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Dutch Creek and Fairmont Chain of Lakes Section 319 Small Watershed Focus Program NKE

MINNESOTA POLLUTION
CONTROL AGENCY

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Executive summary

The Fairmont Chain of Lakes is a primary drinking water source of the City of Fairmont, with the intake to the water treatment plant in Budd Lake. The nitrate concentration in Budd Lake exceeded the maximum contaminant level (MCL) for drinking water in May 2016. This episode resulted in significantly increased public awareness on the effect of nutrient runoff into the lakes. Nitrate concentrations in the lake have since not exceeded the MCL. However, nitrate concentrations are often 5 to 6 mg/l causing concern for the city.

In addition to the elevated nitrates, total phosphorus (TP) concentrations in the lakes often exceed the TP criteria of the lake eutrophication water quality standard for the Western Corn Belt Plains (WCBP) nutrient ecoregion of 65 µg/l. At least one of the other lake eutrophication criteria are also exceeded, such that Amber, Hall, Budd, and George Lakes are listed as impaired. A primary contributor to the pollution in the lakes is Dutch Creek, which is also listed as impaired for fecal coliform and turbidity. For the purposes of this plan, the fecal coliform impairment will be addressed as E. coli and the turbidity impairment as total suspended solids (TSS). Monitoring and modeling indicate that Dutch Creek is the major contributor of nutrients and sediment to the lakes.

The exceedance of the MCL captured local, regional, and national attention. The eutrophication in the lakes is of great interest to watershed residents. The effects of eutrophication go beyond the drinking water concerns from harmful algal bloom (HAB) toxins and have potential recreational and economic impacts due to the aesthetics of the lakes. Fairmont and Martin County have identified and are invested in addressing the nutrient and sediment loading in the watershed. State and federal agencies, including the Minnesota Pollution Control Agency (MPCA), Minnesota Department of Health (MDH), Minnesota Department of Agriculture (MDA), Minnesota Department of Natural Resources (DNR), and U.S. Environmental Protection Agency (EPA), have invested in studies and monitoring in this area.

This plan is meant to approach the watershed system and holistically address all of the area concerns, with emphasis on the nonpoint sources (NPS) of pollution. Much of the early implementation activities have started and will continue in the Dutch Creek Watershed. The plan will be continually evaluated and updated using the plan's milestones and goals.

1. Introduction

The Dutch Creek and Fairmont Chain of Lakes Section 319 Small Watershed Focus Program Grant Workplan was developed by compiling information from previous studies and planning documents conducted in the watershed. Much of the text and concepts in this Workplan are derived from the various existing studies and plans in the watershed. Additional information is provided when necessary to address all the U.S. Environmental Protection Agency's (EPA) nine key elements of a watershed-based plan. Key documents include:

- Dutch Creek and Hall Lake SWAT Modeling Report, 2017
- Draft Minnesota River and Greater Blue Earth River Basin TSS TMDL, 2019
- Greater Blue Earth River Basin Fecal Coliform TMDL Report Implementation Plan, 2007
- Fecal Coliform TMDL Assessment for 21 Impaired Streams in the Blue Earth River Basin, 2007
- Martin County Local Water Plan (2017-2026), 2016
- Marin SWCD 2017 Annual Plan, 2017
- Source Water Assessment (SWA) for the City of Fairmont Public Water System, 2019

This Workplan is a living, working document that serves as a guide and starting point for local stakeholders within the watershed to achieve water quality goals through implementation of nonpoint source pollution control measures. Milestones and measures are built into this plan, providing the partners with a regular opportunity to evaluate the progress toward their goals. This foundation builds an active adaptive management approach to allow for change, reaction, and course correction throughout implementation.

1.1 Document overview

The intent of this document is to concisely address the nine elements identified in EPA's Handbook for Developing Watershed Plans to Restore and Protect our Waters (EPA 2008) that are critical to preparing effective watershed plans to address nonpoint source pollution. EPA emphasizes the use of watershed-based plans containing the nine elements in Section 319 watershed projects in its guidelines for the Clean Water Act Section 319 program and grants (EPA 2013).

This plan's foundation is the data collection, analysis, and development of plans from multiple sources and scales. Most of the monitoring and planning efforts sponsored by the state (Intensive Watershed Monitoring (IWM), Assessments, TMDLs, WRAPS, 1W1P, etc.) are conducted and report on as a HUC 8. These foundational efforts provide the support and understanding to develop the very targeted and detailed Focus Grant Workplans for small watersheds. Instead of broad, strategies, this Focus Grant Workplan will delve into specific and targeted actions to achieve water quality goals in the Dutch Creek and Fairmont Chain of Lakes Watershed.

This Grant Workplan is intended to be a living document. Through the initial development, first steps of implementation, and the final data collection, this road map is intended to change, react, and correct the course of watershed implementation in the Dutch Creek and Fairmont Chain of Lakes Watershed. This is only the first step along the path to water quality goals in the Dutch Creek and Fairmont Chain of Lakes Watershed.

The intent of the nine elements and the EPA watershed planning guidelines is to provide direction in developing a sufficiently detailed plan at an appropriate scale so that problems and solutions are targeted effectively. The nine elements are listed in Table 1 along with the section of this report in which each nine element can be found.

Table 1. Nine elements and applicable report section

Section 319 Nine Elements	Applicable Report Section
Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve needed load reductions, and any other goals identified in the watershed plan.	Section 3.5, 4.0, and 6.0
An estimate of the load reductions expected from management measures.	Section 7.0
A description of the nonpoint source management measures that will need to be implemented to achieve load reductions in element b, and a description of the critical areas in which those measures will be needed to implement this plan.	Section 7.0 and 5.0
An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.	Sections 1.3, 7.0, and 8.0
An information and education component used to enhance public understanding of the project and encourage the public's early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.	Section 8.0
Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.	Section 7.0
A description of interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.	Section 7.0
A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards.	Section 6.3
A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item h immediately above.	Section 9.0

1.2 Planning purpose and process

The Section 319 Focus Grant Workplan provides the opportunity to continue building the framework of the small watershed approach in Minnesota along with continuing the implementation work to achieve the water quality goals for the watershed. The foundation of this plan was written by compiling and synthesizing the information describing previous and current work in the watershed, quantifying current sources and pollutant loads, determining load reductions needed to meet the water quality goals, and identifying the management measures and levels of implementation needed to achieve the reductions. Through this process, gaps in the existing planning efforts have been identified and will be addressed. Efforts will be focused in various levels throughout the watershed in critical areas. As the work continues, critical areas will be refined. Critical area selection includes physical science influence, such as critical loading areas, but also will take into account social aspects such as citizens' priorities and landowner willingness to participate.

1.3 Nonpoint source (NPS) pollution management

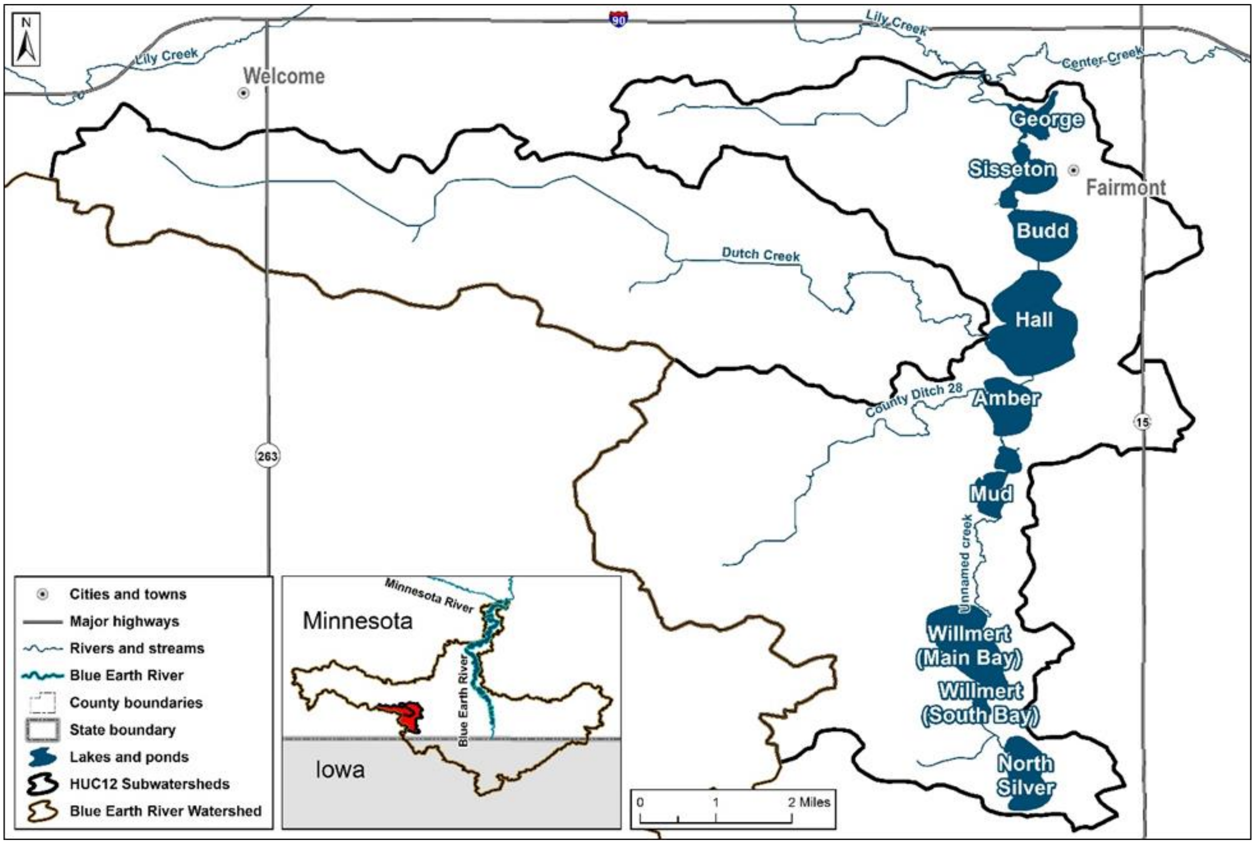
Numerous nonpoint pollution management activities and planning efforts have been and are being conducted in the project area. A summary of these efforts is provided below:

- Minnesota's Watershed Approach. Minnesota has adopted a watershed approach to address the state's major watersheds. The approach incorporates water quality assessment, watershed analysis, public participation, planning, implementation, and measurement of results into a 10-year cycle that addresses both restoration and protection needs. A key aspect of this effort is to develop and use watershed-scale models and other tools to identify strategies for addressing point and nonpoint source pollution that will cumulatively achieve water quality targets. The MPCA is currently drafting a monitoring and assessment report.
- TMDL Development. Several documents have been developed by the Minnesota Pollution Control Agency (MPCA) that are applicable to the project area as part of this process, including the draft Minnesota River and Greater Blue Earth Total Suspended Solids (TSS) Total Maximum Daily Load (TMDL 2019) and the basin-wide fecal coliform TMDL (Water Resources Center et al. 2007) and Implementation Plan. The process used to develop these reports included significant stakeholder involvement; these reports provide much of the background information and inform selection of management activities.
- Source Water Protection. The Minnesota Department of Health (MDH) developed a draft source water assessment (SWA) for Budd Lake (MDH 2019); Budd Lake provides drinking water for approximately 10,000 residents. The purpose of the SWA is to provide information regarding the drinking water sources for public water systems including: identification of the resource used as a drinking water source, its physical setting, public water system intake and treatment, contaminants of concern, and known threats. Nitrates were identified as the highest priority contaminant of concern, followed by toxins from harmful algal blooms. The SWA was designed to be guidance for planning purposes for the next 10 years. Following the SWA, a Surface Water Intake Protection Plan (SWIPP) will be developed with assistance from the MDH. The SWIPP will lay out strategies for protecting and improving source water quality. Upon completion of the SWIPP, the city of Fairmont can be eligible for MDH plan implementation grants to fund documented plan activities. The SWIPP will also guide local planning partners by documenting other potential complementary watershed-level activities to protect drinking water on a larger scale.
- Local Watershed Planning. Several recent efforts have been conducted specific to the project area. In 2018, Martin County Soil and Water Conservation District (SWCD) received technical assistance from the EPA to begin developing an approach to address high nitrate concentrations in the source water (Budd Lake) for the City of Fairmont. A Soil and Water Assessment Tool (SWAT) model was developed to simulate historical conditions and evaluate various management practices (Tetra Tech 2018). This work was included quantifying sources of nitrogen, phosphorus, and sediment loading to the lakes and the simulation of scenarios to reduce nutrient loading to the lakes. This modeling work was expanded upon by the SWCD using the Agricultural Conservation Planning Framework (ACPF) tool to identify locations for specific nutrient reducing agricultural practices within the watersheds. The ACPF Toolbox was developed by the U.S. Department of Agriculture's (USDA) Agricultural Research Service. It is a set of ArcGIS® tools that locate potential best management practice (BMP) placement in a given watershed (Porter et al. 2018). Results of these efforts were instrumental to the development of this Workplan.

2. Watershed description

The project area includes two watersheds identified by 12-digit hydrologic unit codes (HUC-12): Dutch Creek (070200090701) and Fairmont Chain of Lakes, specifically Hall Lake (070200090702) (Figure 1). Both of these watersheds are located within the larger Blue Earth River Watershed (HUC-8 07020009). The project area is located entirety within Martin County, which is in far south-central Minnesota bordering Iowa in the Western Corn Belt Plains ecoregion. The ecoregion is characterized by high agricultural productivity due to high soil fertility, temperature climate and adequate growing season precipitation.

Figure 1. Dutch Creek and Fairmont Chain of Lakes watersheds (Tetra Tech 2018).

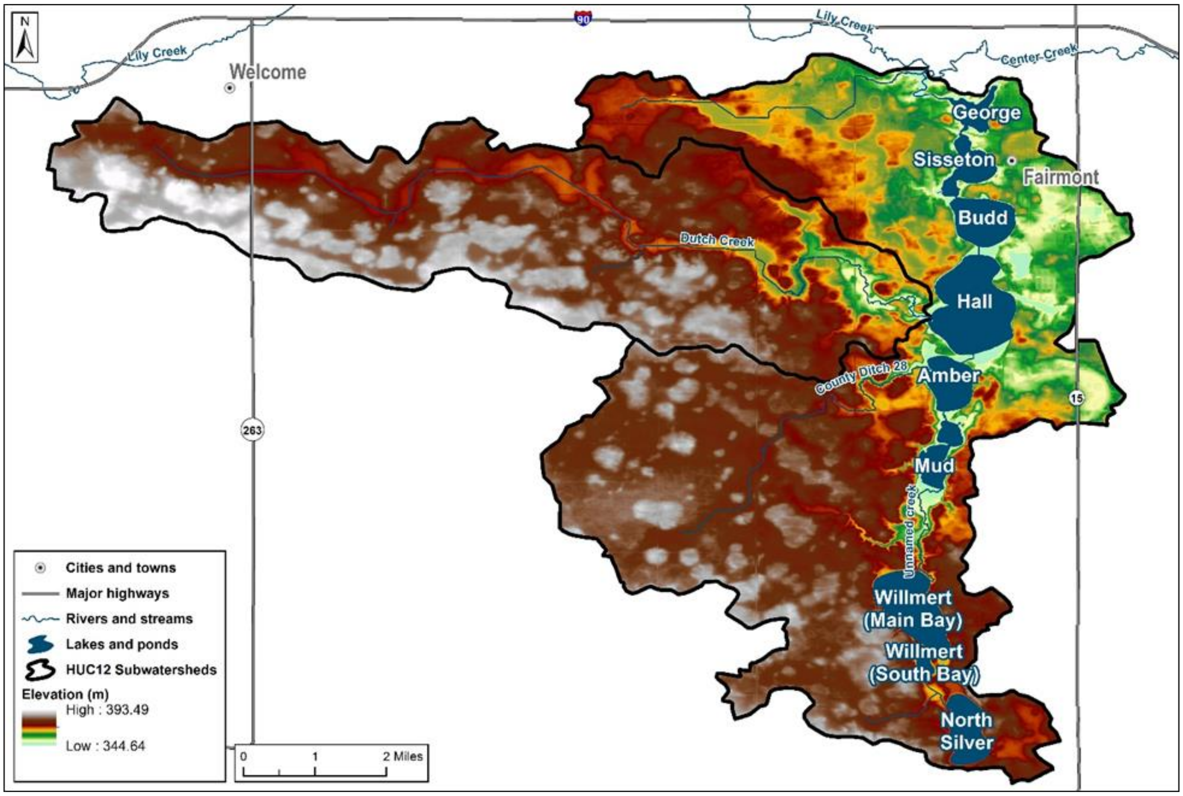


2.1 Topography and drainage

The Fairmont Chain of Lakes watershed spans approximately 31 square miles (19,981 acres), and the Dutch Creek watershed spans approximately 17 square miles (11,084 acres). The chain of lakes are connected hydrologically and flow from south to north to Center Creek and eventually to the Blue Earth River and Minnesota River; Dutch Creek flows eastward and connects with the chain of lakes at Hall Lake.

Topography across the project area ranges from 1,132 to 1,289 feet above mean sea level (Tetra Tech 2018; Figure 2). There is very little variation in elevation across this watershed. Agricultural lands are particularly flat (slope less than 3%) and are typically tile-drained, which impacts watershed hydrologic pathways.

Figure 2. Dutch Creek and Fairmont Chain of Lakes topography (Tetra Tech 2018).



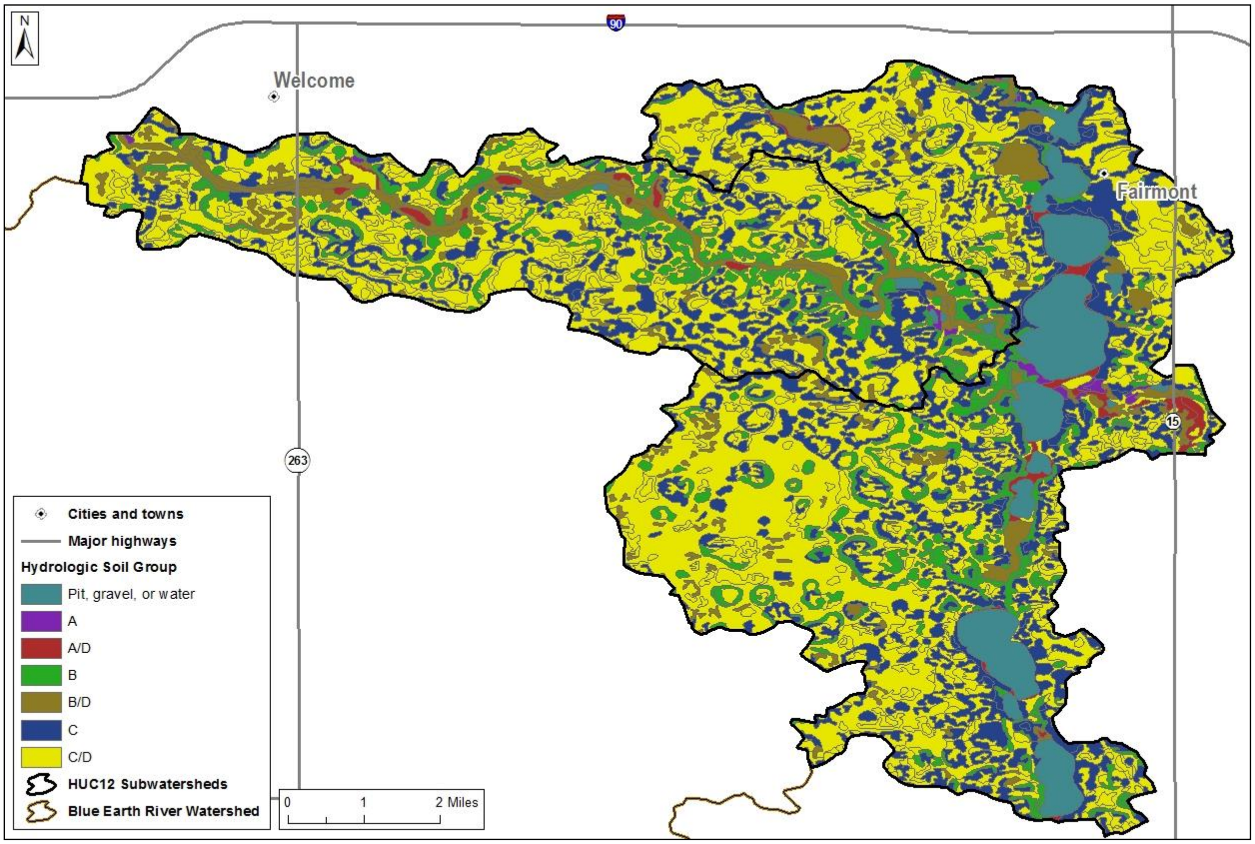
2.2 Soils

Topography of the region is homogeneous and defined by gently rolling glacial till plains, morainal hills and loess deposits. Pertinent soil classifications relevant to this plan are drainage classes, associations, and erodibility. Each is discussed in the following paragraphs. Soil drainage classes are identified by USDA's Natural Resources Conservation Service into hydrologic soils groups (HSGs) that identify general characteristics for runoff and infiltration capacity. Soils in the project area are largely considered HSG type C soils, which are described as "sandy clay loam" with a low infiltration rate when thoroughly wetted (Table 2, Figure 3). Due to the extensive amount of agriculture in the watershed, soils that are dual-listed (A/D, B/D, C/D) are usually considered to be tile drained when they are <3% slope and underlie an agricultural land use class. Tile drainage systems in agricultural fields remove excess water below croplands where infiltration rates are too low to avoid waterlogging and flooding.

Table 2. Soil area by HSG (Tetra Tech 2018)

HSG	Dutch Creek		Fairmont Chain of Lakes		Percent of project area
	Area (acres)	Area (percent)	Area (acres)	Area (percent)	
A	70	<1%	29	<1%	<1%
A/D	248	1%	106	1%	1%
B	1,758	9%	1,592	14%	11%
B/D	1,064	5%	1,294	12%	8%
C	4,522	23%	2,116	19%	21%
C/D	10,430	52%	5,899	54%	53%
Water/gravel/pit	1,889	10%	48	<1%	6%
Total	**19,981**	**100%**	**11,084**	**100%**	**100%**

Figure 3. Dutch Creek and Fairmont Chain of Lakes: hydrologic soil group (HSG; Tetra Tech 2018).



2.3 Waterbodies

2.3.1 Streams

In the Dutch Creek Watershed, the prominent waterbody is Dutch Creek, which flows from west to east. The mouth of Dutch Creek is at Hall Lake. In the Fairmont Chain of Lakes watershed, Center Creek flows from south to north and connects the series of lakes. County Ditch 28 is a tributary of Amber Lake, which is upstream of Hall Lake.

2.3.2 Lakes

Eight lakes are within the Fairmont Chain of Lakes Watershed; each lake is in-line with the mainstem Center Creek that flows from south to north. These eight lakes are: North Silver, Willmert, Mud, Amber, Hall, Budd, Sisseton, and George (Table 3).

Hall Lake is the largest and deepest of the eight lakes within the project area. Lake bathymetry is available from Lake Monitoring Reports (Schlorf Von Hodlt 2001, 2002) or MN Lake Finder (2019).

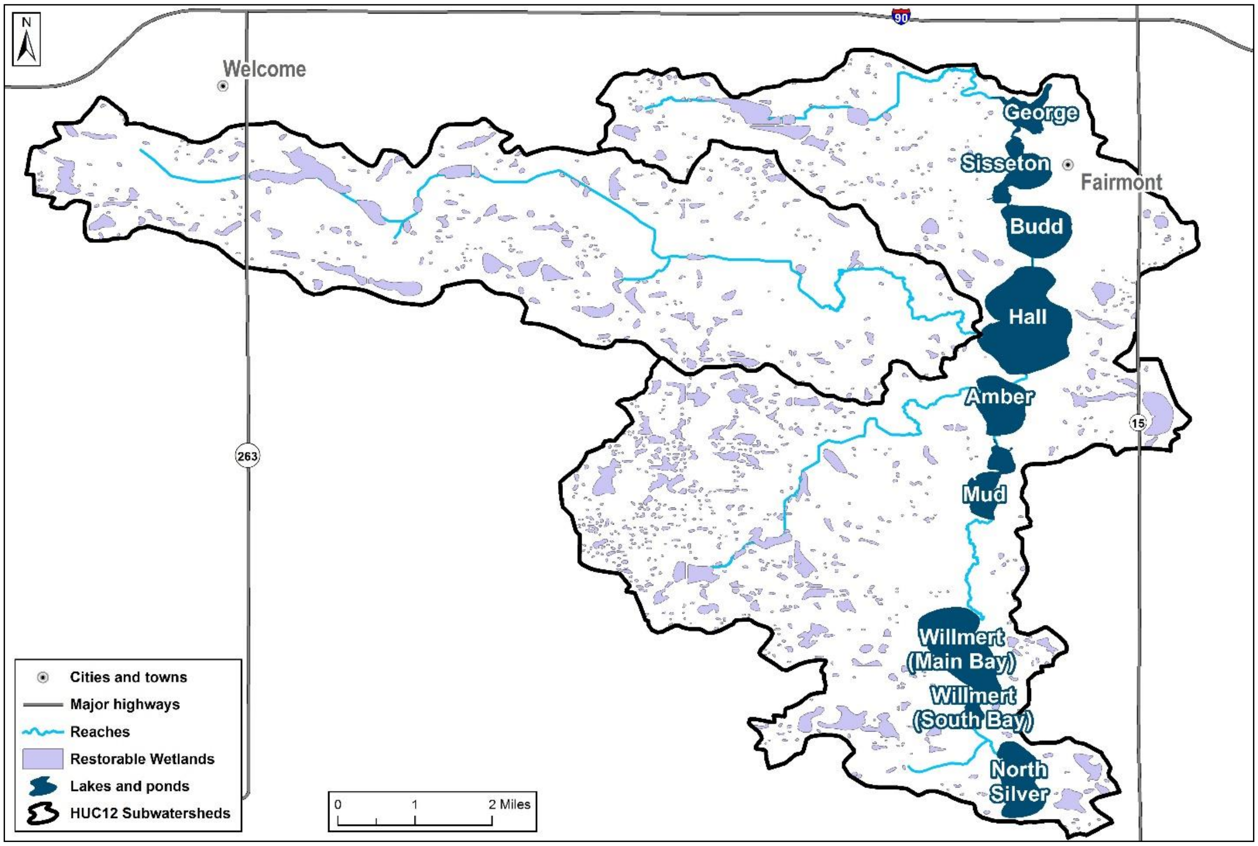
Table 3. General lake information (MN Lake Finder 2019, Schlorf Von Holdt 2001 and 2002)

Lake	Lake ID	Surface Area (ac)	Littoral Area (ac)	Max Depth (ft)	Volume (AF)	Lake to Watershed Ratio
George	46002400	83	83.17	11	442.0	~8.1:1
Sisseton	46002500	138	100	19	1274.0	~12:1
Budd	46003000	228	111	23	2932.8	~4.5:1
Hall	46003100	548	277	27	4159.8	~23:1
Amber	46003400	182	108	19	2296.2	~23:1
Mud	46002300	72	72	--	--	--
Willmert	46001401 (Main Bay), 46001402 (South Bay)	337	337	8	--	--
North Silver	46001600	202	202	5.5	--	--

2.4 Aquatic habitat and wetlands

Wetlands provide many beneficial ecosystem services to watersheds; however, wetlands have been extensively drained across much of Minnesota. In general, over 90% of the original wetlands in the southern and western regions of the state have been lost. Less than 3% of the planning watershed area is classified as wetland, based upon an evaluation of the NLCD 2011 land cover raster. Agricultural drainage has drained many of the wetlands originally present in the watershed. Given the multiple benefits of wetlands, Ducks Unlimited created a restorable wetland inventory in conjunction with many partners to identify potential areas for wetland restoration in Minnesota. The index identifies approximately 2,655 acres of restorable wetlands within the Dutch Creek and Fairmont Chain of Lakes HUC12 Watersheds (Figure 4. Ducks Unlimited potentially restorable wetlands (Tetra Tech 2018)). Wetland restoration is a management strategy in this plan.

