	0.225	NA	NA	NA	NA
Fountain WWTP	**MN0050873**	0.062	30	0.007	126	0.296
Lanesboro Public Utilities - Light Plant	**MNG255021**	0.1	NA	NA	NA	NA
Lanesboro WWTP	**MN0020044**	0.11	30	0.011	126	0.525
MDNR Lanesboro State Fish Hatchery	**MN0004430**	13.4	30	0.862	NA	NA
Ostrander WWTP	**MN0024449**	0.039	30	0.005	126	0.188
Preston WWTP	**MN0020745**	0.392	30	0.045	126	1.869
TOTAL				**0.929**		**2.878**
Industrial Stormwater*						
Pro-Corn LLC dba POET Biorefining - Preston; Stations SD002	**MN0064017**		30	0.01	NA	NA
Pro-Corn LLC dba POET Biorefining - Preston; Stations SD003	**MN0064017**		30	0.01	NA	NA
TOTAL				**0.02**		**NA**

*Industrial Stormwater permittees were given individual WLAs if they had both a limit and a design flow. All other stormwater is covered under the categorical construction and industrial stormwater allocation.

Table 74. NPDES permitted facilities included for Watson Creek (07040008-552).

Facility	Permit Number	Design Flow	TSS limit (mg/L)	TSS WLA (tons/day)	*E. coli* limit	*E. coli* WLA	nitrate limit kg/day	nitrate WLA lbs/day
Municipal/Industrial Wastewater								
Fountain WWTP	**MN0050873**	0.062	30	0.01	126	0.30	10	5.18
TOTAL				**0.01**		**0.30**		**5.18**
Industrial Stormwater*								
Pro-Corn LLC dba POET Biorefining - Preston; Station SD002	**MN0064017**		30	0.01	NA	NA	NA	NA
Pro-Corn LLC dba POET Biorefining - Preston; Station SD003	**MN0064017**		30	0.01	NA	NA	NA	NA
TOTAL				**0.02**		**NA**		**NA**

Table 75. NPDES permitted facilities included for the South Branch Root River (07040008-554).

Facility	Permit Number	Design Flow	TSS limit (mg/L)	TSS WLA (tons/day)
Municipal/Industrial Wastewater				
Foremost Farms USA Cooperative	**MN0001333**	0.225	NA	NA
Ostrander WWTP	**MN0024449**	0.0394	30	0.005
Preston WWTP	**MN0020745**	0.392	30	0.04
TOTAL				**0.05**

Table 76. NPDES permitted facilities included for three sections of the South Branch of the Root River (07040008-555, -556, -557).

Facility	Permit Number	Design Flow	TSS limit (mg/L)	TSS WLA (tons/day)	nitrate limit kg/day	nitrate WLA lbs/day
Ostrander WWTP	**MN0024449**	0.0394	30	0.004	10	2.51
TOTAL				**0.004**		**2.51**

8. South Fork

Table 77. NPDES permitted facilities included for the South Fork Root River (07040008-508).

Facility	Permit Number	Design Flow	TSS limit (mg/L)	TSS WLA (tons/day)	*E. coli* limit	*E. coli* WLA
Canton WWTP	**MN0023001**	0.065	30	0.01	126	0.310
Mabel WWTP	**MN0020877**	0.189	30	0.02	126	0.901
TOTAL				**0.03**		**1.211**

Table 78. NPDES permitted facilities included for the South Fork Root River (07040008-509).

Facility	Permit Number	Design Flow	TSS limit (mg/L)	TSS WLA (tons/day)
Canton WWTP	**MN0023001**	0.065	30	0.01
Mabel WWTP	**MN0020877**	0.189	30	0.02
TOTAL				**0.03**