Figure 4. Ducks Unlimited potentially restorable wetlands (Tetra Tech 2018)



2.5 Land use

Cultivated cropland and developed land uses make up the majority of the land cover in the project area (Table 4, Figure 5). Much of the developed land is within the city of Fairmont. Cultivated cropland was explored further using data products from the USDA's National Agricultural Statistics Service (NASS) Cropland Data Layer (CDL) and the Census of Agriculture (Tetra Tech 2018). In the project area the dominant crop types from the 2015 CDL are corn and soybeans (Figure 6; Table 5). However, the extent of these crop types varies year to year depending on the crop rotation used by an individual producer (Table 7).

The results of the CDL analysis are consistent with published information for Martin County. Countywide, the predominant crops planted are corn and soybeans and the county has a large hog industry (Martin County SWCD 2016). The 2012 Census of Agriculture (USDA NASS 2014) also suggests that corn and soybean have the largest acreages of cultivated crops in Martin County. Generally, a mix of both conventional and conservation tillage occur in both corn and soybean fields.

Table 4. Percent of HUC12 watershed land use by 2011 NLCD classification (Tetra Tech 2018)

Land use classification	Dutch Creek	Fairmont Chain of Lakes	Total
Water	<1%	9%	6%
Low Intensity and Open Space Development	6%	14%	11%
Medium and High Intensity Development	<1%	3%	2%
Barren	<1%	<1%	<1%
Forest (all types)	1%	<1%	<1%
Rangeland (Grassland/Herbaceous and Pasture/Hay)	4%	4%	4%
Cultivated Crops	88%	67%	75%
Wetlands (all types)	1%	3%	2%
Total	**100%**	**100%**	**100%**

Figure 5. Land use in project area (NLCD 2011; Tetra Tech 2018)

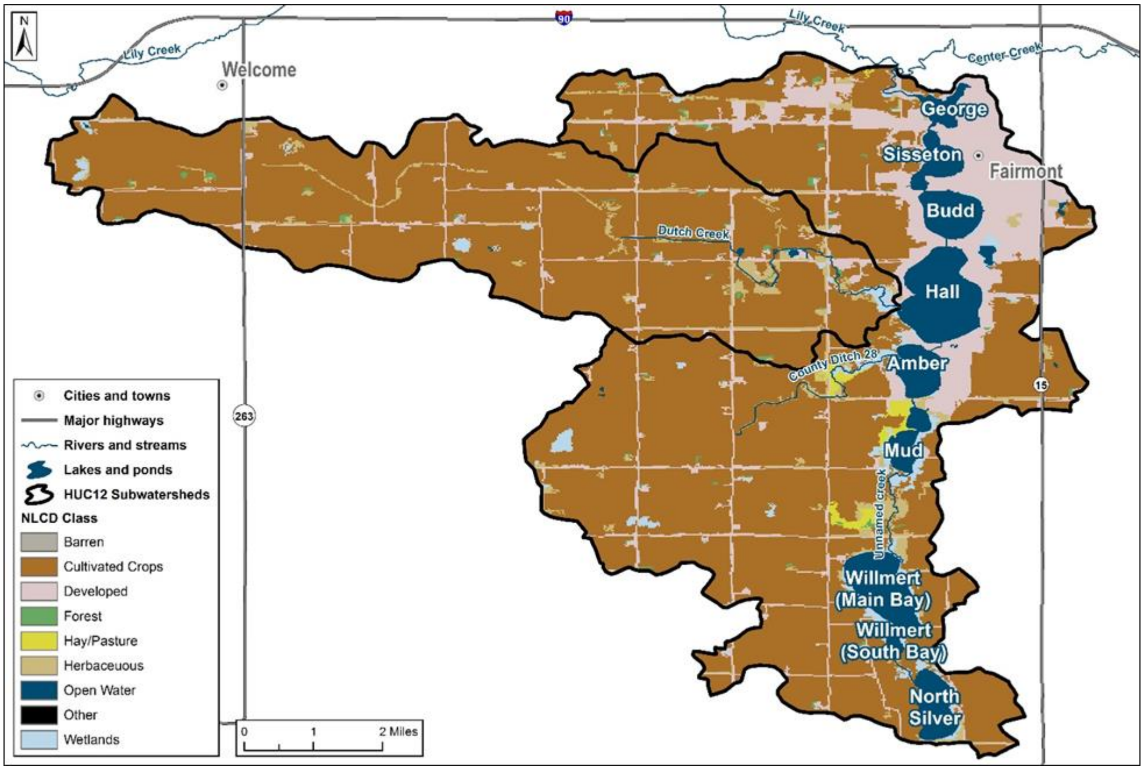


Figure 6. Crops acreages (2010-2015 CDLs; Tetra Tech 2018)

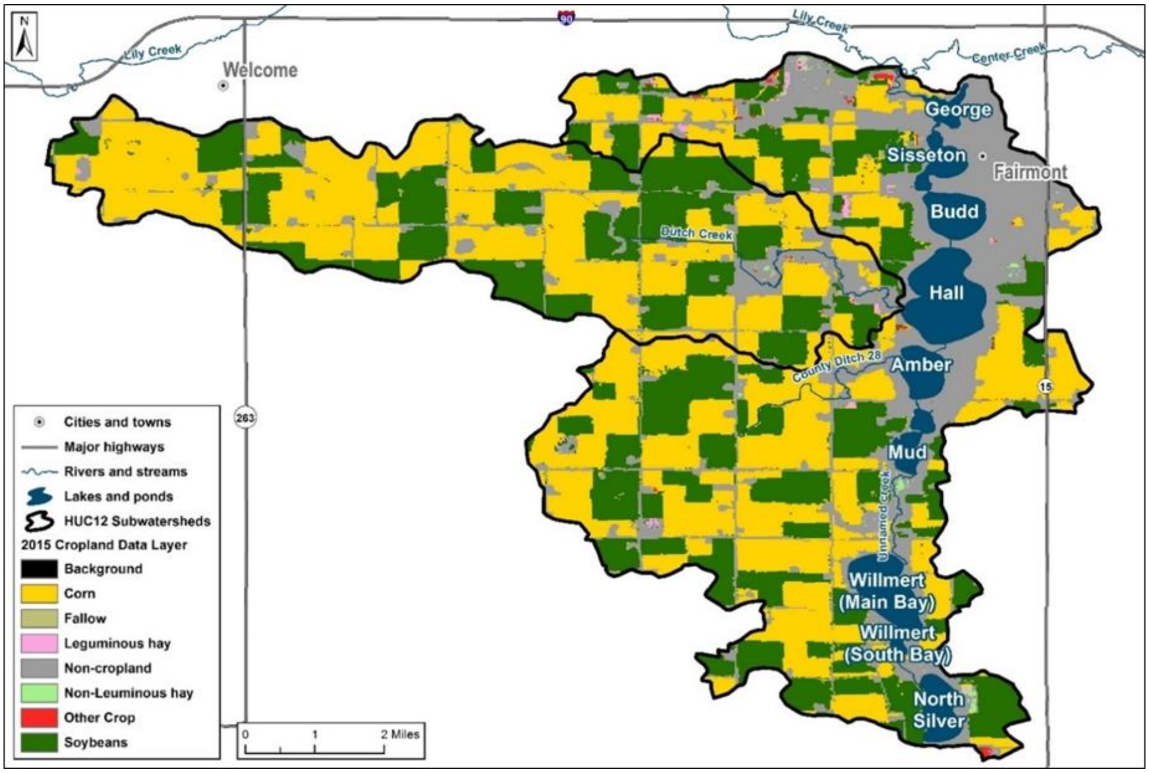


Table 5. Cropland from 2010-2015 (USDA NASS CDLs; Tetra Tech 2018)

Watershed	Crop	Acres						Average
		2010	2011	2012	2013	2014	2015	(% cover)
Dutch Creek	Corn	5,633	5,866	6,252	5,931	5,614	5,817	54%
	Soybean	3,833	3,633	3,170	3,328	3,885	3,705	32%
	Non-cropland	1,583	1,552	1,642	1,630	1,561	1,521	14%
	Other crops [a]	14	4	1	159	3	10	<1%
	Leguminous hay (alfalfa)	11	11	10	19	4	14	<1%
	Non-leguminous hay (other hay/ non alfalfa)	2	9	1	9	9	5	<1%
	Fallow / Idle Cropland	0	0	0	<1	<1	5	<1%
Fairmont Chain of Lakes	Corn	7,204	7,809	7,318	7,569	7,634	7,314	38%
	Soybean	5,411	4,858	5,172	4,912	4,903	5,343	26%
	Non-cropland	7,280	7,156	7,411	7,376	7,277	7,129	36%
	Other crops [a]	24	32	20	32	87	61	<1%
	Leguminous hay (alfalfa)	35	99	51	46	32	76	<1%
	Non-leguminous hay (other hay/ non alfalfa)	21	19	2	41	41	49	<1%
	Fallow / idle cropland	0	0	0	<1	1	3	<1%

a. Other crops represents Cabbage, Dry Beans, Oats, Peas, Rye, Spring Wheat, Sugar beets, and Sweet Corn.

Table 6. Acres of harvested cropland in Martin County (2012 Census of Agriculture) (Tetra Tech 2018)

Crop	Harvested acres	% Total cropland
Corn (grain)	237,118	61%
Soybeans	149,921	38%
Forage	1,936	1%
Corn (silage)	1,719	<1%
Oats	556	<1%
Dry beans	193	<1%
Wheat	158	<1%
Dry peas	114	<1%
Barley	74	<1%
Total cropland	**393,749**	**100%**

Total cropland includes Alfalfa, Other Hay/Non-Alfalfa, and Fallow/Idle Cropland and therefore does not equal the sum of the listed crops.

2.6 Wastewater

Wastewater treatment and handling within the watershed is important as it may impact bacteria and nutrient loading to waterways and waterbodies. Municipal and industrial wastewater treatment facilities are regulated through National Pollutant Discharge Elimination System permits. These permits include pollutant effluent limits designed to meet water quality standards, along with monitoring and reporting requirements to ensure effluent limits are met. The City of Fairmont wastewater treatment facility (Permit number MN0030112) discharges to Center Creek segment that is outside the planning area. There are no wastewater treatment facilities in the Dutch Creek watershed; however, all residents are served by subsurface treatment systems (SSTS).

2.7 Climate and precipitation

The climate of the project area is typical of southcentral Minnesota. The long-term average annual precipitation is 29 inches per year based on records from the Minnesota State Climatology Office for the Blue Earth River HUC-8 watershed. Most of the precipitation (88%) occurs between March and October with the remainder (12%) falling between November and February as mostly snow. The average annual snowfall is about 40 inches. The normal average annual temperature in the watershed is 45 degrees Fahrenheit (F) with the winter and summer normal average temperatures being 17 degrees and 70 degrees F, respectively. The average minimum and maximum temperatures are 8 degrees and 81 degrees F, respectively.

Detailed weather data for the Blue Earth River HUC-8 watershed along with other weather stations and volunteer observation sites are available at http://climate.umn.edu.

2.8 Source water area and drinking water treatment

The City of Fairmont (approximately 10,000 people) obtains its drinking water from Budd Lake, which is one of the few surface sources of drinking water in the state. There are four solar powered aeration devices that aerate and circulate the waters of Budd Lake down to a depth of 6 feet, which increases dissolved oxygen concentrations in the lake.

As part of the SWA developed by the MDH, a drinking water supply area, emergency response area, and spill management area were delineated for Budd Lake. For the City of Fairmont, the drinking water supply area emergency response area is the same boundary as the source water assessment area (Figure 7) and covers approximately 26,400 acres.

Figure 7. The City of Fairmont's Drinking Water Supply Management Area/Source Water Area, Spill Management Area and Emergency Response Area (MDH 2019).

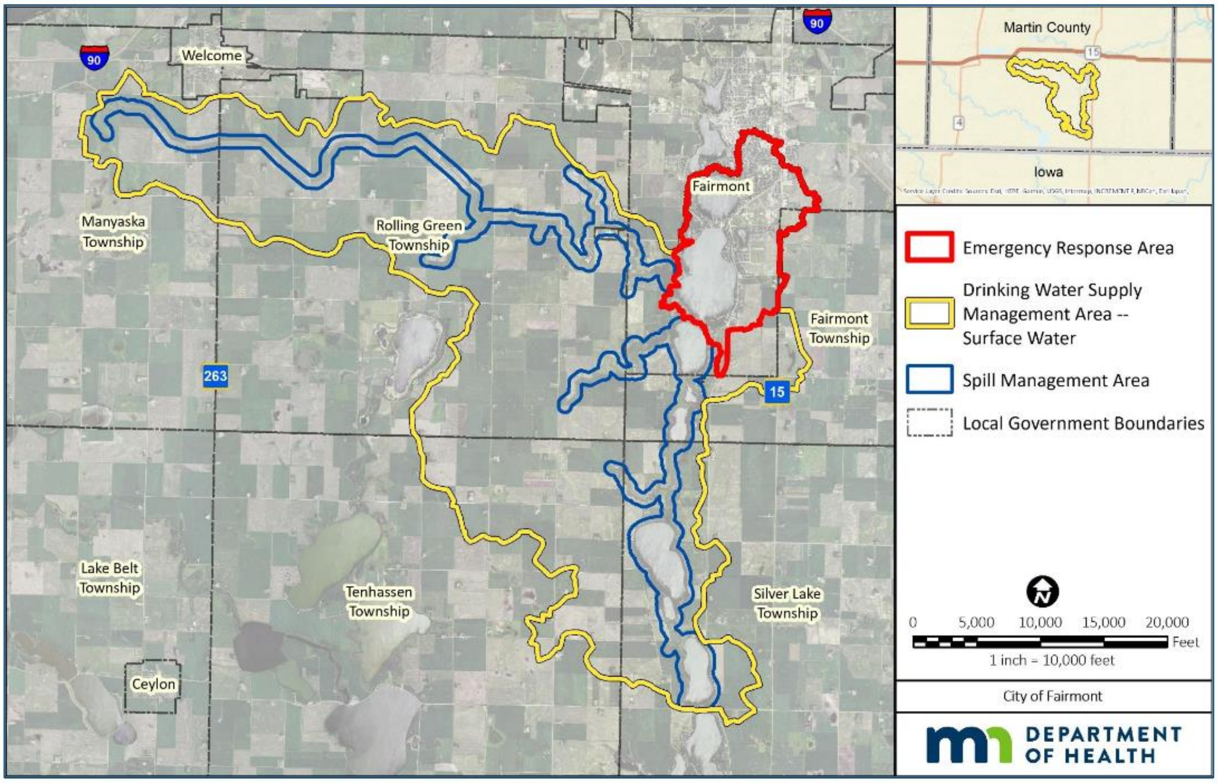


Figure 2 – Fairmont's Drinking Water Supply Management Area, Spill Management Area, and Emergency Response Area

3. Water quality and quantity

3.1 Water quality standards

The federal Clean Water Act requires states to designate beneficial uses for all waters and develop water quality criteria to protect each use. Water quality standards consist of several parts:

- Beneficial uses — Identify how people, aquatic communities, and wildlife use our waters
- Numeric criteria — Amounts of specific pollutants allowed in a body of water and still protects it for the beneficial uses
- Narrative criteria — Statements of unacceptable conditions in and on the water
- Antidegradation protections — Extra protection for high-quality or unique waters and existing uses

Together, the beneficial uses, numeric and narrative criteria, and antidegradation protections provide the framework for achieving Clean Water Act goals.

Minnesota's water quality standards are provided in Minnesota Rules chapters 7050. All current state water rules administered by the MPCA are available on the Minnesota water rules page (https://www.pca.state.mn.us/water/water-quality-rules).

3.1.1 Beneficial uses

The beneficial uses for public waters in Minnesota are grouped into one or more classes as defined in Minn. R. ch. 7050.0140. The classes and beneficial uses are:

- Class 1 – domestic consumption
- Class 2 – aquatic life and recreation
- Class 3 – industrial consumption
- Class 4 – agriculture and wildlife
- Class 5 – aesthetic enjoyment and navigation
- Class 6 – other uses and protection of border waters
- Class 7 – limited resource value waters

The aquatic life use class now includes a tiered aquatic life uses (TALU) framework for rivers and streams. The framework contains three tiers—exceptional, general, and modified uses. All surface waters are protected for multiple beneficial uses.

3.1.2 Numeric criteria and state standards

Narrative and numeric water quality criteria for all uses are listed for four common categories of surface waters in Minn. R. ch. 7050.0220. The four categories are:

- Cold water aquatic life and habitat, also protected for drinking water: classes 1B; 2A, 2Ae, or 2Ag; 3A or 3B; 4A and 4B; and 5
- Cool and warm water aquatic life and habitat, also protected for drinking water: classes 1B or 1C; 2Bd, 2Bde, 2Bdg, or 2Bdm; 3A or 3B; 4A and 4B; and 5
- Cool and warm water aquatic life and habitat and wetlands: classes 2B, 2Be, 2Bg, 2Bm, or 2D; 3A, 3B, 3C, or 3D; 4A and 4B or 4C; and 5
- Limited resource value waters: classes 3C; 4A and 4B; 5; and 7

The narrative and numeric water quality criteria for the individual use classes are listed in Minn. R. ch. 7050.0221 through 7050.0227. The procedures for evaluating the narrative criteria are presented in Minn. R. ch. 7050.0150.

The MPCA assesses individual water bodies for impairment for class 2 uses—aquatic life and recreation. Class 2A waters are protected for the propagation and maintenance of a healthy community of cold water sport or commercial fish and associated aquatic life and their habitats. Class 2B waters are protected for the propagation and maintenance of a healthy community of cool or warm water sport or commercial fish, and associated aquatic life and their habitats. Both class 2A and 2B waters are also protected for aquatic recreation activities including bathing and swimming.

Protection for aquatic recreation entails the maintenance of conditions safe and suitable for swimming and other forms of water recreation. In streams, aquatic recreation is assessed by measuring the concentration of E. coli in the water, which is used as an indicator species of potential waterborne pathogens. To determine if a lake supports aquatic recreational activities, its trophic status is evaluated using total phosphorus, Secchi depth, and chlorophyll-a as indicators. Lakes that are enriched with nutrients and have abundant algal growth are eutrophic and do not support aquatic recreation.

Protection of aquatic life entails the maintenance of a healthy aquatic community as measured by fish and macroinvertebrate IBIs. Fish and invertebrate IBI scores are evaluated against criteria established for individual monitoring sites by water body type and use subclass (exceptional, general, and modified).

The ecoregion standard for aquatic recreation protects lake users from nuisance algal bloom conditions fueled by elevated phosphorus concentrations that degrade recreational use potential.

3.1.3 Antidegradation policies and procedures

The purpose of the antidegradation provisions in Minn. R. ch. 7050.0250 through 7050.0335 is to achieve and maintain the highest possible quality in surface waters of the state. To accomplish this purpose:

1. Existing uses and the level of water quality necessary to protect existing uses shall be maintained and protected.
2. Degradation of high water quality shall be minimized and allowed only to the extent necessary to accommodate important economic or social development.
3. Water quality necessary to preserve the exceptional characteristics of outstanding resource value waters shall be maintained and protected.
4. Proposed activities with the potential for water quality impairments associated with thermal discharges shall be consistent with section 316 of the Clean Water Act, United States Code, title 33, section 1326.

3.1.4 Standards and criteria

The waters in the project area are primarily designated as class 2B waters. The lakes are also protected as sources of drinking water (1C). The water quality standards and criteria used in assessing the waters include the following parameters:

- Escherichia (E.) coli – not to exceed 126 organisms per 100 milliliters as a geometric mean of not less than five samples representative of conditions within any calendar month, nor shall more than ten% of all samples taken during any calendar month individually exceed 1,260 organisms per 100 milliliters. The standard applies between April 1 and October 31.
- Dissolved oxygen (DO) – daily minimum of 5 mg/L.

- pH – to be between 6.5 and 9.0 pH units.
- Total suspended solids – 65 mg/L not to be exceeded more than 10% of the time between April 1 and October 31.
- Stream eutrophication – based on summer average concentrations for the South River Nutrient Region
  - Total phosphorus concentration less than or equal to 150 µg/L and
  - Chlorophyll-a (seston) concentration less than or equal to 35 µg/L or
  - Diel dissolved oxygen flux less than or equal to 4.5 mg/L or
  - Five-day biochemical oxygen demand concentration less than or equal to 3.0 mg/L.
  - If the TP criterion is exceeded and no other variable is exceeded, the eutrophication standard is met.
- Lake eutrophication – based on summer average concentrations in the Western Corn Belt Plains ecoregion:
  - Deep lakes: Total phosphorus less than 65 µg/L and chlorophyll-a less than 22 µg/L or transparency not less than 0.9 meters.
  - Shallow lakes: Total phosphorus less than 90 µg/L and chlorophyll-a less than 30 µg/L or transparency not less than 0.7 meters.
- Biological indicators – The basis for assessing the biological community are the narrative water quality standards and assessment factors in Minn. R. 7050.0150. Attainment of these standards is measured through sampling of the aquatic biota and is based on impairment thresholds for indices of biological integrity (IBI) that vary by use class.
- Class 1 waters protected for drinking water are subject to the EPA's primary (maximum contaminant levels) and secondary drinking water standards, as contained in Code of Federal Regulations, title 40, parts 141 and 143, as amended. These drinking water standards are adopted and incorporated into Minn. R. 7050, including nitrate as nitrogen concentration <10 mg/l.

3.2 Streamflow

Flow data were obtained from the Minnesota Department of Natural Resources (DNR)/MPCA Cooperative Stream Gauging program and from the Minnesota Department of Agriculture (MDA). Continuous flow data are available only at site 30072001 on Dutch Creek (Dutch Creek near Fairmont, 100th St). This gage also has water quality data associated with ID S003-000. Although continuously monitored, there is no commentary provided on the validity of winter data. Beginning in October of 2016, continuous water level data were collected by the MDA at this same Dutch Creek gage which was converted from stage to discharge records using a rating curve developed by Martin County staff. Per MDAs suggestion, data obtained during ice conditions are considered less reliably accurate.

There are no continuous streamflow gages located in the Fairmont Chain of Lakes watershed; however, there are two gages with limited data.

Figure 8. Flow Data at MPCA DNR Site 30072001 along Dutch Creek, 2000-2004 (Tetra Tech 2018)

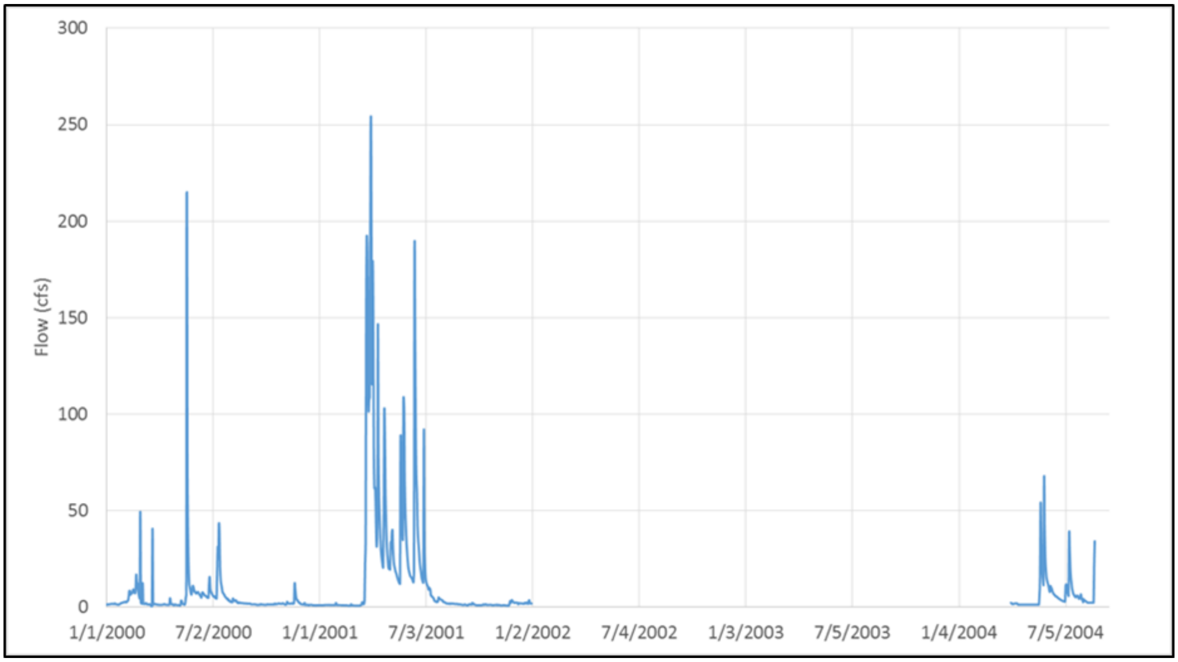


Figure 9. Flow Data at MPCA DNR Site 30072001 along Dutch Creek, 2000-2004 (Tetra Tech 2018)

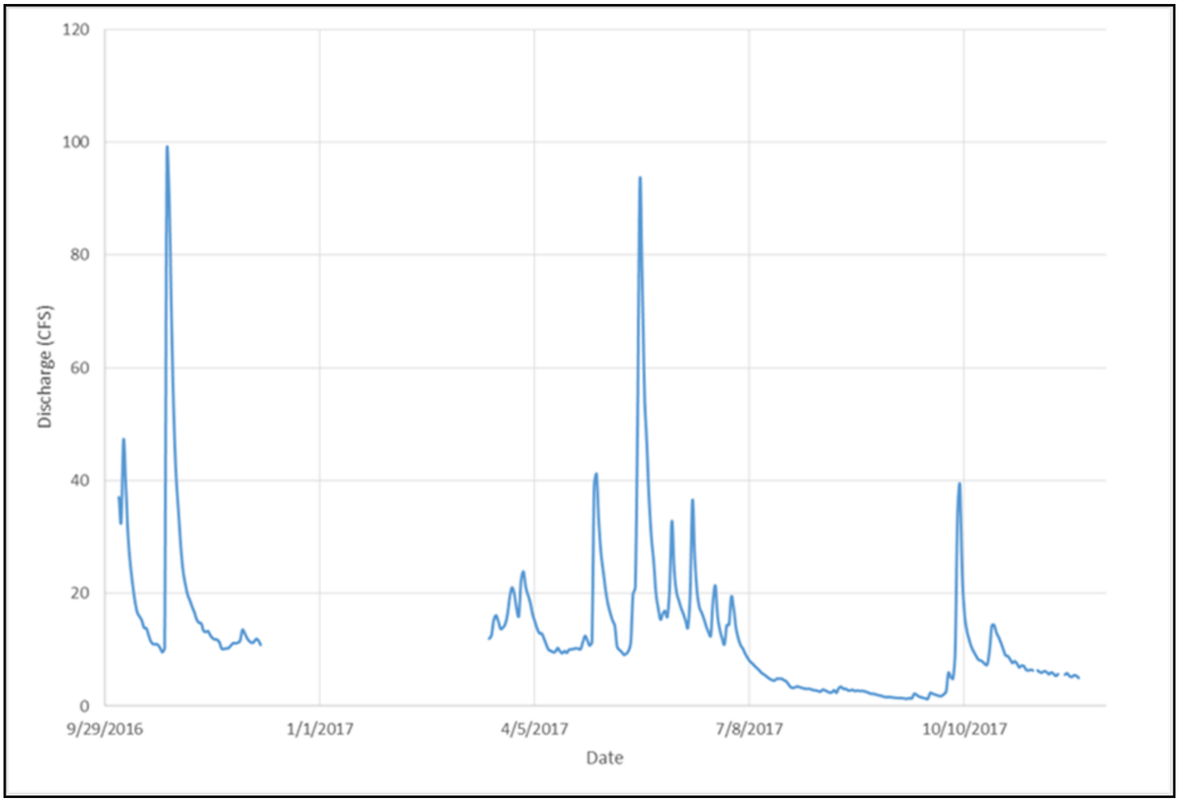
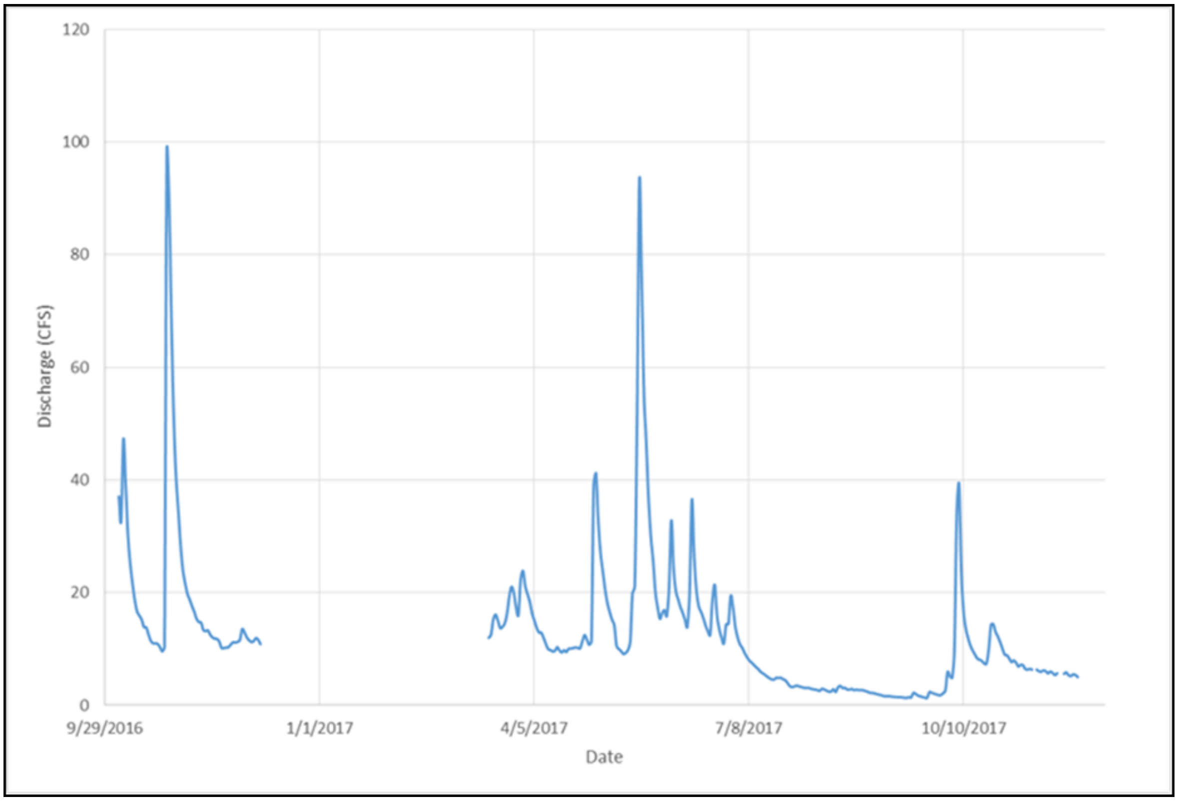


Figure 10. Flow Data at MPCA DNR Site 30072001 along Dutch Creek, 2016-2017 (Tetra Tech 2018)



3.3 Water quality data

Water quality data are present for many sites in the watershed. The largest portion of stream data are for Dutch Creek. Lake water quality data are present for several of the lakes. Data are also present for nitrate given that Budd Lake is the primary source water for the city of Fairmont.

Water quality data were obtained from the MPCA Environmental Quality Information System (EQuIS) database, Martin County SWCD, and Minnesota Department of Health and summarized by Tetra Tech (2018). Historic water quality data were collected at a site on Dutch Creek (S003-000) between April 19, 2000, and June 25, 2010. Martin County SWCD also provided additional sampling data at this monitoring site for 2016 and 2017 for nitrate + nitrite nitrogen, TP, and TSS (Table 7).

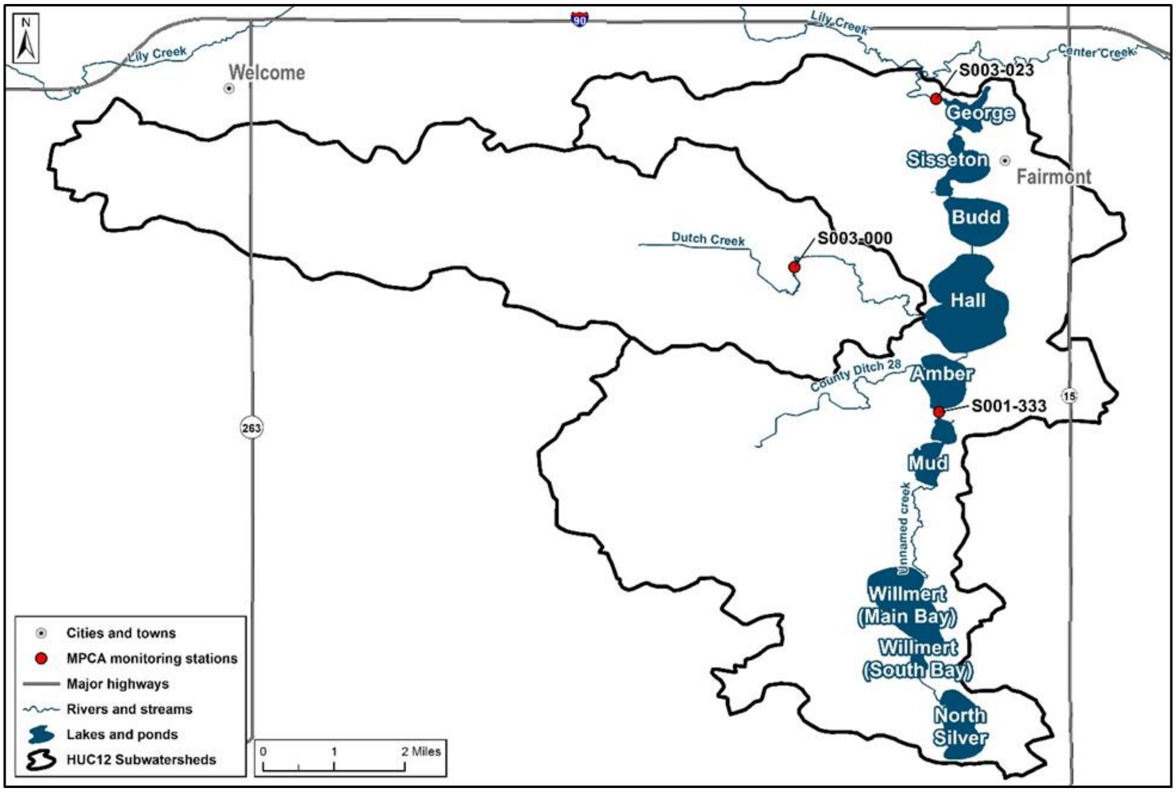
Data were also collected at two stream sites in the Fairmont Chain of Lakes watershed: S001-333 (Amber Lake Inlet) and S003-023 (George Lake Inlet) (Figure 11). Site S001-333 did not have sediment or nutrient data. Site S003-023 had very little data monitoring data from 2000-2001, which may not be representative of current conditions in the watershed.

Table 7. Select water quality data from EQuIS, Dutch Creek (S003-000) (Tetra Tech 2018)

Sample species	Samples	Sample mean	Sample median	Sample range	Units	Sample date range
Ammonia-nitrogen	204	0.076	0.080	Below detection – 1.01	mg/L	4/19/2000-11/26/2001, 5/13/2004, 5/21/2004, 4/4/2005-10/1/2008
Nitrate plus nitrite as nitrogen	219	10.3	11.8	Below detection – 29.6	mg/L	4/19/2000-6/25/2010, 4/4/2016-10/24/2017,
Nitrate as nitrogen	10	13.6	10.6	2.2 – 35	mg/L	3/14/2001-8/20/2001
Orthophosphate	191	0.092	0.057	Below detection – 1.13	mg/L	4/19/2000-10/8/2002, 5/13/2004, 4/4/2005-10/1/2008
Phosphorus	235	0.16	0.098	0.036 – 1.81	mg/L	4/19/2000-10/8/2002, 5/13/2004, 4/4/2005-10/1/2008, 4/4/2016-10/24/2017
Total suspended solids	229	53.5	20.0	0 – 815	mg/L	4/19/2000-10/8/2002, 5/13/2004, 4/4/2005-10/1/2008, 4/4/2016-10/24/2017

a. Additional water temperature grab samples collected in 1999 and 2001 at sites S001-332 and S001-610, respectively.

Figure 11. Stream water quality sampling locations (Tetra Tech 2018).



Lake water quality data were available through EQuIS for both Hall and Budd Lakes and summarized by Tetra Tech (2018) (Table 8, Table 9).

Table 8. EQuIS lake water quality data, Hall Lake (46-0031-00-101) (Tetra Tech 2018)

Sample species	Samples	Sample mean	Sample median	Sample range	Units	Sample date range
Chlorophyll-a, corrected for pheophytin	12	50.6	48.2	20.6 – 132	ug/L	7/3/2001-9/10/2002
Dissolved oxygen [a]	104	4.52, 8.64	4.96, 8.40	0.13 – 12.54	mg/L	7/3/2001-9/10/2002
Kjeldahl nitrogen	17	1.55	1.49	0.87 – 2.42	mg/L	7/3/2001-9/10/2002
Nitrate plus nitrite	9	2.79	2.45	0.6 – 5.8	mg/L	7/3/2001-9/10/2001
Orthophosphate	4	N/A [b]	N/A [b]	Below detection – 0.007	mg/L	7/18/2001-9/10/2001
pH	13	8.29	8.30	7.8 – 8.67		7/3/2001-9/10/2002
Phosphorus [c]	19	0.118, 0.096	0.115, 0.097	0.037 – 0.205	mg/L	7/3/2001, 5/30/2002-9/10/2002
Secchi disk depth	13	1.04	0.70	0.46 – 2.59	m	7/3/2001-9/10/2002
Water temperature [a]	104	22.7, 24.4	22.8, 24.6	16.4 – 29.3	˚C	7/3/2001-9/10/2002
Total suspended solids	11	16.6	16.0	10 – 27	mg/L	7/3/2001-9/10/2002

a. Sampled at various depths between 0 and 7 m, resulting in multiple samples per day at the same time. Mean and median given for 7 and 0 m, respectively.

b. Detection limit not reported.

c. Sampled at both 0 to 2 m and 6.5 to 7 m each sample date. Mean and median given for 7 and 0 m.

Table 9. EQuIS lake water quality data, Budd Lake (46-0030-00-101) (Tetra Tech 2018)

Sample species	Samples	Sample mean	Sample median	Sample range	Units	Sample date range
Chlorophyll-a, corrected for pheophytin	16	82.5	51.5	11.1 – 106	ug/L	7/3/2001-9/10/2002, 8/23/2004, 9/30/2004
Dissolved oxygen [a]	105	3.30, 9.01	2.55, 8.65	0.12 – 14.04	mg/L	7/3/2001-9/10/2002, 8/2/2004, 8/23/2004
Kjeldahl nitrogen	18	1.66	1.84	0.72 – 2.19	mg/L	7/3/2001-9/10/2002
Nitrate plus nitrite	9	2.2	1.9	0.65 – 4.7	mg/L	7/3/2001-9/10/2001 [c]
Orthophosphate	4	N/A	N/A	All below detection	mg/L	7/18/2001-9/10/2001
pH	15	8.37	8.43	7.87 – 8.96	s.u.	7/3/2001-9/10/2002, 8/2/2004, 9/30/2004
Phosphorus [a]	25	0.114, 0.092	0.106, 0.091	0.04 – 0.20	mg/L	7/3/2001, 5/30/2002-9/10/2002, 8/2/2004-9/30/2004
Secchi disk depth	16	1.13	0.84	0.46 – 3.05	m	7/3/2001-9/10/2002, 8/2/2004-9/23/2004
Water temperature [b]	105	22.5, 24.5	23.0, 25.0	15.7 – 29.3	˚C	7/3/2001-9/10/2002, 8/2/2004, 8/23/2004
Total suspended solids	12	12.0	12.5	4.6 – 18	mg/L	7/3/2001-9/10/2002

a. Sampled at both 0 to 2 m and 5.5 to 6.5 m each sample date. Mean and median given for 6 and 0 m.

b. Sampled at various depths between 0 and 6 m, resulting in multiple samples per day at the same time. Mean and median given for 6 and 0 m, respectively.

c. Additional data collected 3/15/2017 – 11/28/2017 by MDH.

3.3.1 Total suspended solid (TSS)

Samples collected from Dutch Creek (S003-000) in 2005 through 2018 were evaluated for TSS. TSS concentrations for the period April through September between 2006 and 2015 exceeded 65 mg/L in 10 out of 104 samples (9.6%). The percent exceedance of the TSS standard increased from 0% in 2016 to 27% and 54% in 2017 and 2018, respectively (Table 10). Table 11 provides the monthly summary for the TSS data collected at the site. Exceedances of the 65 mg/L standard using the combined data for 2005-2018 occurred in each month the TSS standard is applicable (April through September). These data are summarized graphically in Figure 12. Six samples were collected from Center Creek (S003-023) in June through August 2000 and ranged from 16 to 39 mg TSS/L.

Table 10. Annual summary of TSS data for Dutch Creek (AUID 07020009-527, site S003-000, Apr-Sep)

Year	Sample count	Mean (mg/L)	Minimum (mg/L)	Maximum (mg/L)	Number of exceedances	Frequency of exceedances
2005	30	37	2	278	5	17%
2006	42	47	5	460	6	14%
2007	43	27	5	126	3	7%
2008	31	33	3	128	4	13%
2016	18	14	2	52	0	0%
2017	22	65	4	210	6	27%
2018	37	171	2	2,340	20	54%

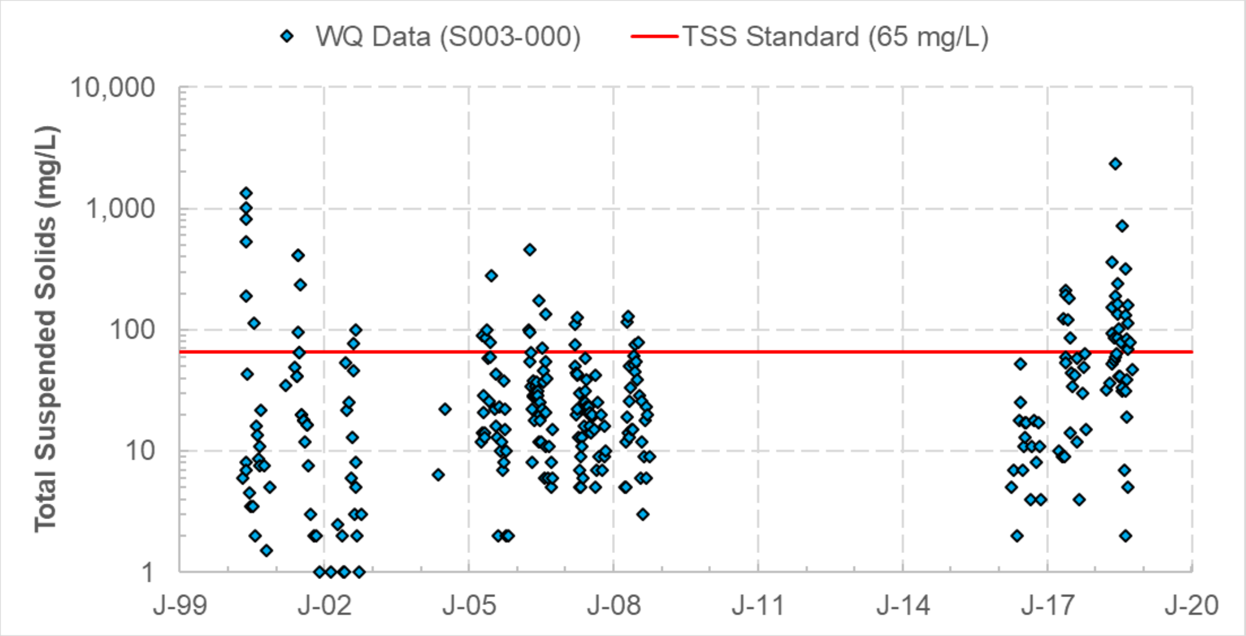
Values in red indicate years in which the numeric criteria (65 mg/L) was exceeded

Table 11. Monthly summary of TSS data for Dutch Creek (AUID 07020009-527, site S003-000, 2005-2018)

Month	Sample count	Mean (mg/L)	Minimum (mg/L)	Maximum (mg/L)	Number of exceedances	Frequency of exceedances
February	1	1	1	1	0	NA
March	10	51	5	126	3	NA
April	35	45	3	460	6	17%
May	54	164	1	2,340	16	30%
June	49	76	1	413	14	29%
July	43	51	2	723	7	16%
August	48	31	0	321	6	13%
September	28	27	1	160	4	14%
October	19	15	2	63	0	NA
November	4	5	1	11	0	NA

Values in red indicate years in which the numeric criteria (65 mg/L) was exceeded

Figure 12. TSS data for Dutch Creek (AUID 07020009-527, site S003-000, 2005-2018)



3.3.2 Fecal coliform and *E. coli*

Fecal coliform data are provided in Figure 13, Figure 14, and Table 12 as summarized in the basin-wide fecal coliform TMDL (Water Resources Center et al. 2007). In Dutch Creek, reductions are needed throughout the summer months; in Center Creek, a reduction was only identified for the month of August.

Figure 13. Monthly geometric mean fecal coliform concentrations (1995-2004) (Water Resources Center et al. 2007)

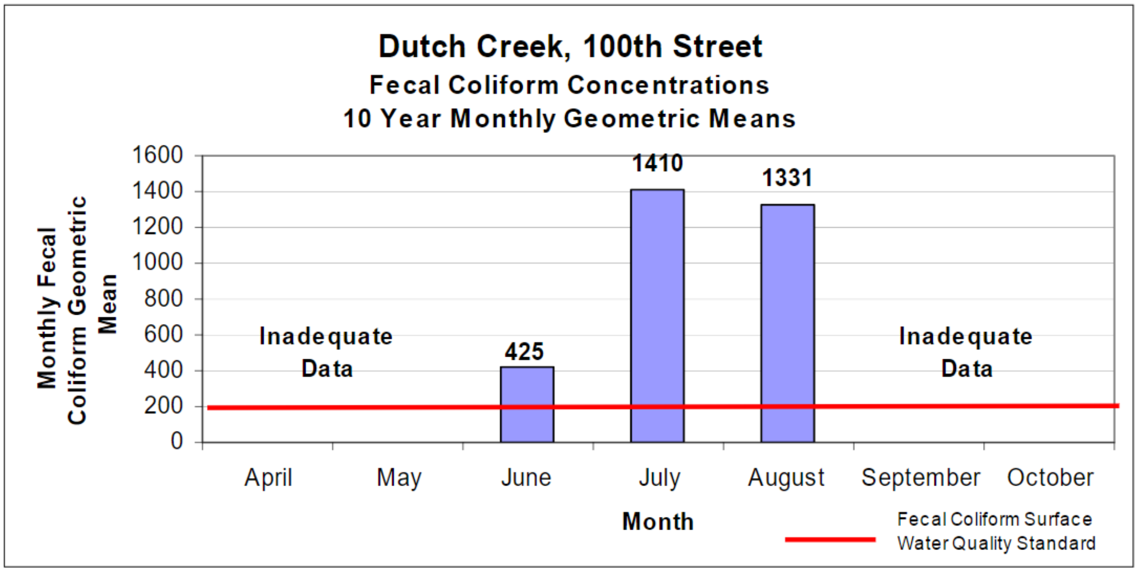


Figure 14. Monthly geometric mean fecal coliform concentrations (1995-2004) (Water Resources Center et al. 2007)

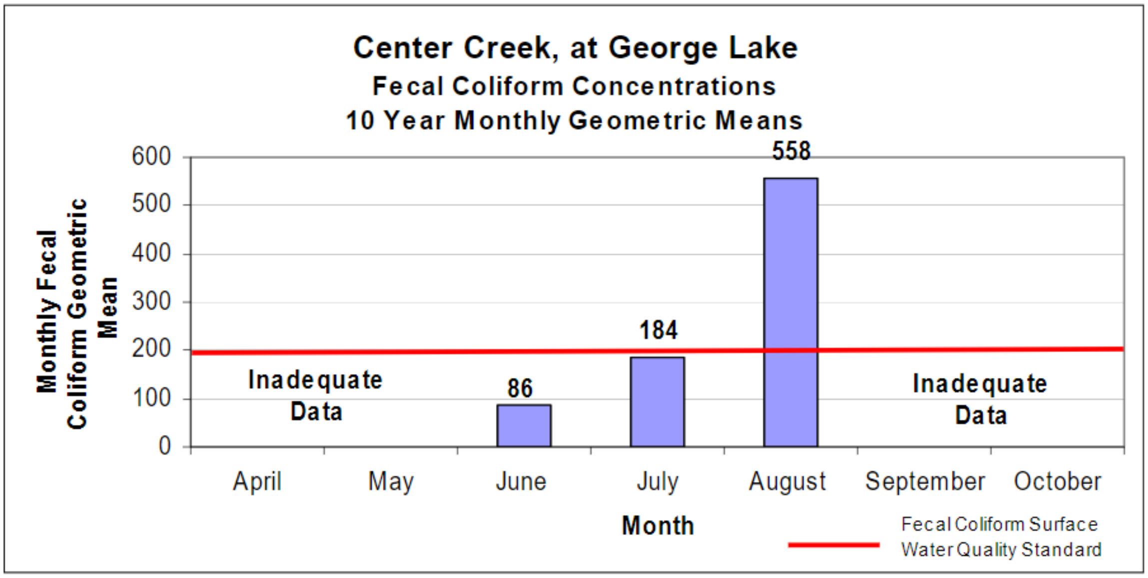


Table 12. Fecal coliform data summary as provided in the TMDL (Water Resources Center et al. 2007)

Stream	Sampling location	# of samples	June geomean (cfu/100mL)	July geomean (cfu/100mL)	August geomean (cfu/100mL)	Years of data
Dutch Creek, Headwaters to Hall Lake	Dutch Creek, 100th St.	55	425	1,410	1,331	2000, 2001, 2002, 2004
Center Creek, George Lake to Lily Creek	Center Creek George Lake	24	86	184	558	2000, 2001

Samples collected from Dutch Creek (S003-000) in 2007, 2008, and 2016 are summarized for E. coli. In 2007 and 2008, results regularly exceeded the 1,260 MPN/100 mL standard; geomeans of the annual data also exceeded the 126 MPN/100 mL standard (Table 13). Exceedances of the 1,260 MPN/100 mL standard were seem in the months of May through October (Table 14). Data are summarized graphically in Figure 15.

Samples collected from Center Creek (S003-023) in July and August 2000 (10 samples) and June through August 2001 (16 samples) were only evaluated for fecal coliform. In 2000, results ranged from 250 to 1,000 MPN/100 mL, while in 2001 results ranged from 10 to 8,000 MPN/100 mL.

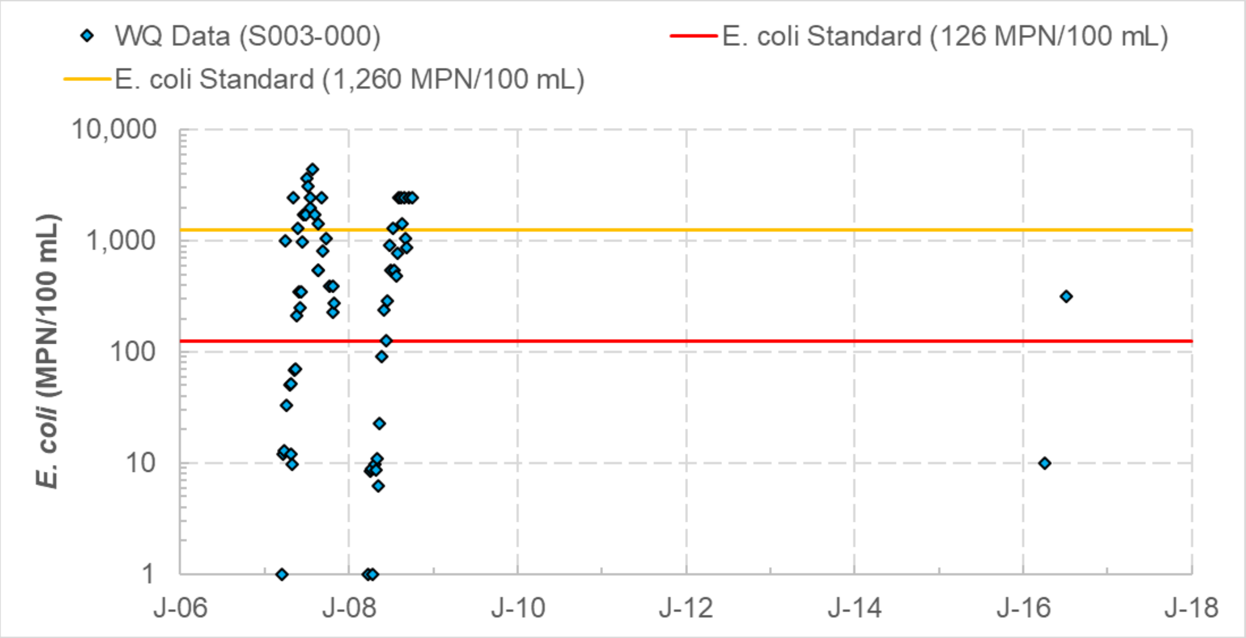
Table 13. Annual summary of E. coli data for Dutch Creek (AUID 07020009-527, site S003-000, Apr-Oct)

Year	Sample count	Minimum (MPN/100mL)	Maximum (MPN/100mL)	Samples >1,260 MPN/100mL
2007	33	10	4,352	12
2008	26	1	2,420	7
2016	2	10	313	0

Table 14. Monthly summary of E. coli data for Dutch Creek (AUID 07020009-527, site S003-000, 2007-2016)

Month	Sample count	Minimum (MPN/100mL)	Maximum (MPN/100mL)	Samples >1,260 MPN/100mL
March	4	1	13	0
April	11	1	1,000	0
May	11	6	2,420	2
June	9	126	1,733	2
July	11	313	4,352	6
August	8	548	2,420	6
September	6	816	2,420	2
October	5	228	2,420	1

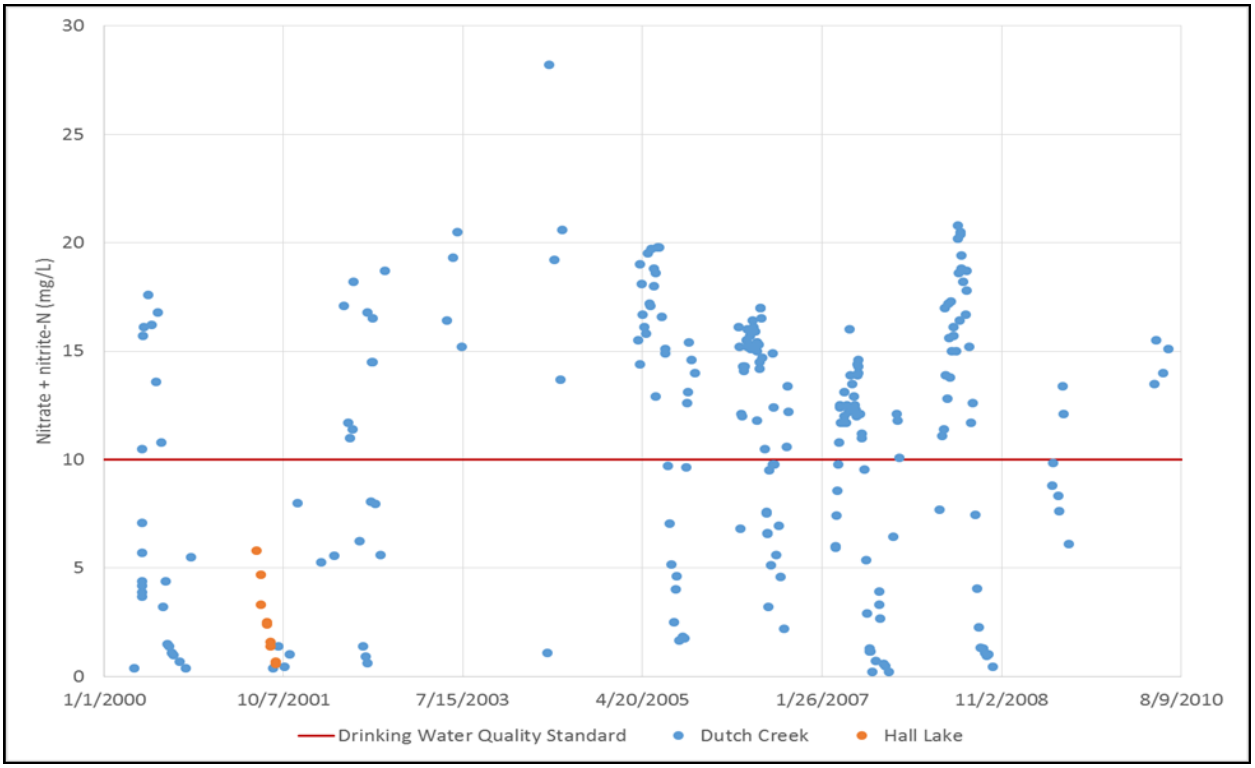
Figure 15. E. coli data for Dutch Creek (AUID 07020009-527, site S003-000, 2007-2016)



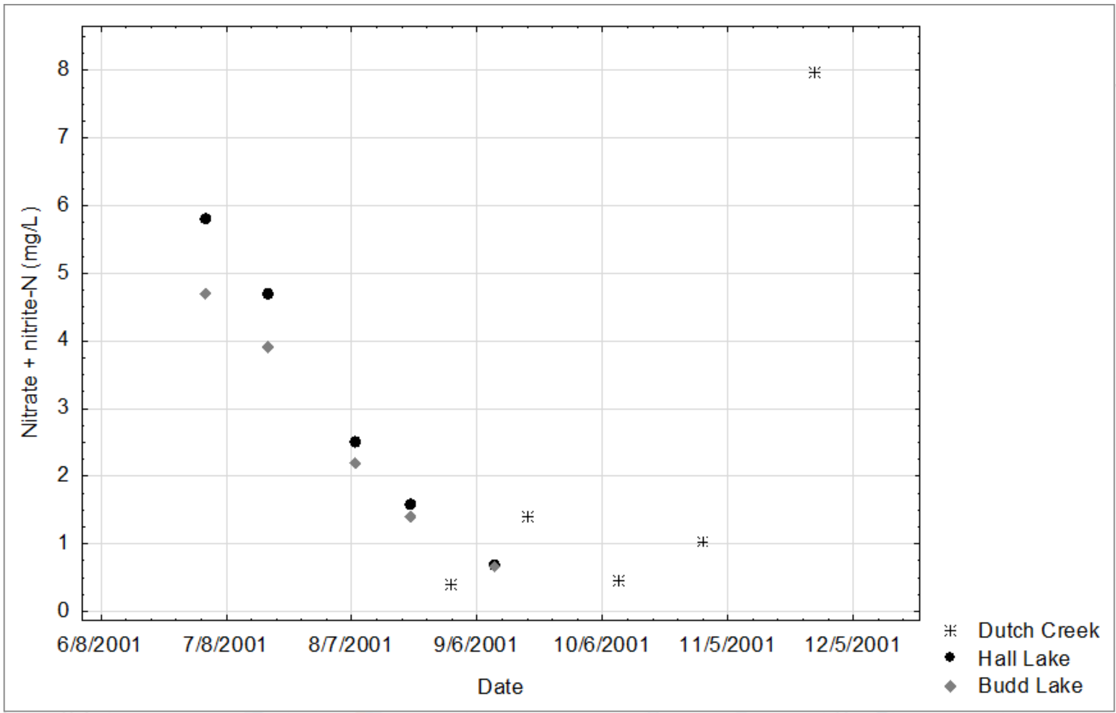
3.3.3 Nutrients

The nutrient descriptions in this section are adapted from Tetra Tech (2018). Nitrogen and phosphorus data for Dutch Creek and Hall Lake are shown in Figure 16 and Figure 17, respectively. The nitrate concentrations in Dutch Creek are variable ranging from near zero to above 20 mg/L. The figure shows the limited data for Hall Lake being less than 6 mg/L in 2001. The elevated nitrate concentrations in Dutch Creek present a concern as a primary source of nitrate to Hall and Budd Lakes and, subsequently the city of Fairmont's source water intake.

Figure 16. Dutch Creek and Hall Lake nitrate plus nitrite nitrogen concentration comparison, 2000-2010 (Tetra Tech 2018)



The phosphorus concentrations for Dutch Creek range from less than 0.05 mg/L total phosphorus to nearly 2.0 mg/L with about 25% of the observed data exceeding the stream eutrophication criteria of 0.150 mg/L for Minnesota's South River Nutrient Region; although it has not been assessed for stream eutrophication. The limited phosphorus data for Hall Lake often exceeded the lake eutrophication criteria (Figure 17).



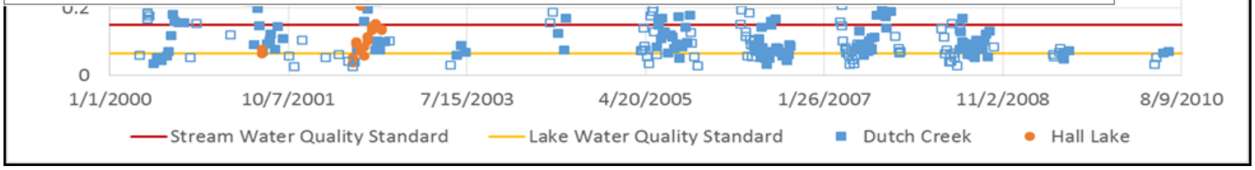
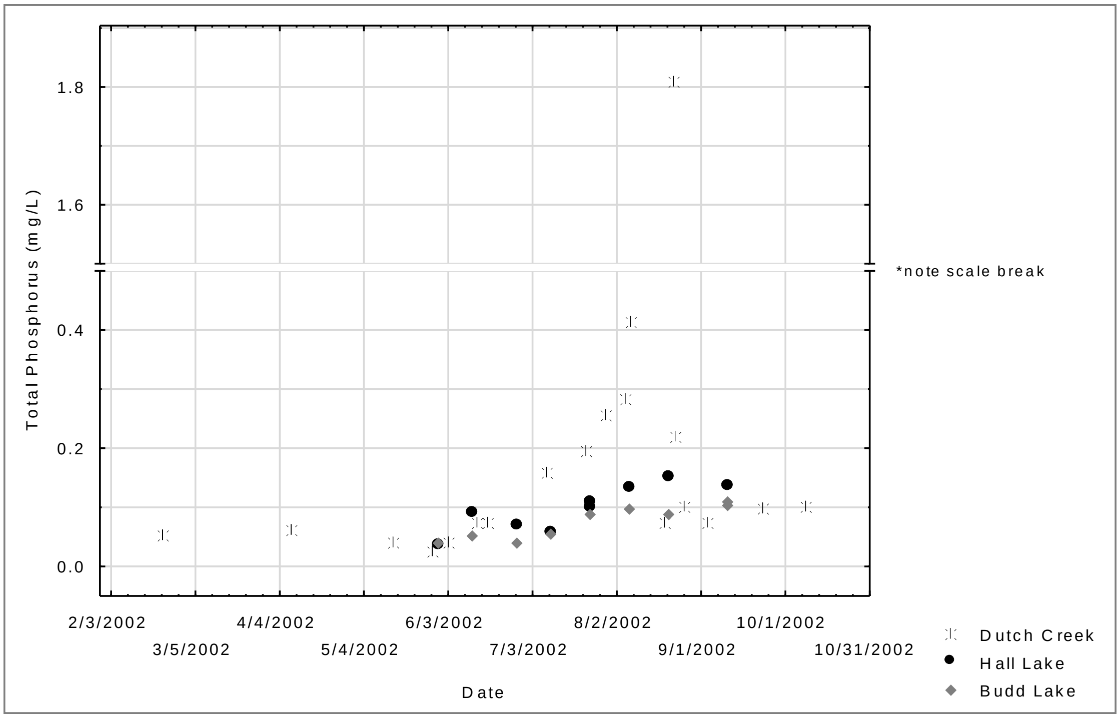


Figure 17. Dutch Creek and Hall Lake phosphorus concentration comparison, 2000-2010 (Tetra Tech 2018) (Hollow squares indicate samples during months when the standard does not apply)

Figure 18 and Figure 19 show the nitrate and phosphorus data for Dutch Creek, Hall Lake, and Budd Lake in 2001 and 2002. These periods were initially the only times when data was available for the three waterbodies in the same year. The overlap in the time period for the nitrate data was limited given that the lake samples were collected between July and September 2001, while the stream samples were collected in late August through November 2001.). Nitrate concentrations in Hall Lake were generally slightly higher than those in Budd Lake. The concentrations were less than 6 mg nitrate-nitrogen/L and decreased throughout the growing season in both lakes. The generally low nitrate concentrations in Dutch Creek likely reflect the time of year.

Figure 18. Nitrate plus nitrite-nitrogen concentrations in Dutch Creek, Hall Lake, and Budd Lake, 2001 (Tetra Tech 2018)

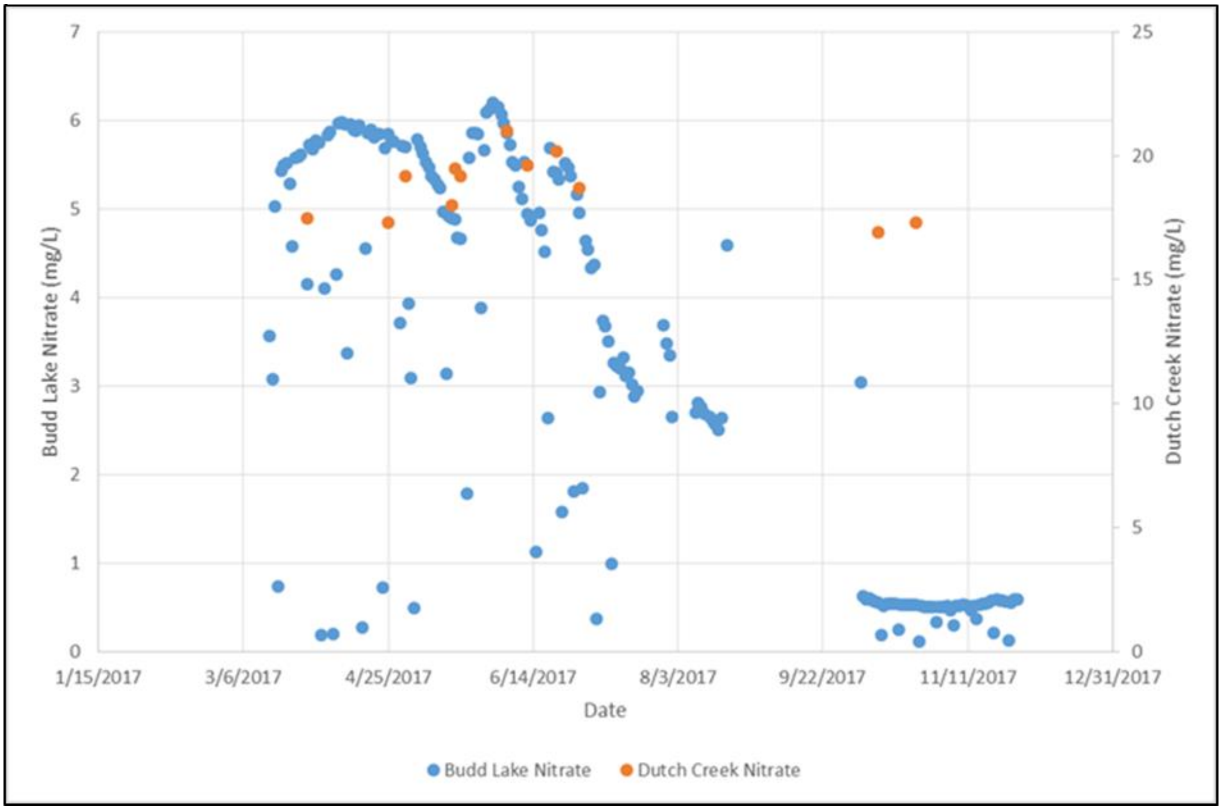
Figure 19. Total phosphorus concentrations in Dutch Creek, Hall Lake, and Budd Lake, 2002 (Tetra Tech 2018)



Phosphorus data were collected for the three water bodies in 2002. The phosphorus concentrations in Dutch Creek were less than 0.1 mg TP/L through June and then increased in July and August before decreasing near the end of August (Figure 19). The phosphorus concentrations in Hall and Budd Lakes parallel each other with the Hall Lake concentrations generally being slightly higher.

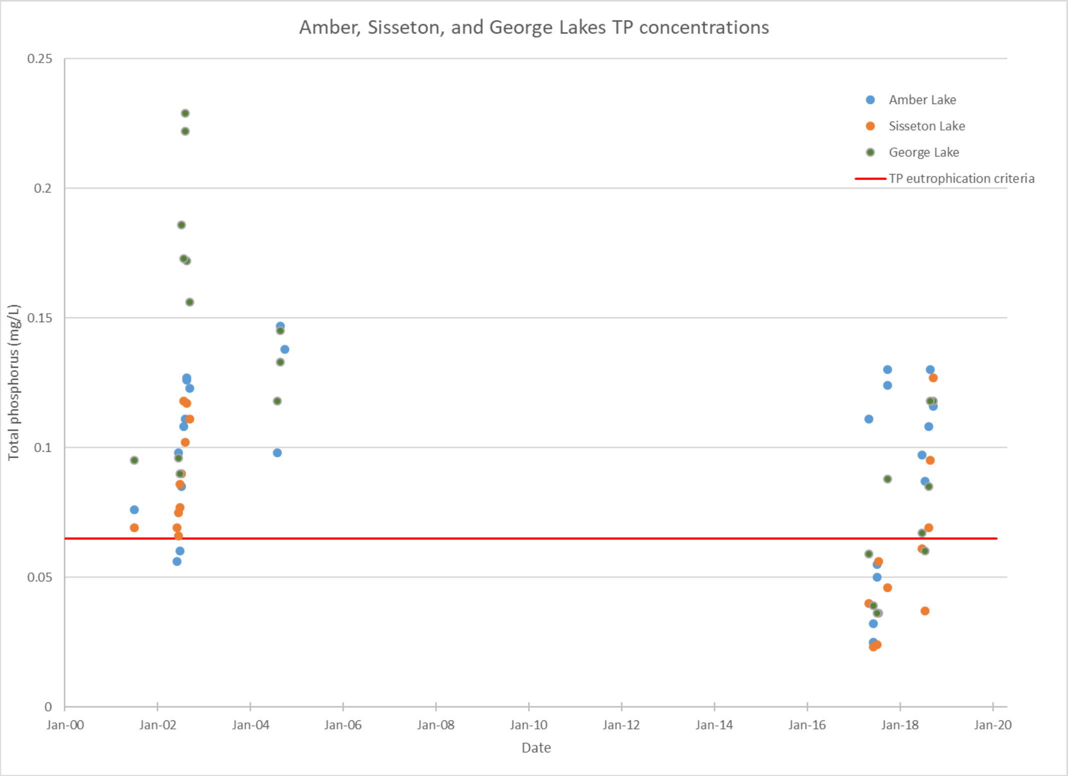
Following the peak in Budd Lake nitrate concentrations in 2016, water quality sampling was completed for Budd Lake and Dutch Creek in 2017. Figure 20displays the Dutch Creek and Budd Lake nitrate concentrations during 2017. The Dutch Creek nitrate concentrations were consistently above 15 mg nitrate-nitrogen/L. The Budd Lake concentrations were less than 6.5 mg/L nitrate throughout the year with concentrations decreasing to less than 1 mg/L in October and November.

Figure 20. Dutch Creek and Budd Lake nitrate concentration comparison, 2017 (Tetra Tech 2018) (Note different scales for each waterbody)



Water quality data is present for George, Sisseton, and Amber Lakes in 1988, early 2000s, and in recent years. Figure 21 provides a plot of the TP concentrations in the three lakes from 2001 – 2019.

Figure 21. Total phosphorus 2001-2019 for Amber, Sisseton, and George Lakes



3.4 Water quality impairment assessments

Dutch Creek, Budd Lake, Amber Lake, Hall Lake, Sisseton Lake, and George Lake had sufficient data to be assessed for water quality impairments. Dutch Creek was listed as impaired for turbidity and fecal coliform bacteria in 2006. A small segment of Center Creek in the planning area was also listed for fecal coliform. The five lakes were listed for impairment due to eutrophication in 2006. Budd Lake was listed as impaired for PCBs in fish tissue in 1998.

The small lakes (North Silver, Willmert, and Mud) upstream of Amber Lake are very shallow and do not have enough water quality data to be assessed for impairments.

TMDLs for fecal coliform were completed in 2007. A TMDL has not been completed for the turbidity impaired given that subsequent data collection indicated that the stream meets the TSS standard that replaced the turbidity standard in 2015. TMDLs for the lake impairments are targeted for completion in 2021.

3.5 Impairment 303(d) listings

Water quality impairments are identified in Minnesota’s 2018 303(d) list, which is the most recent approved 303(d) list; however, Dutch Creek watershed has listed impairments dating back to 1998. Figure 21 shows the impairments and Table 15 and Table 16 describe the criteria, date of listing and the status of total maximum daily load (TMDL) development.

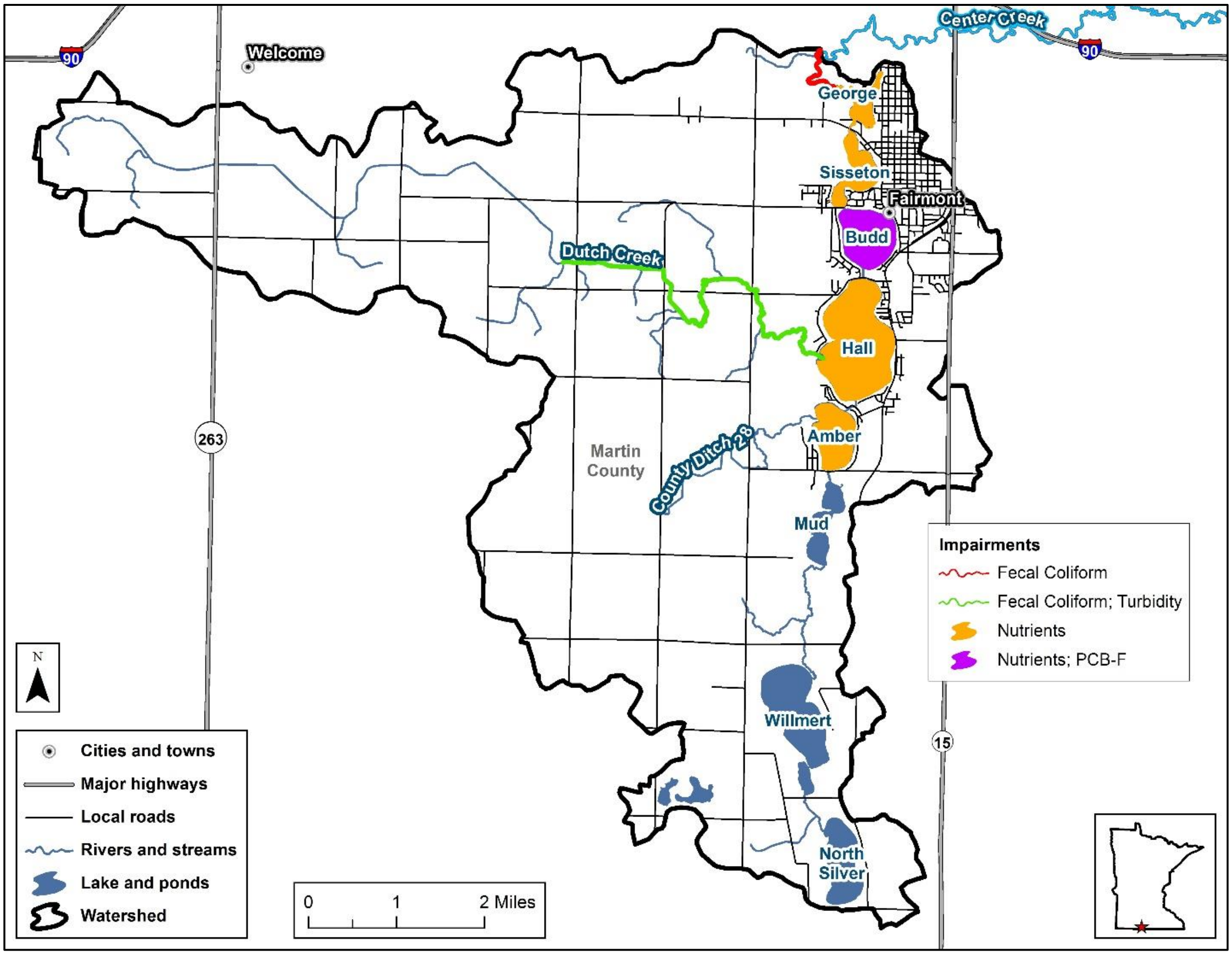
Table 15. Impaired streams

Reach name	Reach description	Classification	Year listed	AUID	Affected designated use	Pollutant or stressor	Status of TMDL
Center Creek	George Lk to Lily Cr	2B, 3C	2006	526	Aquatic Recreation	Fecal Coliform	Approved 2007
Dutch Creek	Headwaters to Hall Lk	2B, 3C	2006	527	Aquatic Life Aquatic Recreation	Turbidity Fecal Coliform	Draft 2019 Approved 2007

Table 16. Impaired lakes

Lake name	Description	Classification	Year listed	Lake ID	Affected designated use	Pollutant or stressor	Status of TMDL
George	In Fairmont	1C, 2Bd, 3C	2006	46-0024-00	Aquatic Recreation	Nutrient/ eutrophication biological indicators	2021 Target Completion
Sisseton	In Fairmont	1C, 2Bd, 3C	2006	46-0025-00	Aquatic Recreation	Nutrient/ eutrophication biological indicators	2021 Target Completion
Budd	At Fairmont	1C, 2Bd, 3C	1998 2006	46-0030-00	Aquatic Consumption Aquatic Recreation	PCB in fish tissue Nutrient/ eutrophication biological indicators	2021 Target Completion
Hall	2 MI SW of Fairmont	1C, 2Bd, 3C	2006	46-0031-00	Aquatic Recreation	Nutrient/ eutrophication biological indicators	2021 Target Completion
Amber	2 MI S of Fairmont	1C, 2Bd, 3C	2006	46-0034-00	Aquatic Recreation	Nutrient/ eutrophication biological indicators	2021 Target Completion

Figure 22. Impairments in the Dutch Creek and Fairmont Chain of Lakes watershed



3.6 Watershed TMDLs

Fecal coliform TMDLs have been developed to address the bacteria impaired stream reaches in the project area. TMDLs for the lakes are scheduled for completion in 2021.

3.6.1 Minnesota River and Greater Blue Earth River Basin TSS TMDL Report

Dutch Creek (537) was added to Minnesota's impaired waters list in 2006 for turbidity. The listing was addressed in a TSS TMDL for the larger Minnesota River and Greater Blue Earth River Basins (MPCA 2019a). According to the TSS TMDL, the data evaluated for Dutch Creek do not show impairment (Table 17; however, this stream is close to the water quality standard and should be addressed to improve water quality.

In light of new data analysis completed following the 2019 TMDL process, the TSS data are presenting a trend of exceedances. The watershed partners will continue to approach this as a restoration project.

The draft TSS TMDL study determined the load duration curve for Dutch Creek (Figure 23).

Figure 23. TSS load duration curve, Dutch Creek (527) (MPCA 2019b)

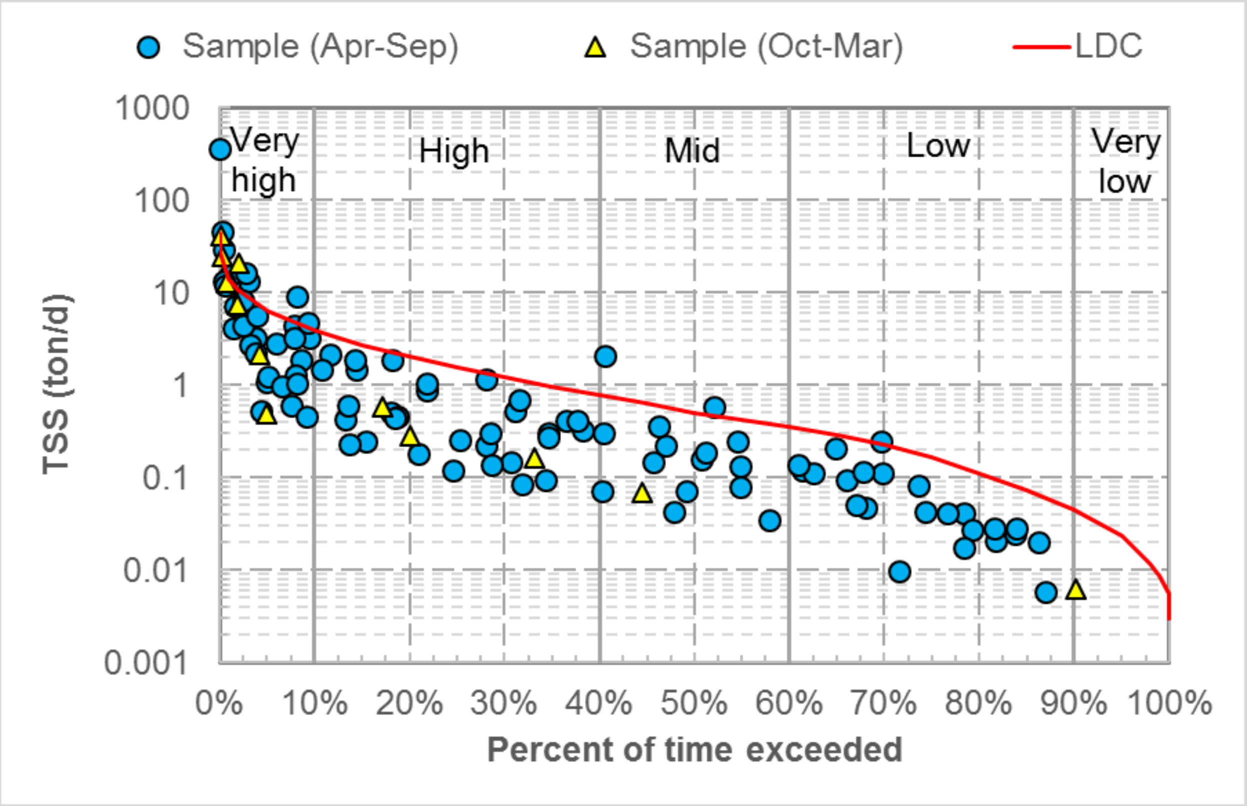


Table 17. TSS TMDL summary, Dutch Creek (527) (MPCA 2019b)

TMDL Parameter	Flow Regimes				
	Very High	High	Mid	Low	Very Low
	TSS Load (ton/d)				
WLA: City, County, Township MS4 [a]	0.061	0.023	0.0091	0.0042	0.0020
WLA: Industrial/Construction Stormwater	0.011	0.0028	0.00091	0.00030	0.000041
WLA: Wastewater	0.00038	0.00038	0.00038	0.00038	0.00038
Load Allocation	5.6	1.3	0.44	0.15	0.018
Margin of Safety	0.63	0.15	0.050	0.017	0.0023
Loading Capacity	6.3	1.5	0.50	0.17	0.023
Existing Concentration (mg/L)	64				
Percent Reduction to Achieve Concentration Standard	– [b]				

[a] To meet the WLAs for permitted MS4s, TSS loading does not need to be reduced but is not allowed to increase.

[b] This impairment was originally listed in 2004 based on turbidity data; however, the TSS data presented in this report do not show impairment. The MPCA will reevaluate the reach in the next impairment assessment for this watershed.

3.6.2 Fecal Coliform TMDL

Center Creek (526) and Dutch Creek (527) were added to Minnesota's impaired waters list in 2006 for excess fecal coliform concentrations. The listings were addressed in a regional fecal coliform TMDL for the Blue Earth River Basin (Water Resources Center, Minnesota State University, Mankato and Blue Earth River Basin Alliance 2007). The TMDL for Center Creek is provided in Table 18 and the TMDL for Dutch Creek is provided in

Table 19.

Table 18. Monthly and daily fecal coliform loading capacities and allocations for Center Creek (Water Resources Center, Minnesota State University, Mankato and Blue Earth River Basin Alliance 2007).

Drainage Area (square miles): 49
USGS gage used to develop flow zones and loading capacities: Blue Earth River, near Rapidan

% MS4 Urban: 22.55% Total WWTF Design Flow (mgd): 0.00	Flow Zone									
	High		Moist		Mid		Dry		Low	
	Monthly	Daily	Monthly	Daily	Monthly	Daily	Monthly	Daily	Monthly	Daily
	values expressed as trillion organisms per month / day									
TOTAL MONTHLY / DAILY LOADING CAPACITY	21.57	7.19	8.85	2.95	4.26	1.42	1.56	0.52	0.23	0.08
Wasteload Allocation										
Permitted Wastewater Treatment Facilities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Communities Subject to MS4 NPDES Requirements	3.82	1.27	1.54	0.51	0.73	0.24	0.21	0.07	0.03	0.01
Livestock Facilities Requiring NPDES Permits	0	0	0	0	0	0	0	0	0	0
"Straight Pipe" Septic Systems	0	0	0	0	0	0	0	0	0	0
Load Allocation	13.13	4.38	5.30	1.77	2.51	0.84	0.71	0.24	0.11	0.04
Margin of Safety	4.62	1.54	2.00	0.67	1.02	0.34	0.64	0.21	0.08	0.03
	values expressed as percent of total monthly/daily loading capacity									
TOTAL MONTHLY / DAILY LOADING CAPACITY	100%		100%		100%		100%		100%	
Wasteload Allocation										
Permitted Wastewater Treatment Facilities	0.0%		0.0%		0.0%		0.0%		0.0%	
Communities Subject to MS4 NPDES Requirements	17.7%		17.4%		17.1%		13.3%		14.5%	
Livestock Facilities Requiring NPDES Permits	0.0%		0.0%		0.0%		0.0%		0.0%	
"Straight Pipe" Septic Systems	0.0%		0.0%		0.0%		0.0%		0.0%	
Load Allocation	60.9%		59.9%		58.9%		45.8%		49.7%	
Margin of Safety	21.4%		22.6%		24.0%		40.9%		35.8%	

Table 19. Monthly and daily fecal coliform loading capacities and allocations for Dutch Creek (Water Resources Center, Minnesota State University, Mankato and Blue Earth River Basin Alliance 2007)

Drainage Area (square miles): 17
USGS gage used to develop flow zones and loading capacities: Blue Earth River, near Rapidan

% MS4 Urban: 5.37%
Total WWTF Design Flow (mgd): 0.00

	Flow Zone									
	High		Moist		Mid		Dry		Low	
	Monthly	Daily	Monthly	Daily	Monthly	Daily	Monthly	Daily	Monthly	Daily
	values expressed as trillion organisms per month / day									
TOTAL MONTHLY / DAILY LOADING CAPACITY	7.57	2.52	3.11	1.04	1.50	0.50	0.55	0.18	0.08	0.03
Wasteload Allocation										
Permitted Wastewater Treatment Facilities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Communities Subject to MS4 NPDES Requirements	0.32	0.11	0.13	0.04	0.06	0.02	0.02	0.01	0.00	0.00
Livestock Facilities Requiring NPDES Permits	0	0	0	0	0	0	0	0	0	0
"Straight Pipe" Septic Systems	0	0	0	0	0	0	0	0	0	0
Load Allocation	5.63	1.88	2.27	0.76	1.08	0.36	0.31	0.10	0.05	0.02
Margin of Safety	1.62	0.54	0.70	0.23	0.36	0.12	0.22	0.07	0.03	0.01
	values expressed as percent of total monthly/daily loading capacity									
TOTAL MONTHLY / DAILY LOADING CAPACITY	100%		100%		100%		100%		100%	
Wasteload Allocation										
Permitted Wastewater Treatment Facilities	0.0%		0.0%		0.0%		0.0%		0.0%	
Communities Subject to MS4 NPDES Requirements	4.2%		4.2%		4.1%		3.2%		3.4%	
Livestock Facilities Requiring NPDES Permits	0.0%		0.0%		0.0%		0.0%		0.0%	
"Straight Pipe" Septic Systems	0.0%		0.0%		0.0%		0.0%		0.0%	
Load Allocation	74.4%		73.2%		72.0%		56.0%		60.8%	
Margin of Safety	21.4%		22.6%		24.0%		40.9%		35.8%	

4. Pollutant source assessments

Pollutant source assessments are conducted for pollutant impairment listings and where a biological stressor identification report process identifies a pollutant as a stressor. The pollutants of concern in the Dutch Creek and Fairmont Chain of Lakes watershed include sediment, phosphorus, nitrogen, E. coli (formerly fecal coliform) and polychlorinated biphenyls (PCBs).

Sources of pollutants to lakes and streams include point sources or nonpoint sources.

4.1 Sediment

Sediment loading in the project area was modeled using SWAT (Tetra Tech 2018). Table 20 summarizes SWAT modeled sediment loading by land use. Cultivated crops contribute the majority of sediment loading, followed by urban land uses. As identified in section 2.5, cultivated crops in this area are predominantly corn and soybean rotations. Minimal streambank or bluff erosion is present in this watershed.

Table 20. Simulated sediment loading by land use in the project area (Tetra Tech 2018)

Land use	**Sediment (tons/year)**
Cultivated Crops	1,659.5
Urban	51.4
Grassland	7.1
Wetland	3.9
Forest	0.2
Barren	< 0.01

4.2 Phosphorus

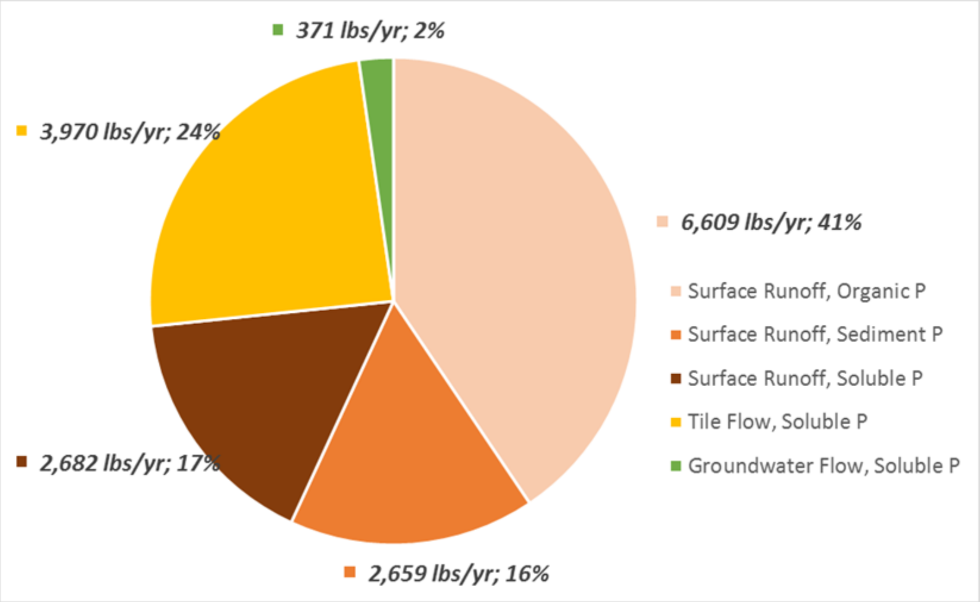
4.2.1 Watershed runoff

Phosphorus loading by land use in the project area was modeled using SWAT (Tetra Tech 2018). Table 21 summarizes modeled total phosphorus loading by land use. Cultivated crops contribute the majority of phosphorus loading, followed by urban land uses. Phosphorus loading by pathway is provided in Figure 24. The majority of phosphorus flows through surface runoff (organic phosphorus and sediment-bound phosphorus) pathways.

Table 21. Simulated total phosphorus loading by land use in the project area (Tetra Tech 2018)

Land use	**Total phosphorus (pounds/year)**
Cultivated Crops	15,333.3
Urban	780.3
Grassland	112.7
Wetland	53.0
Forest	11.0
Barren	0.3

Figure 24. Proportions of phosphorus loads associated with different flow pathways (Tetra Tech 2018)



4.2.2 Internal loading

In 1981, a case study found that internal loading of phosphorus was a substantial portion of the phosphorus load to the Fairmont Chain of Lakes (Stefan and Hanson 1981). Surface water TP concentrations were found to increase over the course of the summer due to mixing of the hypolimnetic phosphorus into the euphotic zone. A 2002 study confirmed these results with five lakes in the chain exhibiting temporary stratification and low dissolved oxygen (<2 mg/L) on one or more sample dates (Schlorf Von Holdt 2002 and MPCA 2002). Hypolimnetic TP typically increased under these conditions and then decreased as the lakes became well-mixed. Epilimnetic TP increased from spring to lake summer on most of the lakes. TP concentrations for these lakes were in the 40-70 microgram per liter (ug/L) range in May and peaks at about 120-140 ug/L in August.

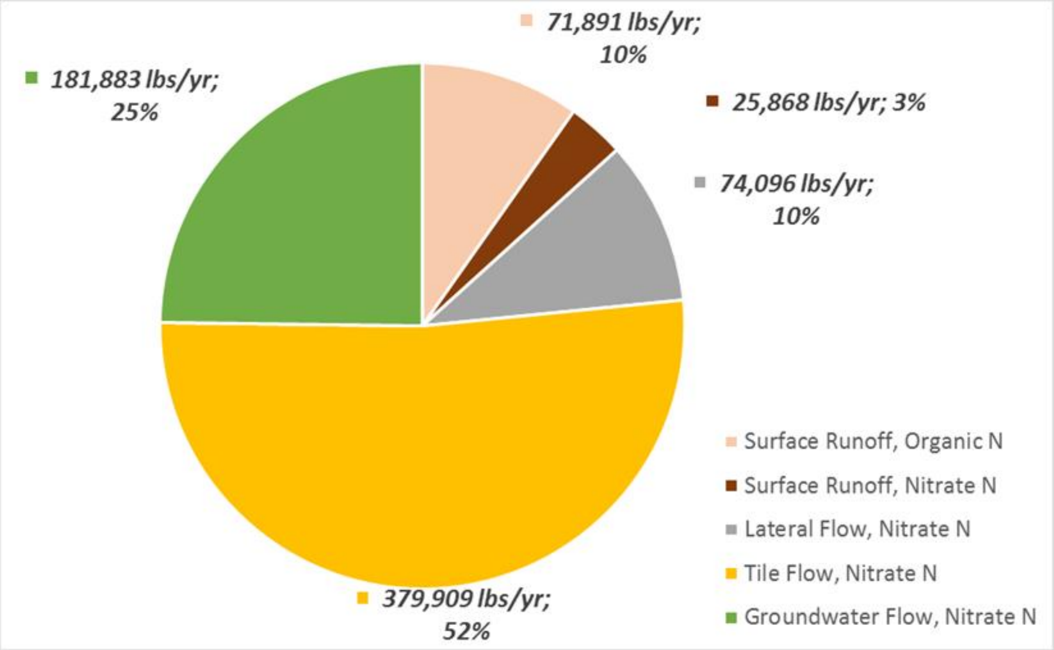
4.3 Nitrogen

Nitrogen was identified as a pollutant of concern in the SWA for the City of Fairmont (MDH 2019). Nitrogen loading by land use in the project area was modeled using SWAT (Tetra Tech 2018). Table 22 summarizes modeled total nitrogen loading by land use. Cultivated crops contribute the majority of nitrogen loading, followed by urban land uses. Nitrogen loading by pathway is provided in Figure 25. The majority of nitrogen flows through tile flow pathways.

Table 22. Simulated total nitrogen loading by land use in the project area (Tetra Tech 2018)

Land use	Total nitrogen (pounds/year)
Cultivated Crops	668,452.5
Urban	48,223.6
Grassland	10,808.7
Wetland	5,069.2
Forest	1,069.6
Barren	23.9

Figure 25. Proportions of nitrogen loads associated with different flow pathways (Tetra Tech 2018)



4.4 *E. coli*

Sources of E. coli to Dutch Creek and Center Creek were evaluated in the Blue Earth River Basin Fecal Coliform TMDL (Water Resources Center, Minnesota State University, Mankato and Blue Earth River Basin Alliance 2007). According to the report, the major source of E. coli to Center Creek and Dutch Creek during wet conditions is surface applied livestock manure. During dry conditions, the major sources of E. coli to the creeks are straight pipe septic systems (and other improperly treated waste from septic systems) and overgrazed pastures (Table 23).

Table 23. Major sources of fecal coliform to Center Creek and Dutch Creek by flow condition (Water Resources Center, Minnesota State University, Mankato and Blue Earth River Basin Alliance 2007)

Category	Source	Wet Conditions	Dry Conditions
Livestock	Overgrazed Pastures near Streams or Waterways	🟩	🟧
	Feedlots or Manure Stockpiles without Runoff Controls	🟨	🟩
	Surface Applied Manure	🟧	🟩
	Incorporated Manure	🟨	🟩
Human	Human – Failing SSTS/straight pipes	🟩	🟧
Pets	Cats & Dogs	🟩	🟩
Wildlife	Deer, Canadian Geese, Wild Turkeys, Pheasants, etc.	🟩	🟩

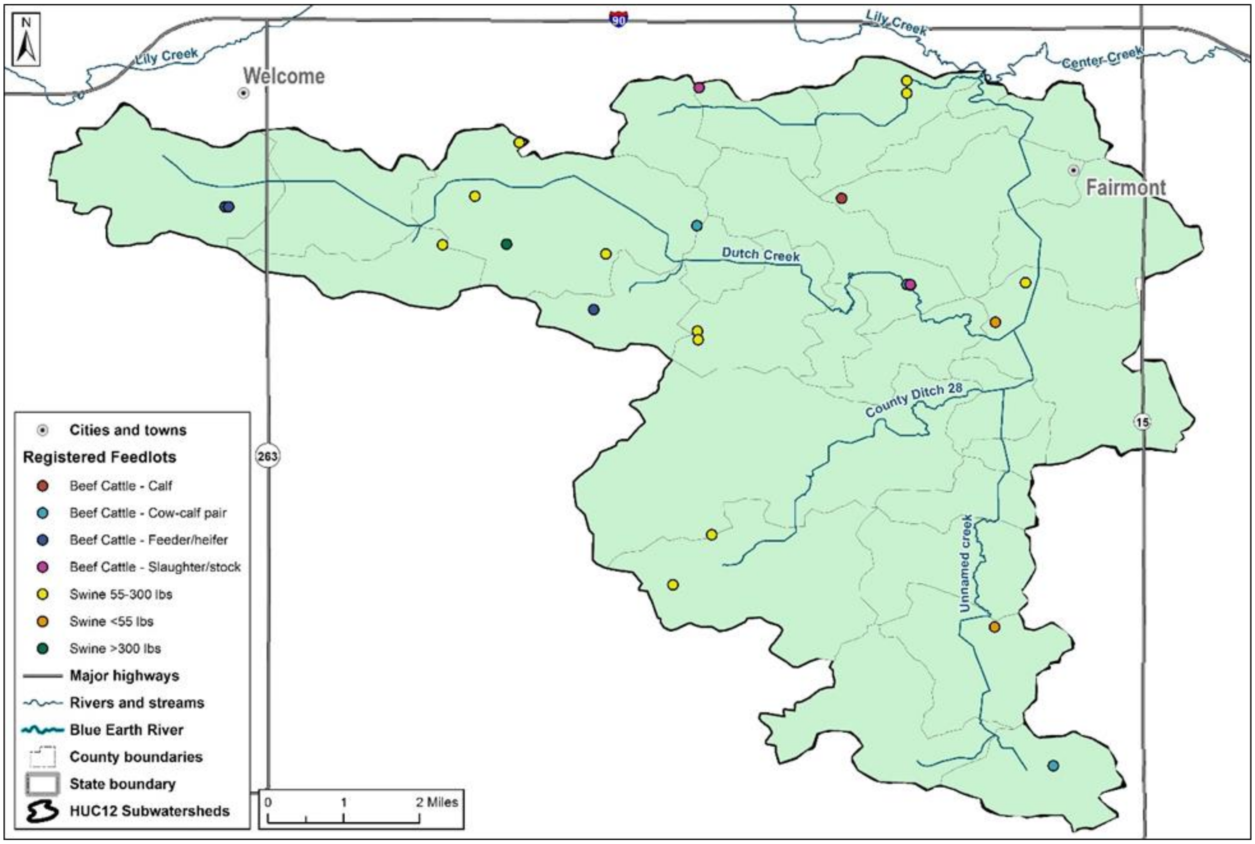
Low contributor	🟩
Moderate contributor	🟨
High contributor	🟧

Locations of feedlots within the project area in 2018 are provided in Figure 26. Manure from these feedlot facilities is likely land-applied to nearby crop fields. There are 9 registered beef operations in the Dutch Creek and Hall Lake Watersheds, with no NPDES permitted facilities.

Table 24. Animal numbers in Hall Lake and Dutch Creek Watersheds

Animal type	Numbers
Beef Cattle - Cow & calf pair	137
Beef Cattle - Slaughter/Stock	995
Beef Cattle - Feeder/heifer	854
Swine <55 lbs	1,200
Swine 55-300 lbs	35,365
Swine >300 lbs	2,304

Figure 26. Registered feedlot locations (Tetra Tech 2018)



There are farms adjacent to Dutch Creek that exhibit signs of overgrazing. These producers are considered a critical loading area for *E. coli* and TSS. The SWCD has the field-level identifications; however, due to privacy concerns, these will not be published as part of this plan.

4.5 Harmful algal bloom toxins

Toxins from harmful algal bloom (HAB) are identified as contaminants of concern in the source water assessment for the City of Fairmont (MDH 2019). HABs are produced by cyanobacteria, a type of photosynthetic bacteria that occur naturally in water but can become a nuisance with excess levels of phosphorus. Cyanobacteria blooms are characterized by dense green/blue areas largely on the surface of the water that can expand over large areas. These blooms can contain the bacteria that create HAB toxins. If exposed, HABs can cause illness in people and pets.

High nutrients are the likely cause of increased cyanobacteria. There is a correlation between high nitrates and increased blue-green algae blooms, although typically these increases are connected to high levels of phosphorus. Implementation in this plan is expected to reduce the concentration of nitrogen and phosphorus, thus reducing the risk of HABs.

4.6 Polychlorinated biphenyls (PCBs)

PCBs are not a single chemical, but a class of 209 synthetic chemicals. They were used as insulators in electrical equipment including transformers, capacitors and ballasts, and as plasticizers in caulking and thermal stabilizers in hydraulic and lubricating fluids (MPCA 2013). They were also used in some building materials, paints, and sealants (EPA 2011). According to EPA (2011) “PCBs can be released from disposal of products discarded as solid waste, ongoing use of PCB-containing equipment and materials, industrial processes, and other sources. These releases may have cross-media impacts.”

Commercial production of PCBs in the United States occurred between 1929 and 1977 when it was banned. Certain imported materials continued to contain PCBs until 1979. Potential sources of PCBs may include landfills, locations where capacitors, transformers, or other PCB-laden products have been used, atmospheric deposition, contaminated sediment, runoff from contaminated sites, and groundwater (EPA 2011).

5.0 Critical areas and priorities

The Dutch Creek and the Fairmont Chain of Lakes Watersheds are high priorities given the lakes being a source water for the City of Fairmont's drinking water and for their recreational value in the region. Within the watersheds three priority areas were identified for management. These priority areas were identified using information in existing planning documents and from Martin County SWCD. Priority areas represent the areas with the most potential to address the stressors and sources of impairment within the project area. Critical areas representing the highest potential loading site are identified through the use of SWAT and ACPF modeling. Implementation will be prioritized to address critical areas.

- **Priority Area #1: Dutch Creek watershed.** Dutch Creek was identified as a priority area by Martin County SWCD. In addition, Dutch Creek is impaired due to two pollutants of concern (sediment and *E. coli*), is largely agricultural, and discharges directly into the Chain of Lakes. Watershed runoff from crops contributes the largest amount of phosphorus, nitrogen, and sediment in the project area (Tetra Tech 2018). Three main sources of pollutants can be addressed in this priority area:
    - Runoff from row crop fields
    - Feedlots
    - SSTS within riparian areas
- **Priority Area #2: Urbanized area in the City of Fairmont.** Urban runoff is the second largest contributor of phosphorus, nitrogen, and sediment in the project area (Tetra Tech 2018) and the City of Fairmont is the main urbanized area is the project area.
- **Priority Area #3: Chain of Lakes shorelines.** The Fairmont Chain of Lakes is highly recreated and has numerous homes (seasonal and year-round). As such, their shoreline areas are identified as a critical area.

Critical areas have been determined as the highest loading areas through the use of various modeling tools, including SWAT, ACPF, and PTMApp. The critical areas to be addressed are included under each management suite in section 7.0 Management strategies and activities.

6.0 Watershed goals

Watershed goals are developed for impairments within the Dutch Creek and Fairmont Chain of Lakes project area and are derived from existing TMDLs and planning documents. The primary goals of this plan is to restore and to protect the water quality of the waterbodies in the watershed. Implementation of the plan will make progress towards achieving these goals over a ten-year timeframe and evaluate the progress towards the goals. Implementation work will be prioritized to critical areas, with a focus on the impaired waters. Protection for waters trending toward impairments will be considered high priority areas of concern. Specific goals are:

- To further reduce TSS concentrations for Dutch Creek below the TSS water quality standard.
- To meet the *E. coli* water quality standard in Dutch and Center Creeks.
- To attain the lake water quality standards for George, Sisseton, Budd, Hall, and Amber Lakes.
- To protect Budd Lake from exceeding the nitrate-nitrogen concentrations below the MCL of 10 mg/l.

The TSS data collected during the development of the draft *Minnesota River and Greater Blue Earth River Basin Total Suspended Solids Total Maximum Daily Load Study* indicated that Dutch Creek was not exceeding the TSS standard; therefore, a TSS TMDL was not developed for Dutch Creek as part of the overall study. Given that the data shows a nearly impaired status, TSS load reductions are needed to ensure that the standard is obtained. The milestone table reductions of 15.9% of TSS loading are the goal for Dutch Creek. Further data collection and monitoring will guide future actions through this plan’s iterative and adaptive nature.

7.0 Management strategies and activities

Management strategies and activities to meet watershed goals have been described in many existing documents. This section summarizes existing strategies and activities and expands upon them based on local input and priorities.

7.1 Agricultural BMPs

Management strategies and activities to address nutrient (phosphorus and nitrogen) loading from agricultural sources throughout the entire project area were developed by area-weighting the results of implementation scenarios created for the SWAT Modeling Report (Tetra Tech 2018) to the entire project area.

Since no specific nutrient load reduction goals have been set for the chain of lakes through a TMDL, two agricultural BMP scenarios were developed that represent a lower and higher level of implementation (Table 25). Upon the completion of the lake TMDLs (target completion date of 2021), the two scenarios can be reevaluated to determine the necessary level of implementation to achieve nutrient load reductions.

Agricultural BMPs were selected based on input provided by Martin County SWCD during SWAT model development. These BMPs have multi-pollutant benefits and reductions in sediment are also expected but were not calculated. The suitable area for conservation tillage, nitrogen management, and cover crops includes all agricultural land in the watershed. However, priority will be given to the critical areas for implementation practices (Figure 28). Critical loading areas for sediment, nitrogen, and phosphorus in the Dutch Creek Watershed are included in Figure 30, Figure 31, and Figure 32.

Table 25. Summary of agricultural BMP scenarios (Tetra Tech 2018)

Combination Scenario #2 – Higher level of implementation
1. Implementation of the large wetland at the Dutch Creek outlet
2. Increase cropland practicing conservation tillage to 75% from 50% under existing conditions (a 50% increase)
3. Implementation of a 30 lbs-N/acre reduction in N-fertilizer application on 60% of cropland area
4. Implementation of cover crop on 50% of cropland area
5. Restoration of 2% of restorable upland wetlands

The scenario includes the construction of an offline treatment wetland near the mouth of Dutch Creek, which is proposed to be built on city-owned land with ideal adoption cooperation. The proposed location for the large offline wetland is provided in Figure 27 and covers approximately 27 acres. In addition to the SWAT modeling work, Martin County SWCD recently ran the ACPF tool to identify critical areas for agricultural BMPs in the area. Results of this effort are provided in Figure 28 and Figure 29.

Figure 27. Proposed off-line wetland location (Tetra Tech 2018)

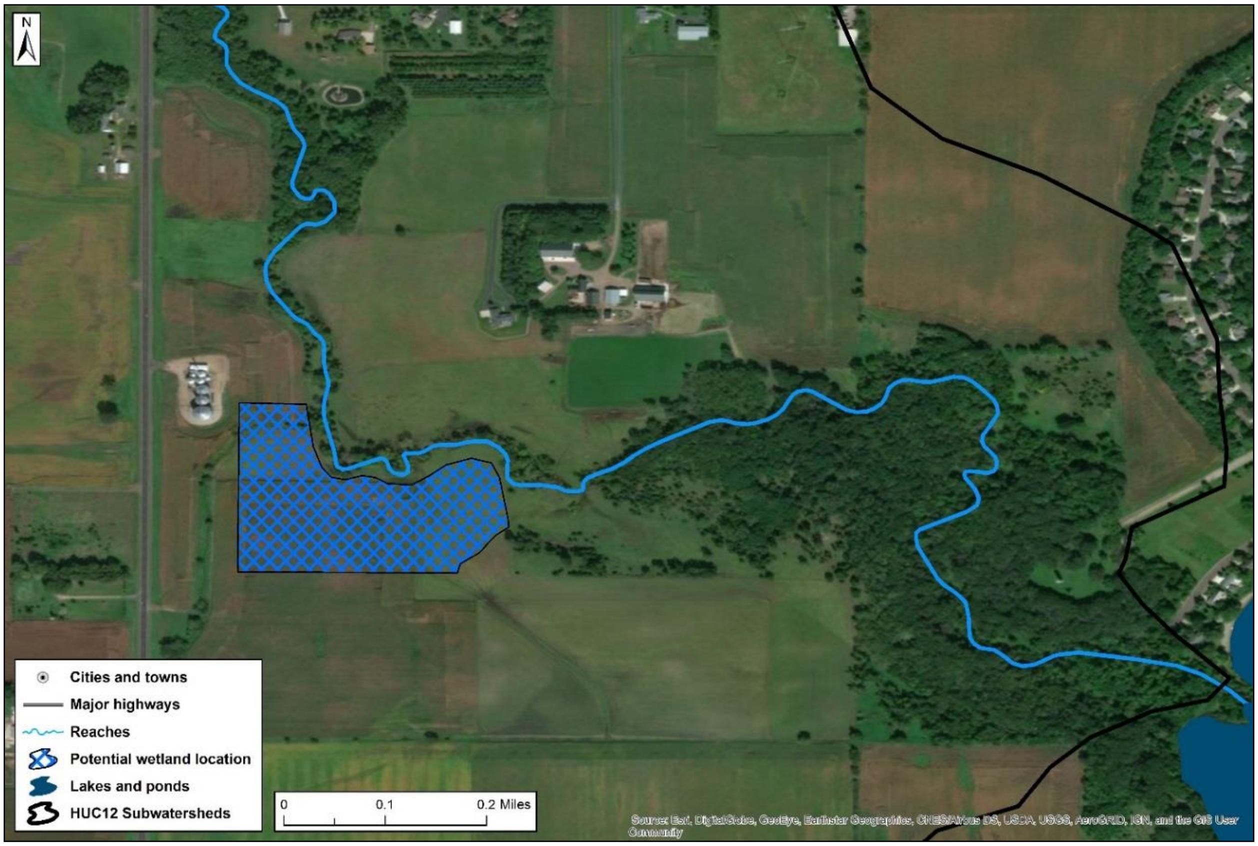


Figure 28. Critical areas for implementation of BMPs in the Dutch Creek Watershed identified by ACPF (Image from Martin County SWCD)

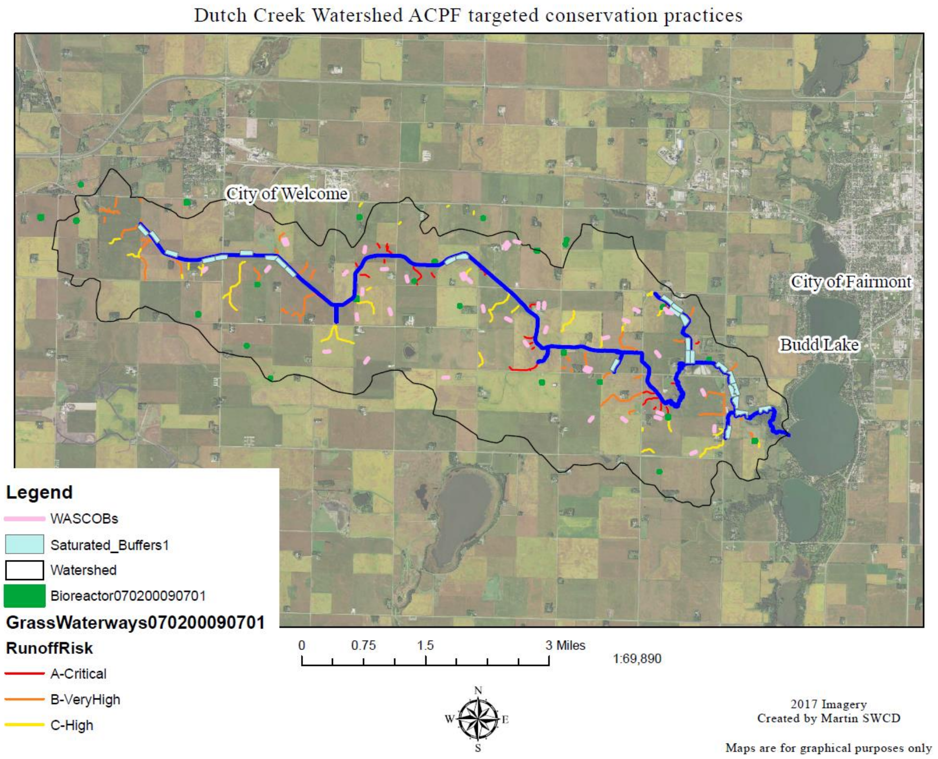


Figure 29. Critical areas for agricultural BMPs in the Fairmont Chain of Lakes (aka Hall Lake Watershed) Watershed identified by ACPF (Image from Martin County SWCD)

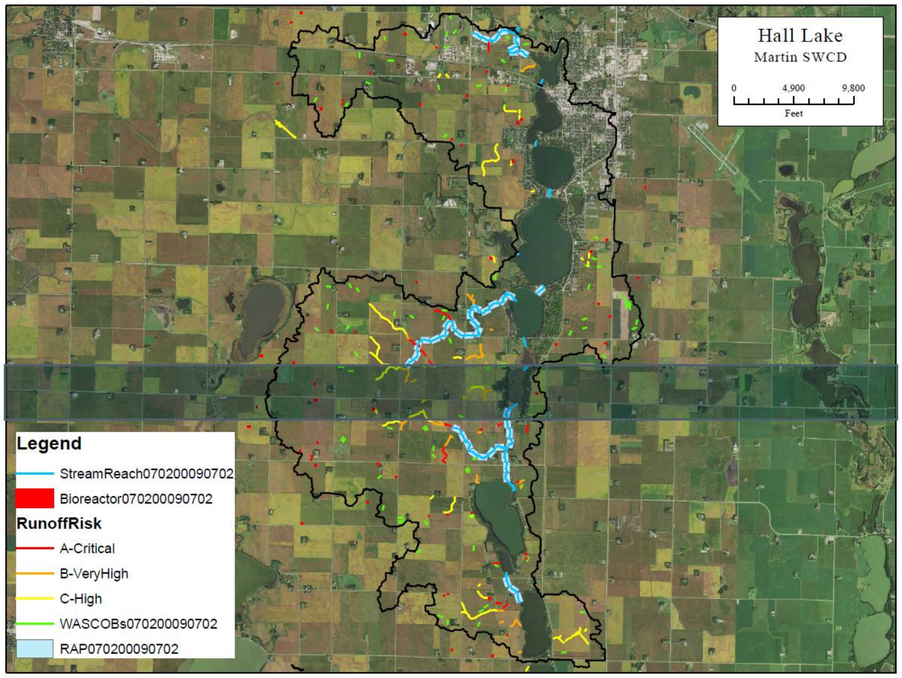


Figure 30. Critical sediment loading in planning area (Dutch Creek and Fairmont Chain of Lakes Watersheds)

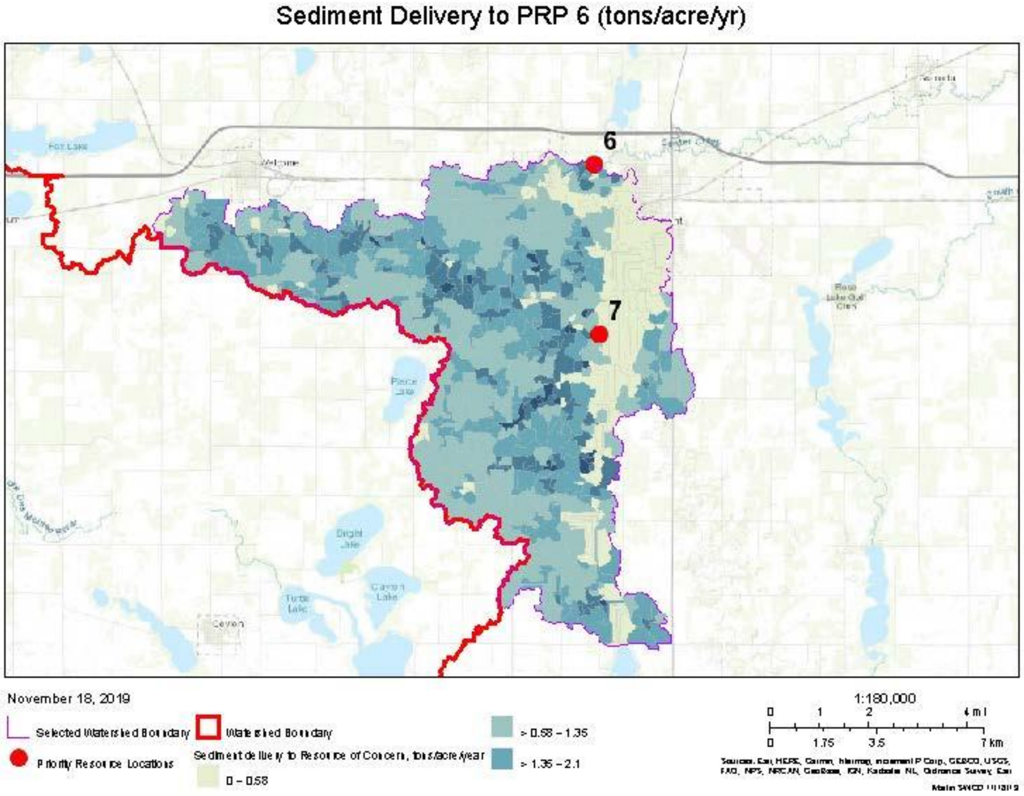


Figure 31. Critical loading areas of TN in the planning area

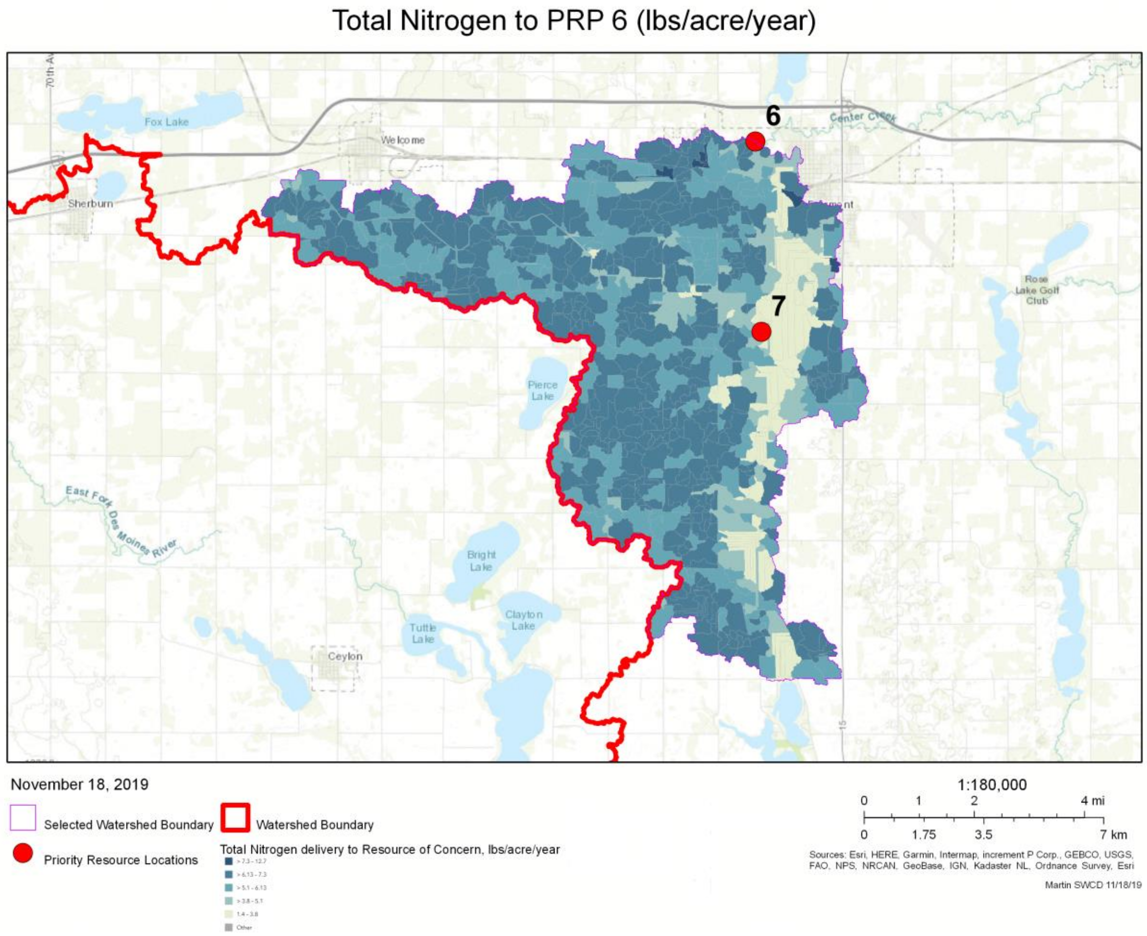
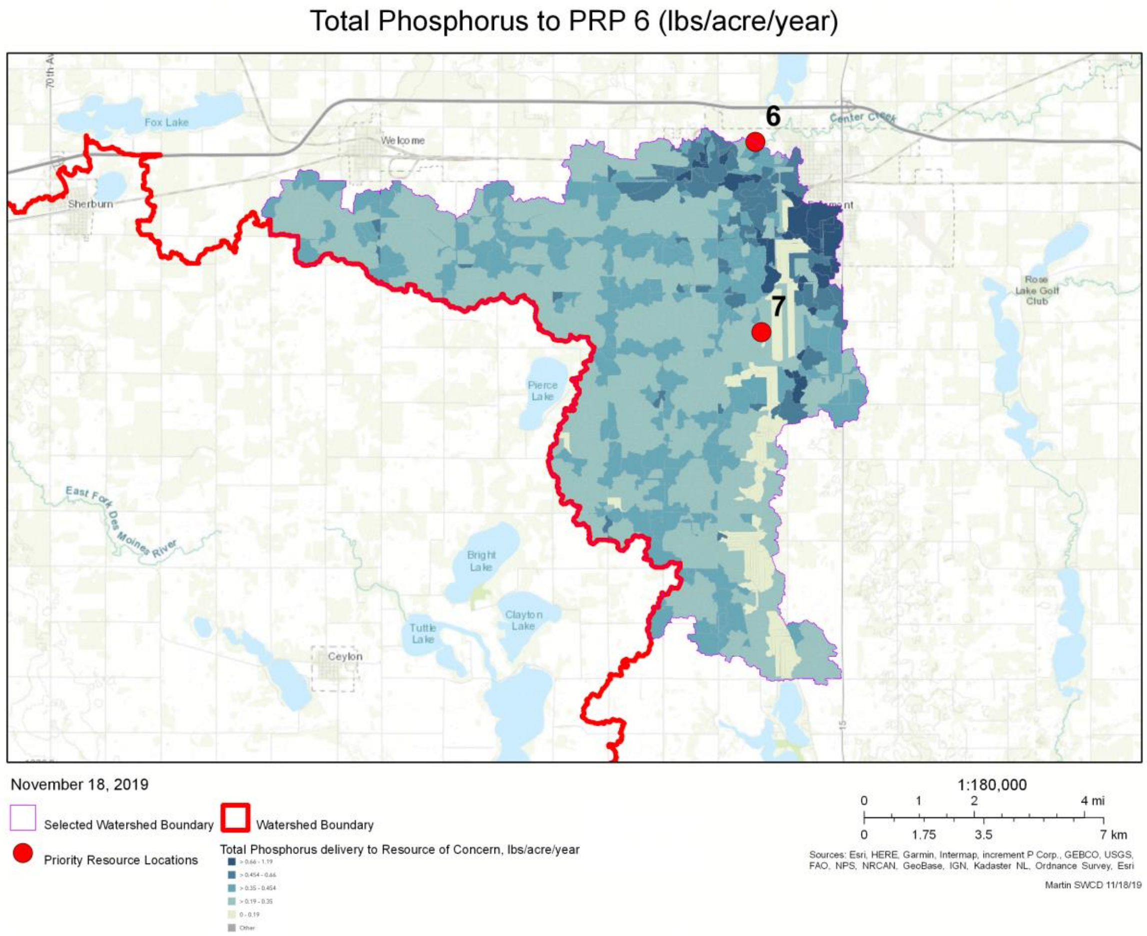


Figure 32. Critical loading areas of TP in the planning area



Practices identified by the Watershed Partners are listed in the milestones, goals, assessment criteria, estimated reductions, and per practice costs in Table 26. The practices and milestones cover the first 10 years of implementation, but it is expected that many of this suite of BMPs will be continued and adapted for implementation to reach water quality standards over the long term.

Table 26. Milestones, goals, and assessment criteria for Agricultural BMPs

Treatment Groups	Treatment type	Milestones					Long-Term Goals	Assessment	Estimated reduction	Cost
		2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)				
Reduction goals	Phosphorus load reduction needed						1,702 lbs/yr Phosphorus reduction			
	Nitrogen load reduction needed						49,465lbs/yr nitrogen reduction			
	TSS WQS						< 65 mg/L of TSS fewer than 10% of the time meeting water quality standards	TSS levels in stream		
Monitoring	Monitoring needed (milestones described further in Section 9.0)	IWM completed; analysis to commence				Reevaluate TSS impairment during next monitoring cycle	Determine the level of impairment, if any	IWM Complete	N/A	
		Martin SWCD conducts continues load monitoring on Dutch Creek with partners	Martin SWCD conducts continues load monitoring on Dutch Creek with partners	Martin SWCD conducts continues load monitoring on Dutch Creek with partners	Martin SWCD conducts continues load monitoring on Dutch Creek with partners	Martin SWCD conducts continues load monitoring on Dutch Creek with partners	Long term data available	Data collected	N/A	$5,000/annually
		In-lake monitoring by SWCD to begin 5/2020	Annual in-lake monitoring during open water season	Annual in-lake monitoring during open water season	Annual in-lake monitoring during open	Annual in-lake monitoring during open water season	Long term data available	Data collected	N/A	$7,000/annually

Treatment Groups	Treatment type	Milestones					Long-Term Goals	Assessment	Estimated reduction	Cost
		2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)				
					water season					
	Aquatic invasive species (AIS)	Prevent AIS program education and outreach	Prevent AIS program education and outreach	Prevent AIS program education and outreach	Prevent AIS program education and outreach	Prevent AIS program education and outreach	Continue to stay AIS free	AIS continued to be blocked		$1,000
	Offline treatment wetland	Design specifications of wetland construction project, funded by LSOHC grant	Offline treatment wetland near mouth of Dutch Creek (27 acres) begin construction	Wetland maintained	Wetland maintained	Wetland construction	107 lbs/yr of phosphorus reduction 24,746 lbs/yr of nitrogen reduction	# of pounds reduced	TP 107 lbs/yr N - 24,747 lbs/yr	$1.2 M
Conservation cover	Small wetland restorations	Identify potential sites, design, and apply for CREP funding	7 acres of wetland restored	4 acres of wetland restored	4 acres of wetland restored	15 acres of restored small wetlands	53 acres of wetlands restored	# of acres of small wetlands restored	N 1960 lbs/yr reduced N 37 lbs/yr/acre TP 70 lbs/yr reduction TP 1.5 lbs/yr/acre	$2 M
	Filter strips	5 acres of filter strips installed (above and beyond MN Buffer Law)	5 acres of filter strips installed (above and	5 acres of filter strips installed (above and	5 acres of filter strips installed (above and	20 acres of filter strips installed (above and beyond MN Buffer Law),	Adequate buffers beyond law on all streaks and ditches	# acres of filter strips	14 lbs/yr/acre TP	$4,000

Treatment Groups	Treatment type	Milestones					Long-Term Goals	Assessment	Estimated reduction	Cost
		2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)				
			beyond MN Buffer Law)	beyond MN Buffer Law)	beyond MN Buffer Law)	effectiveness evaluated				
	MN Buffer law	100% compliance continued	100% compliance continued	100% compliance continued	100% compliance continued	MN Buffer law enforced				$500
Agricultural BMPs	Grassed waterways	Site identification and placement/landowner outreach	7,500 linear ft.	Continue to locate appropriate sites		Total of 7,500 linear feet of grassed waterways	Appropriate grassed waterways sited and installed in the watershed	# linear feet of grassed waterways	100 TP lbs/yr 25 TSS t/yr	$100,000
	Bioreactors	Landowner education and outreach about the benefits of bioreators-10 knock and talks per year	Landowner education and outreach about the benefits of bioreators-10 knock and talks per year	2 bioreactors installed		Total of two bioreactors installed	Maintenance of bioreactors	# of bioreactors	500 N lbs/yr reduction	$50,000
	Saturated buffers	Work with landowners to promote and site and design projects	2 saturated buffers (500 ft ea)	Continue outreach and landowner engagement	Monitor potential effectiveness and maintain the BMPs	Total of 2 saturated buffers installed (500 ft each)	Verify effectiveness and plan accordingly to continue or change the goal (2,000 ft total)	# of saturated buffers # of feet saturated buffers	300 lbs/yr N 50 lbs/yr TP 20 T/yr TSS	$50,000
	WASCOBs	Work with landowners to promote and site and design projects	3 WASCOBs	Continue outreach and landowner engagement	Monitor potential effectiveness and maintain the BMPs	Total of 3 WASCOBs installed	Verify effectiveness and plan accordingly to continue or change the goal	# of WASCOBs	100 lbs/yr TP 50 T/yr of TSS	$150,000

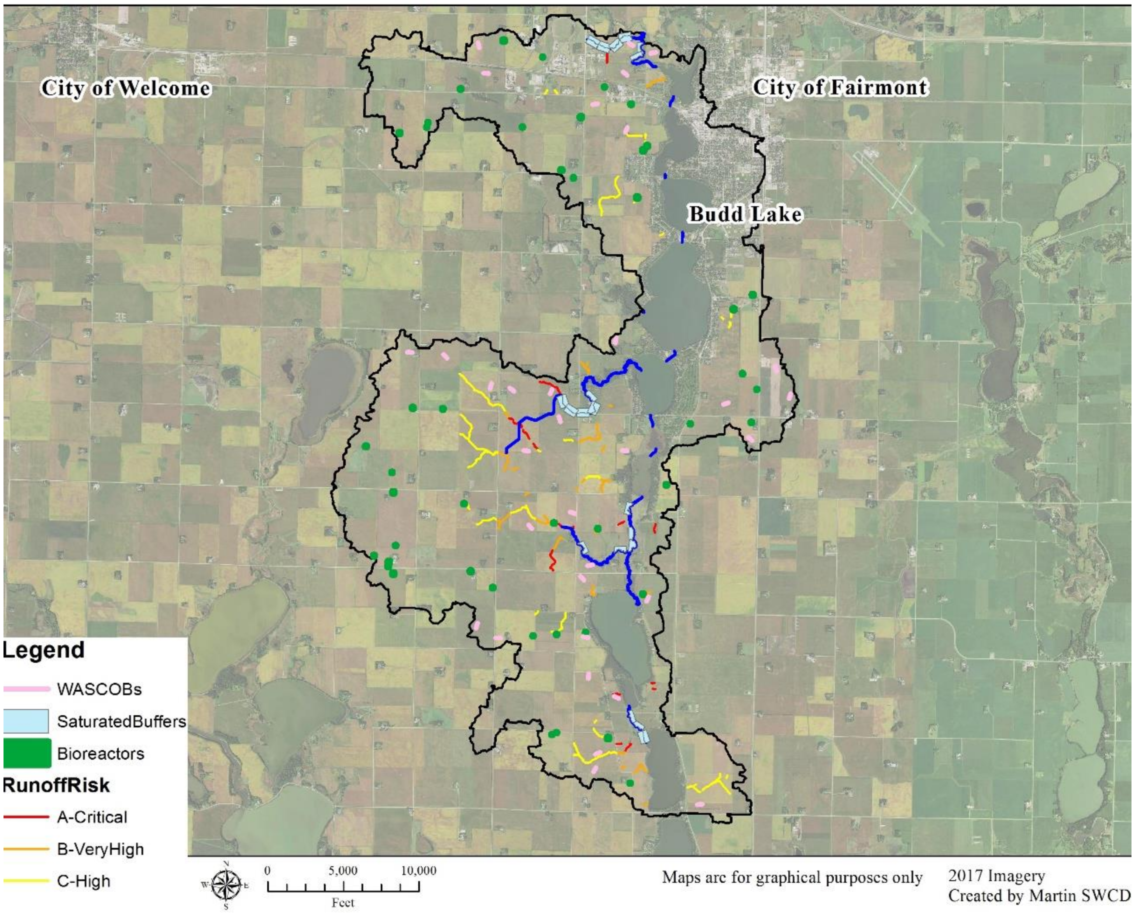
Treatment Groups	**Treatment type**	**Milestones**					**Long-Term Goals**	**Assessment**	**Estimated reduction**	**Cost**
		2-year (2023)	**4-year (2025)**	**6-year (2027)**	**8-year (2029)**	**10 year (2031)**				
Soil health	Reduced tillage practices (no plowing)	Add 1,744 acres in conservation tillage	Add 1,744 acres in conservation tillage	Add 1,744 acres in conservation tillage	Add 1,744 acres in conservation tillage	Increase conservation tillage acreage by 50%	90% of acres in reduced tillage (no plowing)	# of acres in conservation tillage	TP 537 lbs/yr	$10/acre
	No till/strip till practices	Outreach and promotion of producers	200 acres in no till/strip till practices	400 acres in no till/strip till practices	600 acres in no till/strip till practices	800 acres total in no till/strip till practices	Increase producer participation in no till/strip till practices of 25% of cropland acres	# of acres in no till/strip till	TP 537 lbs/yr	$10/acre
	peer load mentoring needed	Conduct feasibility to purchase minimal disturbance manure injection system for rent by SWCD		Leverage demonstration of no till/strip till practices by producer for education		Potential rental program, based on feasibility and funding	To increase availability of tools and support peer-to-peer mentoring	Study complete program implemented	N/A	$200,000
	Cover crops		200 acres in cover crops	400 acres in cover crops	600 acres in cover crops	800 acres total in cover crops	Increase producer participation in cover crops (25% of cropland acres)	# of acres with cover crops	N 44,209 lbs/yr reduction TP 1,982 lbs/yr	$60/acre
		2 Soil health days (annually)	2 Soil health days (annually)	2 Soil health days (annually)	Evaluate the soil health day effectiveness	Continue effective outreach and education program		# of field days/demos		$2,000
	Outreach activities	Fair booth, radio promotion, social media, newsletters, knock and talk	Fair booth, radio promotion, social media, newsletters, knock and talk	Fair booth, radio promotion, social media, newsletters, knock and talk	Fair booth, radio promotion, social media, newsletters,			# of outreach events		$1,000

Treatment Groups	Treatment type	Milestones					Long-Term Goals	Assessment	Estimated reduction	Cost
		2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)				
					knock and talk					
		Equipment rental program: Brillion seeding equipment and Truax no till drill	Equipment rental program: Brillion seeding equipment and Truax no till drill	Equipment rental program: Brillion seeding equipment and Truax no till drill	Equipment rental program: Brillion seeding equipment and Truax no till drill	Program continues, with potential addition of equipment	Appropriate equipment to support watershed goals available for rent through the SWCD.	Program continues to supply producers with affordable access to equipment for Soil Health improvement		$1,000

7.2 Stormwater runoff control

The city of Fairmont has an NPDES MS4 permit to control its stormwater runoff. It is assumed that compliance with the MS4 permit will result in meeting the stormwater waste load allocation. The Chain of Lakes does not currently have a TMDL developed; however, the assumption will be that continued compliance with the permit will result in reductions. The City is continuing to explore options for expanding BMPs, including targeting placement in the watershed. Critical BMP placements in the Fairmont Chain of Lakes (aka Hall Lake Watershed) identified by ACPF model are shown in Figure 33. Critical areas include managing stormwater outside of the MS4 permit boundaries.

Figure 33. Fairmont Chain of Lakes (Hall Lake Watershed) targeted conservation practices



Practices identified by the Watershed Partners are listed in the milestones, goals, assessment criteria, estimated reductions, and per practice costs in Table 27. In addition to following the MS4 permit requirements, the City will encourage the implementation of private, residential raingardens to exceed the permit requirements, as well as encourage adoption outside the permit’s boundaries.

Table 27. Urban Stormwater Runoff milestones, goals, and assessment criteria

Treatment type	Milestones					Long-Term Goals	Assessment	Estimated reduction	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)				
Urban stormwater runoff control									
Residential rain gardens	4 raingardens on private, residential property	4 raingardens on private, residential property	4 raingardens on private, residential property	4 raingardens on private, residential property	4 raingardens on private, residential property	Encourage private rain gardens on residential lots	# of raingardens		$500/cost share
	Follow BMPs and reporting permits in MS4 permits and SWPP	Follow BMPs and reporting permits in MS4 permits and SWPP	Follow BMPs and reporting permits in MS4 permits and SWPP	Follow BMPs and reporting permits in MS4 permits and SWPP	Follow BMPs and reporting permits in MS4 permits and SWPP	No increases in TSS loading under MS4s		Meeting WLA for Fairmont	
Public education and outreach	2 stormwater education events (Annual SWPPP Meeting Presentation)	2 stormwater education events (Annual SWPPP Meeting Presentation)	2 stormwater education events (Annual SWPPP Meeting Presentation)	2 stormwater education events (Annual SWPPP Meeting Presentation)	2 stormwater education events (Annual SWPPP Meeting Presentation)	Annual public stormwater SWPPP Meeting presentation	# of meetings	Meeting WLA for Fairmont	$250
	LIDs promotion: social media, newsletters, articles, contacts	LIDs promotion: social media, newsletters, articles, contacts	LIDs promotion: social media, newsletters, articles, contacts	LIDs promotion: social media, newsletters, articles, contacts	LIDs promotion: social media, newsletters, articles, contacts	Continue to promote use of LIDs		Meeting WLA for Fairmont	$500
	2 fall leaf pick ups	2 fall leaf pick ups	2 fall leaf pick ups	2 fall leaf pick ups	2 fall leaf pick ups	Annual leaf pick-ups	# of pickups	Meeting WLA for Fairmont	$2,000
Public participation and involvement	Continue to develop methods to increase public involvement	Continue to develop methods to increase public involvement and assess current progress	Continue to develop and adapt methods to increase public involvement	Continue to develop methods to increase public involvement and assess current progress	Continue to develop and adapt methods to increase public involvement	Plan to increase public involvement		Meeting WLA for Fairmont	

Illicit discharge detection and elimination	City continues to look for and eliminate nonconformance/illicit discharges	City continues to look for and eliminate nonconformance/illicit discharges	City continues to look for and eliminate nonconformance/illicit discharges	City continues to look for and eliminate nonconformance/illicit discharges	City continues to look for and eliminate nonconformance/illicit discharges	Policy and procedure for detecting and eliminating illicit discharges	Policy completed	Meeting WLA for Fairmont	$1,000
Construction runoff controls	Promotion of construction stormwater controls	Ongoing	Ongoing	Ongoing	Ongoing	Construction stormwater policy and compliance program	Policy completed	Meeting WLA for Fairmont	$2,000
	Continue to issue and inspect permittees	Ongoing	Ongoing	Ongoing	Ongoing		Policy completed	Meeting WLA for Fairmont	$2,000
Post-construction stormwater management	Continue program administration	Ongoing	Ongoing	Ongoing	Ongoing		Policy completed	Meeting WLA for Fairmont	$2,000
Pollution prevention/good housekeeping	Continue maintenance and operation of stormwater BMPs	Ongoing	Ongoing	Ongoing	Ongoing		Policy completed	Meeting WLA for Fairmont	$2,000

7.3 Livestock and manure management

Livestock and livestock manure in feedlots and pastures are a potential source of E. coli, sediment, and nutrients to streams, particularly when direct access to streams is not restricted and where feeding structures are located near riparian areas. Permitted and registered feedlots are expected to follow permit requirements and MPCA feedlot guidance (https://www.pca.state.mn.us/water/county-feedlot-program). Feedlots that are in compliance with their permits and follow the feedlot guidance, are assumed to not be significant contributors of pollutants. Several different BMPs can be used to limit pollutant loading from livestock and livestock manure that are not permitted nor registered. Land application of manure from animal operations can be sources of E. coli and nutrients, if not managed correctly. It is estimated that the surface and land application of manure accounts for almost 98% of the *E. coli* loading in the Dutch Creek Watershed; therefore, manure management is critical to load reductions. The ten-year goals of one cattle exclusion and 5,750 acres under a manure management plan will likely meet the necessary load reductions to meet water quality standards. Coupled with SSTS replacement or upgrades, it is expected that this will be delisted in the next 10 years.

Practices that can be used to mitigate the impact from animal operations include:

- Exclusion fencing limits or eliminates livestock access to a stream or waterbody. Fencing can be used with controlled stream crossings to allow livestock to cross a stream while minimizing disturbance to the stream channel and streambanks. EPA (2003) estimates that fecal coliform reductions between 29 and 46% can be expected; sediment and nutrient load reductions are also achieved.
- Runoff management (runoff from production areas)
  - Grading, earthen berms, and such to collect and direct manure-laden runoff
  - Filter strips
  - Storage ponds
- Manure land application
  - Nutrient management strategy (e.g., the 4Rs: Right Source, Right Rate, Right Time, Right Place)
  - Filter strips and grassed waterways

Table 28 describes the milestones, goals, assessment criteria, expected reductions and costs for livestock and manure management BMPs.

Nutrient management will also curb the HAB by reducing both nitrogen and phosphorus inputs in the chain of lakes.

Table 28. Livestock and manure management milestones, and assessment criteria

Treatment Groups	Treatment type	Milestones					Long-Term Goals	Assessment	Estimated reduction	Cost
		2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)				
E. coli reduction goals	Center Creek (526)	Monthly geometric mean < 558 cfu/100 mL fecal coliform	Monthly geomean < 450 cfu/100 mL fecal coliform	Monthly geomean < 350 cfu/100 mL fecal coliform	Monthly geomean < 250 cfu/100 mL fecal coliform	Monthly geomean < 200 cfu/100 mL fecal coliform	Monthly geometric mean of 126 orgs/100 mL *E. coli*	Average reduction of 64%		
	Dutch Creek (527)	Monthly geomean < 1,410 cfu/100 mL fecal coliform	Monthly geomean < 800 cfu/100 mL fecal coliform	Monthly geomean < 600 cfu/100 mL fecal coliform	Monthly geomean < 500 cfu/100 mL fecal coliform	Monthly geomean < 400 cfu/100 mL fecal coliform	Monthly geometric mean of 126 orgs/100 mL *E. coli*	Average reduction needed of 75% (52.9% in Jun, 85.8% Jul, and 85% in Aug)		
Livestock Management										
	Exclusion fencing	NRCS cost share program promotion	1 site fenced (4,000 lin-ft)	Continue to promote NRCS program	Continue to promote NRCS program	One cattle site excluded from stream	All cattle excluded from streams	# of sites excluded	29% reduction in *E. coli* loading	$1.60 /ft
	Feedlot program compliance Martin County Planning and Zoning	100% compliance with MN feedlot rules and county policies/ordinances	100% compliance with MN feedlot rules and county policies/ordinances	100% compliance with MN feedlot rules and county policies/ordinances	100% compliance with MN feedlot rules and county policies/ordinances	100% compliance with MN feedlot rules and county policies/ordinances	100% compliance with MN feedlot rules and county policies/ordinances	% compliance		$200,000/annually
		Maintain existing program	100% of feedlots inspected		100% of feedlots inspected		All feedlots inspected every four years	% inspected		
Nutrient management	Fertilizer application rates					30 lb-N/acre reduction of N-fertilizer application on 30% of the cropland	Reduce N-fertilizer application rates by 30 lbs-N/acre 60% of the cropland			
	Fertilizer rates and timed application	2,000 acres using timed application and reduced N application rates	2,000 acres using timed application and reduced N application rates	2,000 acres using timed application and reduced N application rates	2,000 acres using timed application and reduced N application rates	8,000 acres of reduced rate of application and timing in Dutch Creek	16,000 acres using timed application and reduced rates	# of acres using timed application and reduced application rates	26,300 lbs/yr NOx reductions	$5/acre
	Manure management plan	1,450 acres implementing a manure plan	1,450 acres implementing a manure plan	1,450 acres implementing a manure plan	1,450 acres implementing a manure plan	Total of 5,750 acres using a manure management plan	All farms applying manure with a manure management plan	# of acres under manure management plan	24% reduction in *E. coli* loading	$4,200/plan
		Develop manure management plans for nonregistered feedlots/guidance to	Promote manure management plan develop, provide technical assistance and outreach	Promote manure management plan develop, provide technical assistance and outreach	Promote manure management plan develop, provide technical assistance and outreach	Promote manure management plan develop, provide technical assistance and outreach	Continue to develop program	Program continues		$5,000

Treatment Groups	Treatment type	Milestones					Long-Term Goals	Assessment	Estimated reduction	Cost
		2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)				
		follow existing manure management plans								
	Chain of Lakes									
TP		Complete TMDL Study for lake nutrients/eutrophication				Reductions, specific implementations, and feasibility study completed		Studies completed	N/A	$140,000
		Complete WRAPS report for lake nutrients/eutrophication		Internal loading feasibility study	Assess whether to pursue internal loading mitigation					
Monitoring	Expand *E. coli* sampling along Dutch and Center Creeks to understand current conditions	Conduct a microbial source tracking assessment to further narrow sources	Develop plan to target specific sources of pathogen loading.					Assessment complete Plan developed		$10,000

7.4 SSTS compliance

SSTS are identified as a source of fecal bacteria in the watershed. SSTS that are conforming and are appropriately sited are assumed to not contribute fecal bacteria to surface waters but still discharge small amounts of phosphorus. Septic systems that discharge untreated sewage to the land surface or directly to streams are considered imminent threats to public health and safety and can contribute fecal bacteria and nutrients to surface waters.

The most cost-effective BMP for managing loads from septic systems is regular maintenance. EPA (2002) recommends that septic tanks be pumped every 3 to 5 years depending on the tank size and number of residents in the household. When not maintained properly, septic systems can cause the release of pathogens, as well as excess nutrients, into surface water. Annual inspections, in addition to regular maintenance, ensure that systems are functioning properly. An inspection program would help identify those systems that are currently connected to tile drain systems or storm sewers and those that may be failing. Inspections would also help determine if systems discharge directly to a waterbody ("straight pipe"). The program would require and support upgrading and replacing noncompliant systems. Table 29 describes the expected reductions, costs, milestones, goals, assessment criteria, estimated reductions, and costs for SSTS compliance practices. This is a high contributor during dry conditions. It will account for approximately a 5% reduction in *E. coli* in the planning area. It is assumed that coupled with the manure management practices discussed in section 7.3, that the reduction will be met in the next 10 years.

Table 29. SSTS compliance milestones, and assessment criteria

Treatment type	Milestones					Long-Term Goals	Assessment	Estimated reduction	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)				
SSTS Ordinances	Local ordinances/ regulations enforced	Local ordinances/ regulations enforced	Local ordinances/ regulations enforced	Local ordinances/ regulations enforced	SSTS program continues	100% SSTS in compliance	% in compliance	N/A	$50,000
SSTS upgrades/replacements	2 SSTS replaced or upgraded	3 SSTS replaced or upgraded	5 SSTS replaced or upgraded	5 SSTS replaced or upgraded	Total of 15 SSTS replaced or upgraded	100% SSTS in compliance	# of SSTS upgraded	5% *E. coli* reduction	$15,000 /SSTS
SSTS Education	2 events	2 events	2 events	2 events	10 SSTS education events		# of events	N/A	$5,000

7.5 Internal loading

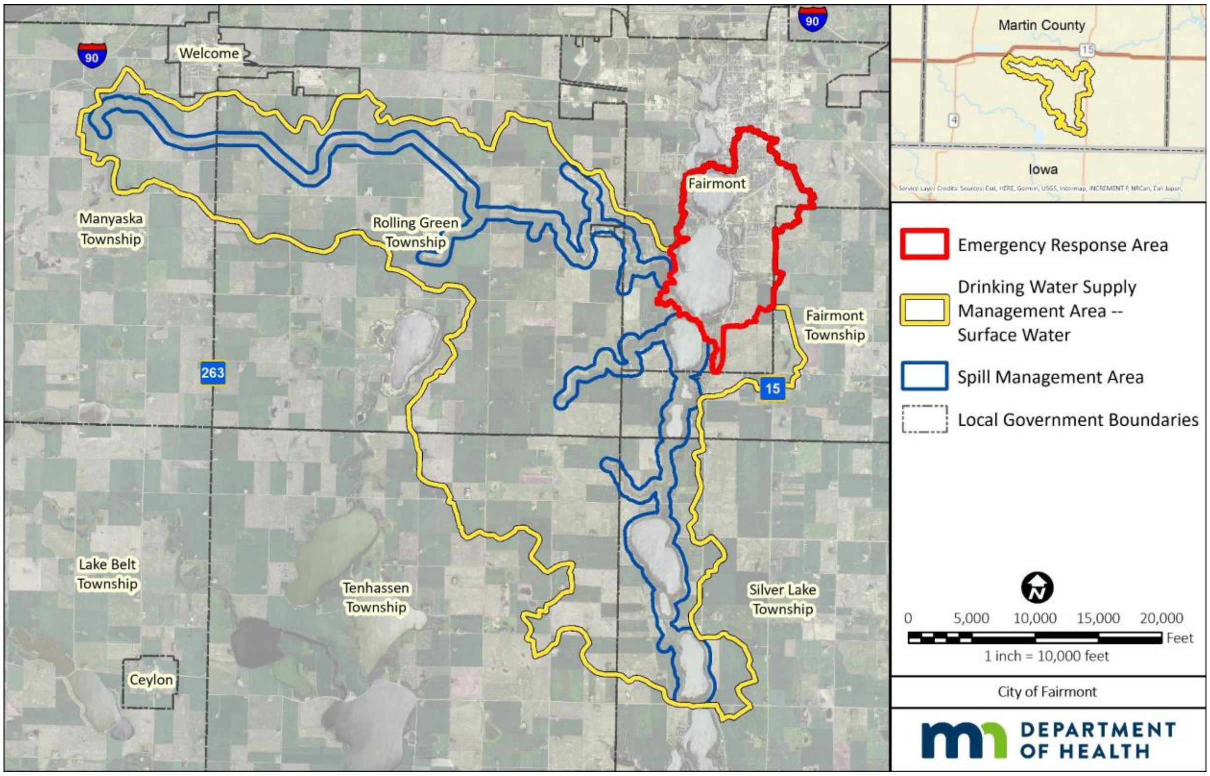
A 2002 monitoring report of the Fairmont chain of Lakes (Schlorf Von Holdt 2001) notes that while internal loading can be a significant contributor to TP in a lake, most lakes that have excessive internal loading have or had excess external phosphorus loading. Ultimately, a reduction in external sources of phosphorus could be a solution to solve internal loading. Determining the extent of internal loading and the feasibility of addressing the results will be the only tasks addressed in the next ten-years. There will be no direct reductions from these studies and determinations and the cost is estimated to be approximately $10,000 for data collection, analysis, and feasibility report.

Internal loading assessments will begin in year five. In year six, the results of the studies will be used to formulate an implementation plan. It is believed that this timeline is appropriate to allow for time to address the external loading first.

7.6 Source water protection

The MDH completed a source water assessment that will assist Fairmont to develop a surface water intake protection plan (SWIPP) that will lay out strategies for protecting and improving source water quality. Figure 34 illustrates the areas identified by the MDH as critical for planning and protection. The plan will be developed and address the recommendations from the SWA as outlined in Table 30. The city of Fairmont can also receive assistance from the MDH Surface Water Planner and Hydrologist to complete the planning document. Upon completion of the SWIPP, Fairmont can be eligible for MDH plan implementation grants to fund documented plan activities. Where applicable, information from the SWIPP should be incorporated into this Workplan, and vice versa.

Figure 34. Fairmont's drinking water supply management area, spill management area, and emergency response area (MDH



Direct reductions for the planning efforts are unlikely; however, the nitrogen and phosphorus loading from Dutch Creek will be addressed through agricultural BMPs (Table 26) and livestock and manure management BMPs (Table 28). Load reductions are detailed in those sections. The city of Fairmont will also address phosphorus loading through their urban stormwater BMPs and MS4 permit. These BMPs and reductions will be detailed in the urban stormwater runoff control section (Table 27).

Table 30 describes the milestones, goals, assessment criteria, and costs for source water protection activities. There are no reductions directly tied to these activities; however, actions taken in the plans, modeling, etc. will yield reductions.

Table 30. Source water protection milestones and assessment criteria

Treatment Groups	Treatment type	Milestones					Long-Term Goals	Assessment	Estimated reduction	Cost
		2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)				
Nitrate	Overall reductions from other practices	< 10 mg/L of N	< 10 mg/L of N	< 10 mg/L of N	< 10 mg/L of N	< 10 mg/L of N or below	Keep drinking water source for the city of Fairmont under the safe nitrate levels (SNRS 20% reduction in N)	Meets standards as shown through water quality assessment monitoring and treatment facility testing	--	
Monitoring Source Water										
	Monitoring of source water	Continued monitoring of source water to determine and refine the best implementation approaches	Implement changes needed for a robust monitoring	Continue monitoring	Continue monitoring	Continue monitoring	Adequate data collection to understand the source water			
	Modeling	Additional watershed modeling of the planning area		Update as needed			Adequate models created to influence decision making			
	Citizen lake monitoring	Promote and support a citizen lake monitoring program	Promote and support a citizen lake monitoring program	Promote and support a citizen lake monitoring program	Promote and support a citizen lake monitoring program	Promote and support a citizen lake monitoring program	Involved and engaged citizens taking ownership in their lakes			
Emergency preparedness										
	Planning	Develop a PWS emergency spill prevention and response plan				Evaluate plan effectiveness	Adequate PWS emergency spill prevention protocol	Plan completed		$10,000
Potential contaminant source management										
	Coordination between nonpoint source and source water protection planning and mitigation	2 meetings of coordination NPS/SWP	2 meetings of coordination NPS/SWP	2 meetings of coordination NPS/SWP	2 meetings of coordination NPS/SWP	10 meetings of coordination NPS/SWP	Minimum of annual meetings to coordinate NPS and SWP protection	# of meetings	N/A	$5,000
Contaminant Conveyances and Potential Releases										

Treatment Groups	Treatment type	Milestones					Long-Term Goals	Assessment	Estimated reduction	Cost
		2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)				
	Work with MPCA to ensure that the Chain of Lakes is listed a s primary drinking water source in the MS4 permit	Develop a contaminant conveyance inventory	Develop an understanding of the contaminant conveyance system	Guide implementation practices	Guide implementation practices	Guide implementation practices	Systems understanding of the contaminant conveyances and risk of potential releases	Understanding achieved	N/A	$15,000
NPS pollution and land management										
Monitoring	Monitoring expanded to early spring for cyanotoxins during highest risk	Annual monitoring for HABs	Annual monitoring for HABs	Annual monitoring for HABs	Annual monitoring for HABs	Annual monitoring for HABs	HAB risk assessed			
	Educating landowners/farmers/residents on algal bloom causes, occurrence, and impacts	Newsletter, news articles, radio spots, social media	Newsletter, news articles, radio spots, social media	Newsletter, news articles, radio spots, social media	Newsletter, news articles, radio spots, social media	Newsletter, news articles, radio spots, social media	Public understanding of HAB risk and abatement			
Alternative water supply										
	Alternative water sources such as groundwater studied with DNR, including permit amendment	TBD	TBD	TBD	TBD	TBD				
	Explore possibility of a full-capacity back-up of drinking water	TBD	TBD	TBD	TBD	TBD				
	Upgrading treatment technologies to accommodate blending concerns	TBD	TBD	TBD	TBD	TBD				
Surface water intake protection planning										
	Develop surface water intake protection plan (SWIPP)	SWIPP developed					Plan developed and updated as necessary	Plan completed		$5,000

7.7 PCB remediation

In Minnesota, PCBs are subject to the Federal Toxic Substance Control Act Regulations administered by the EPA and the Minnesota Hazardous Waste Rules administered by the MPCA (MPCA 2013). This pollutant understanding is limited. The strategy for this pollutant will be to confirm the continued presence of PCBs in fish tissue, conduct source assessment, and develop a mitigation plan, if necessary.

Table 31 describes the expected costs, milestones, goals and assessment criteria for PCB remediation practices and activities.

Table 31. PCB remediation milestones, and assessment criteria

Treatment Groups	Treatment type	Milestones					Long-Term Goals	Assessment	Estimated reduction	Cost
		2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)				
PCBs	Tissue analysis				Redo tissue analysis and confirm PCB levels in fish		Fish tissue remains below maximum threshold	mg/kg in fish tissue		$5,000
	Remediation of source(s) of PCB in Budd Lake	Feasibility study on PCB removal/ containment	Plan developed for PCB removal/ containment	Implement plan (update milestones)	Implement plan (update milestones)	Plan completed and implementation milestones set for years 4, 6, and 8	< 0.22 mg/kg PCBs in fish tissue	Meet standards as shown through fish tissue sampling	TBD	$10,000

7.8 Summary of costs and reductions

Reductions have been calculated using the Spreadsheet Tool for Estimating Pollutant Load (STEPL) for the practices planned (Table 32). It is expected that practices described in this plan will achieve load reductions needed to meet water quality standards when fully implemented.

During the development of the draft Minnesota River and Greater Blue Earth Basin TMDL the available data indicated that Dutch Creek was hovering at the water quality standard and no reduction was given for the stream. The practices to be implemented in the next 10 years are expected to yield a 142 ton/yr reduction in sediment (Table 32). This equates to a 15.6% reduction in TSS loading to Dutch Creek Watershed and a 29.8% reduction in TSS loading to Hall Lake, if the plan is fully implemented. This will ensure that Dutch Creek is meeting water quality standards for TSS, as the waterbody is currently nearly impaired. There are no reductions required to the Hall Lake Watershed; however, TSS has been a concern of the watershed partners. STEPL assumptions and efficiencies will be detailed in Appendix A.

The *E. coli* loading will be reduced for Dutch Creek by 93.9%, ensuring that it will meet the water quality standard for *E. coli*. The reductions for *E. coli* are expected to be approximately 83.2% in the Hall Lake Watershed in 10 years and the plan is fully executed. As Dutch Creek is a tributary to the Hall Lake Watershed, combined reductions in *E. coli* will be 8.2E+05 billion MPN/yr or 88.1%. This will ensure that Center Creek will meet water quality standards for *E. coli.*

The TMDL for the Chain of Lakes is expected to be developed in 2021. The NKE plan will reduce loading in Dutch Creek by 35,398 lbs/yr of N (36.8%) and 5,287 lbs/yr of P (59.1%). For Hall Lake Watershed BMPs will decrease loading by 51,770 lbs/yr of N (38.9%) and 8,514 lbs/yr of P (54.2%). Together with the Dutch Creek contributions, this will reduce the N loading by 38% and the P loading by 56.2%. Once the TMDL has been completed, the plan will be evaluated and adapted to ensure there are enough reductions to meet water quality standards in the Chain of Lakes.

The costs are included on a per practice basis in the tables following each practice group. It is estimated that the total cost of implementation of all practices that would likely achieve water quality standards is $3.7 million.

Every two years, the progress of the plan will be checked against the milestones to determine any necessary course corrections and milestones will be amended or new ones added. As TMDLs for waterbodies are calculated and approved, this NKE plan practices, milestones, and goals will be updated appropriately.

Table 32. Expected reductions in N, P, TSS and *E. coli* estimated by STEPL

Practices	**Watershed**	**N load (no BMP) lbs/yr**	**P load (no BMP)**	**TSS load (no BMP) t/yr**	***E. coli* load (no BMP)**	**N reduction lbs/yr**	**P reduction lbs/yr**	**TSS reduction t/yr**	***E. coli* reduction**	**N load (with BMP) lbs/yr**	**P load (with BMP) lbs/yr**	**TSS load (with BMP) t/yr**	***E. coli* load (with BMP)**	**N reduction %**	**P reduction %**	**TSS reduction %**	***E. coli* reduction %**
Agricultural, feedlot, and pasture practices	Dutch Creek	55253.5	12481.0	913.3	42799.4	19855.3	7193.7	142.4	6785.1	35398.2	5287.4	770.9	36014.3	35.9	57.6	15.6	15.9
	Hall Lake	83945.4	18208.3	957.6	50523.0	32174.6	9694.1	285.7	8636.4	51770.8	8514.2	671.9	41886.5	38.3	53.2	29.8	17.1
	Total BMPs	139198.9	30689.3	1870.9	93322.3	52029.9	16887.8	428.0	15421.5	87169.0	13801.6	1442.9	77900.8	37.4	55.0	22.9	16.5
SSTS replacement /upgrades	Dutch	466.32	182.64	--	33420.3	466.32	182.64		33420.3					100	100	--	100.0
	Hall Lake	466.32	182.64	--	33420.3	466.32	182.64		33420.3					100	100	--	100.0
	Total SSTS	932.64	365.28		66840.5	932.6	365.3		66840.5					100	100		100.0
Total all practices	Dutch Creek	55253.5	12481.0	913.3	42799.4	20321.6	7376.3	142.4	40205.4	35398.2	5287.4	770.9	36014.3	36.8	59.1	15.6	93.9
	Hall Lake	83945.4	18208.3	957.6	50523.0	32640.9	9876.8	285.7	42056.7	51770.8	8514.2	671.9	41886.5	38.9	54.2	29.8	83.2
	Totals	139198.9	30689.34	1870.894	93322.33	52962.5	17253.1	428	82262.1	87169	13801.55	1442.865	77900.8	38.0	56.2	22.9	88.1

8.0 Information and education

Information and education activities recommended for the Dutch Creek and Fairmont Chain of Lakes in existing reports include:

- Develop factsheets for impaired waterbodies and host annual tour of impaired watersheds.
- Disseminate information on impaired waters through radio, meetings, mailings, news articles, and others.
- Collaborate with stakeholders at the local, state, and federal levels on watershed management activities.
- Increase educational efforts on watershed sources of nitrate and phosphorus to drinking water, especially on the impacts of drain tiles
- Increase educational efforts to lake residents and users on health risks of HABs and efforts to reduce their occurrence.
- Education and demonstration projects for:
  - Cropland runoff control measures
  - Urban stormwater runoff control measures
  - Livestock and manure management
  - Proper septic maintenance

9. Monitoring

Monitoring in the context of this plan will include elements of various on-going programs Dutch Creek and Hall Lake Watershed-specific activities.

The every ten-year cycle of MPCA HUC-8 IWM and assessment provides the framework for monitoring and assessing the use support for Minnesota's waterbodies. The Dutch Creek and Fairmont Chain of Lakes Watershed is part of the Blue Earth River major watershed which just completed the first cycle of IWM and with the second cycle scheduled to begin in 2027. IWM monitoring consists of biological and water chemistry monitoring over a two-year period in the major watershed. Monitoring sites are identified with stakeholder input prior to the start of monitoring.

Implementation activities will be tracked using the BWSR eLink database for state and Section 319-funded activities. Implementation activities funded by the USDA are tracked using their database. Field measurements, preliminary and final engineering designs, as-built plans, and photographs will be used to document the improvement in streambank activities. Field measurements will include streambank and streambed profile measurements and field observations to track streambank changes over time due to streambank erosion and subsequent restoration activities.

Changes in land cover and land use not associated with BMP implementation will be tracked using visual observations, field measurements, and aerial imaging.

A stream flow and water quality monitoring site near the mouth of Dutch Creek will be established. The site will provide the data needed to determine progress toward and eventual achievement of the TSS and *E. coli* water quality standards. The site will include continuous water level, turbidity, and temperature monitoring, development and maintenance of a streamflow rating curve, routine field measurements, and discrete water sampling and laboratory analysis. Discrete water samples will be collected on a storm event basis, targeting minimum of 25 samples per year. Lab analysis will include TSS, *E. coli*, TP, and nitrate. Field measurements will include turbidity, Secchi tube transparency, temperature, DO, and specific conductivity. Streamflow and water quality sampling will provide load calculations to evaluate for load reductions and the effectiveness of the practices implemented in the Dutch Creek Watershed. Load monitoring in Dutch Creek will include continuous stream flow and water sampling to provide pollutant load calculations for TSS, TP, and nitrate. The MDA also conducts pesticide monitoring in Dutch Creek as part of their surface water pesticide monitoring program.

Yearly biological monitoring will be completed, if resources are available. Stream habitat and geomorphology monitoring will be completed in conjunction with the flow, chemistry, and biology monitoring. The estimated cost of conducting this monitoring for ten years is $370,000 (Table 33).

The MPCA Citizen Lake Monitoring Program will continue and more participation in the Citizen Stream Monitoring Program will be encouraged (https://www.pca.state.mn.us/water/citizen-water-monitoring). Volunteers measure water clarity at least twice a month each summer at designated locations using a Secchi tube. The data can then be correlated with TSS concentrations and be used as an indicator of sediment in the stream. The goal for the watershed partners is to get four volunteer monitoring sites established in the watershed.

Additional monitoring will include:

- Expanded monitoring to help identify when the water supply is most at risk for cyanotoxins each year.
- Expanded *E. coli* sampling along Dutch Creek and Center Creek to understand current conditions.

Table 33. Monitoring costs in Dutch Creek Watershed

Monitoring type	Description	Unit cost (annual)	Total (10-years)
Streamflow and water quality sampling and analysis	0.1 FTE for 2 sites 0.1 FTE for data analysis Lab costs/site Equipment/2 sites	\$10,000 \$10,000 \$2,000 \$5,000/site	\$230,000
Expanded *E. coli* monitoring for Dutch Creek	0.1 FTE for 2 sites 0.1 FTE for data analysis Lab costs/site Equipment/2 sites	\$10,000 \$10,000 \$2,000 \$5,000/site	\$230,000
Biological monitoring	0.1 FTE for 10 sites 2-4 person crew and data analysis	\$10,000	\$100,000
Habitat and stream geomorphology	0.2 FTE (2 times per 10-year period)	\$20,000	\$40,000
Expanded monitoring for cyanotoxins	0.1 FTE for 2 sites 0.1 FTE for data analysis Lab costs/site Equipment/2 sites	\$10,000 \$10,000 \$2,000 \$5,000/site	\$230,000
Total			**\$830,000**

The city of Fairmont will continue nitrate monitoring at the source water intake in Budd Lake. The Martin SWCD with state agencies' support will conduct stream and lake monitoring for the purpose of evaluating Dutch Creek and the lakes for changes in water quality.

10.0 Financial and technical resources

Implementation of the Dutch Creek and Fairmont Chain of Lakes Workplan will require additional financial and technical resources.

A list of existing funding sources available to support implementation is provided in Table 34.

Table 34. Partial list of funding sources for restoration and protection strategies

Sponsor or Information Source	**Program Description**
MPCA	Section 319 Grants: Federal grant funding from the EPA as part of the Clean Water Act, Section 319. Grants awarded by MPCA to local governmental units and other groups are to address nonpoint source pollution through implementation projects. Clean Water Partnership Loan: The state funded Clean Water Partnership Program awards no-interest loans to local governmental units for work on projects that address nonpoint source pollution. Clean Water State Revolving Fund: The state revolving fund provides loans to for both point source (wastewater and stormwater) and nonpoint source water pollution control projects.
BWSR	Clean Water Fund Competitive Grants: These grants are to restore, protect, and enhance water quality. Eligible activities must be consistent with a comprehensive watershed management plan, county comprehensive local water management plan, soil and water conservation district comprehensive plan, metropolitan local water plan or metropolitan groundwater plan that has been State approved and locally adopted or an approved TMDL, Watershed Restoration and Protection Strategy document, surface water intake plan, or well head protection plan. Targeted Watershed Demonstration Program: This program awards grants to local governmental units organized for the management of water in a watershed or subwatershed where multiyear plans that will result in a significant reduction in water pollution in a selected subwatershed are in place. The Erosion Control and Water Management Program, commonly known as the State Cost-Share Program: This program provides funds to SWCDs to share the cost of systems or practices for erosion control, sedimentation control, or water quality improvements that are designed to protect and improve soil and water resources. Through this program, land occupiers can request financial and technical assistance from their local District for the implementation of conservation practices.
LCCMR	The city of Fairmont has a grant for the implementation of a bioreactor.
LSOHC	The city of Fairmont has a grant for the implementation of a wetland at the mouth of Dutch Creek.
MDA	AgBMP Loan Program: This program encourages implementation of BMPs that prevent or reduce pollution problems, such as runoff from feedlots, erosion from farm fields and shoreline, and noncompliant septic systems and wells. MDA provides a wide array of other information from their agency as well as other state and federal agencies on conservation programs addressing agriculture and other land uses. In addition, Clean Water Research Projects are available for funding.
Minnesota DNR	DNR grants are available for a variety of programs relating to land preservation, wildlife and habitat, native prairie, forestry and wetlands.

11.0 Literature Cited

Blue Earth Watershed "Overview" from Greater Blue Earth River Basin Alliance: https://www.gberba.org/blue-earth-watershed/.

EPA (U.S. Environmental Protection Agency). 2002. Onsite Wastewater Treatment Systems Manual. EPA/625/R-00/008. U.S. EPA, Office of Water and Office of Research and Development. February 2002.

EPA (U.S. Environmental Protection Agency). 2003. National Management Measures to Control Nonpoint Source Pollution from Agriculture. EPA 841-B-03-004. U.S. EPA. July 2003.

EPA (United States Environmental Protection Agency). 2011. PCB TMDL Handbook. US Environmental Protection Agency Office of Wetlands, Oceans and Watersheds. Watershed Branch (4503T) 1200 Pennsylvania Avenue, NW Washington, DC 20460. December 2011. EPA 841-R-11-006.

GBERBA (Greater Blue Earth River Basin Alliance). 2007. Greater Blue Earth River Basin Fecal Coliform TMDL Report Implementation Plan. Document number wq-iw7-05c. September 2007.

Martin Soil and Water Conservation District (SWCD). 2017. 2017 Annual Plan.

Martin Soil and Water Conservation District (SWCD). 2016. Martin County Local Water Plan 2017-2026. Martin County Water Planning.

Minnesota Department of Agriculture. 2002. 1999 Nutrient Management Assessment of Agricultural Practices in the Dutch Creek and South Chaim of Lakes Watersheds, Fairmont, MN.

MDH (Minnesota Department of Health). 2019. 2019 Source Water Assessment for the City of Fairmont Public Water System. Minnesota Department of Health Drinking Water Protection –Source Water Protection PO Box 64975St. Paul, Minnesota 55164-0975.

MPCA. 2005. Minnesota Lake Quality Assessment Report: Developing Nutrient Criteria. Third Edition. Document number: wq-lar3-01.

MPCA (Minnesota Pollution Control Agency). 2013. Manifest and Dispose of PCBs. MPCA document number: w-hw4-48d. June 2013.

MPCA (Minnesota Pollution Control Agency). 2015. Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River. wq-iw4-02. St. Paul, Minnesota. January 2015. https://www.pca.state.mn.us/sites/default/files/wq-iw4-02.pdf

MPCA (Minnesota Pollution Control Agency). 2019a. Draft Minnesota River and Greater Blue Earth River Basin Total Suspended Solids Total Maximum Daily Load Study. Wq-iw7-47b. Prepared by Tetra Tech.

MPCA (Minnesota Pollution Control Agency). 2019b. Total Maximum Daily Load Report summary: Minnesota River – Greater Blue Earth River Basin TMDL for TSS. Document number wq-iwy-47a. July 2019.

Porter, S.A., M.D. Tomer, D.E. James, and J.D. Van Horn. 2018. Agricultural Conservation Planning Framework ArcGIS® Toolbox User's Manual, Version 3.0. August 2018.

Sands, G.R. 2018. Impact of Agricultural Drainage in Minnesota. University of Minnesota Extension. https://extension.umn.edu/agricultural-drainage/impact-agricultural-drainage-minnesota

Shlorf Von Holdt, Becky, and MPCA. 2003. Fairmont Chain of Lakes Monitoring Report 2002. Martin County Environmental Services Department and MPCA Staff.

Schlorf Von Holdt, Beck, and MPCA. 2002. Fairmont Chain of Lakes Monitoring Report 2001. Martin County Environmental Services Department and MPCA Staff.

Stefan, H.G. and M.J. Hanson. 1981. Phosphorus recycling in five shallow lakes. ASCE Env.

Eng. Div. 107:714-730.

Tetra Tech. 2018. Dutch Creek and Hall Lake SWAT Modeling Report. Prepared for MPCA and USEPA.

Water Resources Center, Minnesota State University, Mankato and Blue Earth River Basin Alliance. 2007. Fecal Coliform TMDL Assessment for 21 Impaired Streams in the Blue Earth River Basin. Minnesota State University, Mankato Water Resources Center. Publication No. 07-01.

Appendix A
STEPL assumptions and results

The STEPL was used to estimate P, N, TSS and *E. coli* loads and reductions for the watershed.

The reductions for BMPs identified in the ten-year milestone table calculated as combined efficiencies and the BMP calculator in STEPL. Reduction efficiencies for *E. coli* were assumed from MPCA (2011) and Wright Water Engineers, Inc. (2010) and added to the "BMPList" worksheet in STEPL. The practices and assumed reduction efficiencies are shown in Table 35. The BMPs with area and percent of watershed treated and assumptions made for STEPL are described in Table 36. The treatment efficiencies for the BMPs that are not in the original list of BMPs and reduction efficiencies (BMPList) in STEPL were assigned based on the similarity of the treatment processes with selected BMPList practices.

Table 35. Land use, BMPs, and efficiencies for STEPL (added all *E. coli* efficiencies)

Land use	BMP & Efficiency	N	P	Sediment	*E. coli*	Assumptions and additions
Cropland						
Cropland	Bioreactor	0.453	ND	ND	0.9	Assume treats 20 acres
Cropland	Buffer - Grass (35ft wide)	0.338	0.435	0.533	0.65	
Cropland	Combined BMPs-Calculated	0	0	0	0	
Cropland	Conservation Tillage 2 (equal or more than 60% Residue)	0.25	0.687	0.77	0.65	
Cropland	Cover Crop 3 (Group A Traditional Early Planting Time) (High Till only for TP and Sediment)	0.204	0.15	0.2	0.5	
Cropland	Filter Strips	0.253	0.308	0.4	0.3	Added Filter Strip, assuming same efficiencies as STEPL practice Terrace, assume 10 acres treatment per acre of filter strip
Cropland	Grade Stabilization Structures	0.253	0.308	0.4	0.3	Added Grade Stabilization Structures, assuming same efficiencies as STEPL practice Terrace, assume 40 acres treated per practice.
Cropland	Manure/Nutrient Management	0.154	0.45	ND	0.9	
Cropland	Nutrient Management 2 (Determined Rate Plus Additional Considerations)	0.247	0.56	ND	0.9	
Cropland	Saturated Buffer	0.338	0.435	0.533	0.65	Added Saturated Buffer, assuming same efficiencies as STEPL practice Buffer-Grass; Assume 1,000 ft with

Land use	BMP & Efficiency	N	P	Sediment	*E. coli*	Assumptions and additions
						treatment as 40 ac/mil (1/8 mile width) as Two-Stage Ditch
Cropland	WASCOB (Water and Sediment Control Basin	0.253	0.308	0.4	0.3	Added WASCOB, assuming the same efficiencies as Terrace, assuming 40 acres treated per WASCOB
Cropland	Wetland Restoration	0.898	0.808	0.95	0.9	Added Wetland Restoration, assuming same efficiencies as STEPL practice Land retirement assuming 40 acres treated per acre of wetland
Pastureland						
Pastureland	Cattle Exclusions	0.203	0.304	0.62	0.65	Added pastureland Cattle Exclusions, assuming same efficiencies as STEPL practice Livestock exclusion fencing
Feedlots						
Feedlots	Waste Storage Facility	0.65	0.6	ND	0.9	
Urban						
Urban	Raingardens	0.6	0.65	0.75	0.9	Added Urban STEPL raingardens, assuming same efficiencies as STEPL practice Infiltration basin (urban)

Table 36. Percent watershed treated and assumptions for milestone and completed BMPs as STEPL inputs

Acres	BMPs	% of land treated	Assumptions
1,200	WASCOBs	2.4%	Assume same efficiencies as STEPL practice Terrace, created water and sediment control basin practice, assume 20 acres treated per WASCOB
800	Grade Stabilizations	1.6%	Assume same efficiencies as STEPL practice Terrace
	Cover crops	100.0%	Assume same efficiencies as STEPL practice Cover Crop 3
	Conservation tillage	100.0%	Assume same efficiencies as STEPL practice Conservation Tillage 2
200	Grassed waterways	0.4%	Assume 1,000 ft of grass waterways treats 20 acres
40	Bioreactors	0.1%	Assume 20 acres treated per STEPL practice bioreactor
38	9 miles of private ditches buffers	0.1%	Assume 47,520 feet of 35' Buffer = 38 acres as STEPL practice grassed buffer
	100% buffer compliance	100.0%	Assume 100% treated as STEPL practice grassed buffer 35' wide

Acres	BMPs	% of land treated	Assumptions
20	Restore 10, 2 acre wetlands	0.0%	Assume 40 acres treated per acres of wetland, created wetland practice as same efficiencies as STEPL practice Land Retirement
460	60% of pasture in rotational grazing plan	100.0%	Assume same efficiencies as STEPL practice pastureland Perimeter Fencing as part of rotational grazing plan, assume same efficiencies as STEPL practice Grazing Land Management (rotational graze with fencing)
768	Manure land application plans	100.0%	Assume the same efficiencies as STEPL practice Nutrient Management 1, created Manure application
80	Cover conservation crops as part of rotational grazing	10.4%	Assume this has the same efficiencies as STEPL practice cropland Critical Area Planting. Created pastureland Cover crops and conservation tillage in rotational grazing practice in STEPL
120	Perimeter fencing	15.6%	Assuming same efficiencies as STEPL practice Stream Protection w/out fencing, created pastureland Perimeter fencing
200	Drainage management projects (5)	0.4%	Assuming same efficiencies as STEPL practice Terrace, with 40 acres treated per project
2,000	Nutrient management with variable rate testing	4.0%	Assuming same efficiencies STEPL practice Nutrient management 2
2,000	Spring application	4.0%	Assuming same efficiencies as STEPL practice Nutrient management 1, created Spring application
280	WASCOB	0.6%	Assume same efficiencies as STEPL practice Terrace, created water and sediment control basin practice, assume 20 acres treated per WASCOB
773	Cover crops	1.6%	Assume same efficiencies as STEPL practice Cover Crop 3
691	No till	1.4%	Assume same efficiencies as STEPL practice Conservation Tillage 2
2	Wetland restoration	0.2%	Assume same efficiencies as STEPL practice Land Retirement, assume 40 acres treated per acre of wetland
160	Underground outlet	0.3%	Assume same efficiencies as STEPL practice Terrace
340	WASCOB	0.7%	Assume same efficiencies as STEPL practice Terrace, created water and sediment control basin practice, assume 20 acres treated per WASCOB
1	Grassed water	0.0%	Assume same efficiencies as STEPL practice Terrace, 1000 ft of grass waterways treats 20 acres
40	Sediment basin	0.1%	Assume same efficiencies as STEPL practice Terrace
123	Conservation cover	0.2%	Assume same efficiencies as STEPL practice Cover Crop 3

Acres	BMPs	% of land treated	Assumptions
1	Critical Area Planting	0.0%	Assume same efficiencies as STEPL practice as Cover Crop 3
901	No till	1.8%	Assume same efficiencies as STEPL practice Conservation Tillage 2
901	Reduced till	1.8%	Assume same efficiencies as STEPL practice Conservation Tillage 2
407	Cover crops	0.8%	Assume same efficiencies as STEPL practice Cover Crop 3
160	Drainage Water Management	0.3%	Assume same efficiencies as STEPL practice Terrace
160	Tile inlets	0.3%	Assume same efficiencies as STEPL practice Terrace
160	Grade Stabilization	0.3%	Assume same efficiencies as STEPL practice Terrace
44	Wetland restoration	0.1%	Assume same efficiencies as STEPL practice Land Retirement, assume 40 acres treated per acre of wetland
44	Wetland restoration	0.1%	Assume same efficiencies as STEPL practice Land Retirement, assume 40 acres treated per acre of wetland
324	nutrient management	0.7%	Assume same efficiencies as STEPL practice as Nutrient Management 2
40	Underground outlet	0.1%	Assume same efficiencies as STEPL practice Terrace
3,366	No till	6.8%	Assume same efficiencies as STEPL practice as Conservation Tillage 2
5,930	Cover crops	11.9%	Assume same efficiencies as STEPL practice Cover Crop 3
100	WASCOB	0.2%	Assume same efficiencies as STEPL practice Terrace, created water and sediment control basin practice, assume 20 acres treated per WASCOB
3	Grassed water	0.0%	Assume same efficiencies as STEPL practice Terrace, assume 1000 ft of grass waterways treats 20 acres
40	Drainage Water Management	0.1%	Assume same efficiencies as STEPL practice Terrace
40	Tile inlets	0.1%	Assume same efficiencies as STEPL practice Terrace
40	Grade Stabilization	0.1%	Assume same efficiencies as STEPL practice Terrace

The reductions for replacing and/or upgrading failing or non-conforming SSTS were estimated using the STEPL septic tab. Outputs from this worksheet are described in Table 37.

Table 37. STEPL output for SSTS *E. coli* load reductions

Watershed	# of SSTS	Pop/ SSTS	SSTS failure rate, %	Pop/ failing SSTS	Direct discharge population	Failing SSTS flow gal/day	Failing SSTS flow l/hr	N load lb/hr	P load lb/hr	E. coli, MPN/hr billion MPN/yr
Dutch Creek	15	2.43	100	36.45	0	2551.500	402.437	0.053	0.021	3.8E+00
Hall Lake	15	2.43	100	36.45	0	2551.500	402.437	0.053	0.021	3.8E+00

SSTS nutrient load in lb/yr except E. coli in billion MPN/yr)				**Load after reduction**			
Watershed	**N Load, lb/yr**	**P Load, lb/yr**	***E. coli* billion MPN/yr**	**N Load, lb/yr**	**P Load, lb/yr**	**BOD, lb/yr**	***E. coli* billion MPN/yr**
Dutch Creek	466.32	182.64	3.3E+04	0	0	0	0
Hall Lake	466.32	182.64	3.3E+04	0	0	0	0

Assumptions made for SSTS

The direct contribution of nutrients to a stream is mainly from failing septic systems.

Required input for calculating septic nutrient load are number of systems, failure rate, loading rate (lb/hr) and flow (cfs).

Assumption: failing septic systems are distributed evenly across the watershed based on land area.

Assume the average concentrations reaching the stream (from septic overcharge) are:

Total Nitrogen	60	mg/L (range of 20 to 100)
Total Phosphorus:	23.5	mg/L (range of 18 to 29)
Organics (BOD):	245	mg/L (range of 200 to 290)
*E. coli **	948,000	MPN/100ml
Typical septic overcharge flow rate of:	70	gal/day/person(range of 45 to 100)

* *E. coli* effluent # assumed to be 948,000 as equivalent from the BWSR Septic System Improvement Estimator Tool (Heger 2017) assumption

Appendix B.
PTMApp

The PTMApp products can be used to complete a pollutant source assessment, evaluate the feasibility of Best Management Practices, estimate the water quality benefits of one or more practices, and assess the ability to achieve measurable goals. The sequential use of the products allows the user to create a targeted implementation strategy to improve water quality, whether within a local drainage area or a large watershed. The products are also useful for developing targeted grant applications for improving water quality, and further refining implementation strategies described in Watershed Restoration and Protection Strategies (WRAPS). The documentation surrounding PTMApp is available at https://ptmapp.bwsr.state.mn.us/User/Documentation.

The assumptions used by the Dutch Creek and Fairmont Chain of Lakes partners are below.

Toolset	Tool (run #)	Parameters	Input	Output File Name	Notes	Done
Stream Network Development Tools	Manual Cutter/Dam Builder	Input Cut Lines (optional)	BreachLines.shp	--	First ran this tool with the Dam Lines only. Then re-ran the tool with the NewDEM as the Input Unfilled DEM, and inputted the BreachLines.	X
		Input Dam Lines (optional)	Walls.shp	--		
		Input unfilled DEM	DEM070200090701	--		
		Output New DEM	--	NewDEM070200090701		
		Output Filled DEM	--	DEMFill070200090701		
		Output D8 Flow Direction Raster	--	D8FlowDir070200090701		
		Output D8 Flow Accumulation Raster	--	D8FlowAcc070200090701		
		Output Hillshade Raster	--	Hshd070200090701		
	Flow Network Definition - Area Threshold (1)	Input D8 Flow Accumulation raster	D8FlowAcc070200090701	--		X
		Input D8 Flow Direction raster	D8FlowDir070200090701	--		
		Area threshold (acres)	30	--		
		Input Watershed Boundary (optional)	Not included	--		
		Output Flow Network	--	AreaFlowNet_30ac070200090701		
	Flow Network Definition - Area Threshold (2)	Input D8 Flow Accumulation raster	D8FlowAcc070200090701	--		X
		Input D8 Flow Direction raster	D8FlowDir070200090701	--		
		Area threshold (acres)	5	--		
		Input Watershed Boundary (optional)	Not included	--		
		Output Flow Network	--	AreaFlowNet_5ac070200090701		
	Flow Network Definition - Peuker Douglas	Input Filled DEM	DEMFill070200090701	--		X
		Input D8 Flow Direction raster	D8FlowDir070200090701	--		
		Input Watershed Boundary	bnd070200090701	--		
		Pour Point(s) Provided? (optional)	Included, PourPoints070200090701	--		
		Output Automatically Generated Pour Points? (optional)	Not included	--		
		Output Peuker Douglas Flow Network (polyline)	--	PDFlowNet070200090701		
	Identify Impeded Flow (Depression Depth)	Input unfilled DEM	NewDEM070200090701	--		X
		Output Depth Grid	--	DepthGrid070200090701		
	Stream Reach & Catchments	Input Flow Network	AreaFlowNet_30ac070200090701	--	StreamType Definitions in AreaFlowNet_30ac070200090701: 0 = Not Perennial 1 = Public Waters Inventory 2 = Ditch Dataset/Other Perennial 3 = Wetland (other waters) 4 = Identified in PWI, but no open water	X
		Input D8 Flow Direction raster	D8FlowDir070200090701	--		
		Input Filled DEM	DEMFill070200090701	--		
		Input Watershed Boundary (polygon)	bnd070200090701	--		
		Create stream reach and catchments from a subset of flow segments? (field name) (optional)	StreamType	--		
		Classification value (optional)	1, 2	--		
		Input Pour Point(s) (optional)	Included, PourPoints070200090701	--		
		Output Stream Reach (polyline)	--	StreamReach070200090701		
		Output Catchments (polygon)	--	Catchments070200090701		
		Output Watershed Boundary (optional)	--	bnd_new070200090701		
Field Characterization Tools	By-Field Slope Statistics	Input Field Boundary feature class (polygon)	FB070200090701	--	75th Percentile Slope* Statistics (for agricultural fields): max = 9.79 min = 1.57 mean = 4.05 standard deviation = 1.44 *The 75th percentile slope of a field means that 25% of the field consists of slopes greater than this value	X
		Input unfilled DEM	NewDEM070200090701	--		
		Output Slope Table	--	SlopeTable070200090701		
		Output Slope raster	--	Slope070200090701		
	Tile-Drainage Classification	Input Field Boundary feature class	FB070200090701	--	Agricultural Fields: 92.1% tile-drained 7.9% not tile-drained	X
		Input gSSURGO raster	gSSURGO	--		
		Input Slope table	SlopeTable070200090701	--		
		Condition 1: SLOPE	>= 90% of the field is < 5% slope	--		
		AND / OR	OR	--		
		Condition 2: SOILS	b. Poorly drained soils (A/D, B/D, C/D, or D soils) occupy >= 40% of field	--		
		Output Drainage table	--	DrainageTable070200090701		
	D8 Distance to Stream Tool	Input Stream Reach (polyline)	StreamReach070200090701	--		X
		Input D8 Flow Direction raster	D8FlowDir070200090701	--		
		Output Distance To Stream raster	--	DistToStrm070200090701		
	Runoff Risk Assessment	Input Field Boundary feature class (polygon)	FB070200090701	--	**Sediment Delivery Ratio Statistics (for agricultural fields):** max = 1 min = 0.17 mean = 0.42 standard deviation = 0.32 **Runoff Risk for Agricultural Fields:** 9.4% critical 15.8% very high 16.5% high 51.8% present	X
		Input Slope table	SlopeTable070200090701	--		
		Input Distance To Stream raster	DistToStrm070200090701	--		
		High 3rd Quartile Slope value (% rise) (optional)	used default (20-40-40%)	--		
		Medium 3rd Quartile Slope value (% rise) (optional)	used default (20-40-40%)	--		
		High Sediment Delivery Ratio (optional)	used default (20-40-40%)	--		
		Medium Sediment Delivery Ratio (optional)	used default (20-40-40%)	--		
		Output Runoff Risk table	--	RunoffRisk070200090701		
Precision Conservation Practice Siting Tools	Depression Identification	Input unfilled DEM	NewDEM070200090701	--	343 depressions identified. **Depression Area (m^2) Statistics:** max = 488,527 min = 4,079 mean = 23,518 standard deviation = 41,912 total depression area = 8,066,629 **Maximum Depth (cm) Statistics:** max = 227 min = 15 mean = 51 standard deviation = 29	X
		Input gSSURGO raster	gSSURGO	--		
		Input Field Boundary feature class (polygon) (optional)	Not included	--		
		Input Stream Reach feature class (polyline) (optional)	Not included	--		
		Minimum percent hydric (optional)	60	--		
		Minimum depth (in cm) (optional)	15	--		
		Minimum surface area (acres), optional	1	--		
		Output Depressions feature class (polygon)	--	Depressions070200090701		
		Output Depression Raster (optional)	--	DepRas070200090701		
	Depression Drainage Area	Input Depressions (polygon)	Depressions070200090701	--	Drainage Area (hectares) Statistics: max = 87.1 min = 0.98 mean = 8.5 standard deviation = 10.2	X
		Input unfilled DEM	NewDEM070200090701	--		
		Output Drainage Areas (polygon)	--	Depress_Wsheds070200090701		
	Drainage Water Management	Input Field boundary feature class (polygon)	FB070200090701	--	19 opportunities identified.	X
		Input unfilled DEM	NewDEM070200090701	--		
		Input Drainage table	DrainageTable070200090701	--		
		Contour Interval (meters)	0.5	--		
		Minimum Percent of Field that the user-defined contour must occupy (optional)	left blank	--		
		Minimum Acreage within field that the user-defined contour must occupy (optional)	20	--		
		Output Drainage Water Management contours (polygon)	--	DrainageMgmt070200090701		
	Moore Terrain Derivatives	Input DEM (filled or unfilled - see tool help for guidance)	DEMFill070200090701	--		X
		Input Slope raster	Slope070200090701	--		
		Output Specific Catchment Area	--	SCA_Fill070200090701		
		Output Stream Power Index	--	SPI_Fill070200090701		
		Output Topographic Wetness Index	--	TWI_Fill070200090701		
	Grassed Waterways - SPI Threshold	Input Field Boundary feature class	FB070200090701	--	A standard deviation of 3 corresponded to a SPI value of 10.13. 289 opportunities identified.	X
		Input Stream Reach feature class	StreamReach070200090701	--		
		Input Stream Power Index raster	SPI_Fill070200090701	--		
		Standard Deviation Threshold (must provide either a Standard Deviation or Value threshold) (optional)	3	--		
		Value Threshold (must provide either a Standard Deviation or Value threshold) (optional)	left blank	--		
		Input depressions (optional)	Not included	--		
		Output grassed waterways	--	GrassWaterwayFill3SD070200090701		
	Contour Buffer Strips	Input field boundary feature class	FB070200090701	--	295 opportunities identified.	X
		Input slope raster (in % rise)	Slope070200090701	--		
		Input Slope Table	SlopeTable070200090701	--		
		Input unfilled DEM	NewDEM070200090701	--		
		Input D8 Flow Accumulation Raster	D8FlowAcc070200090701	--		
		Buffer Strip Width (in feet)	30	--		
		Output Contour Buffer Strips (polygon)	--	CBS070200090701		
	Edge-of-Field Bioreactors	Input field boundary feature class	FB070200090701	--	27 opportunities identified.	X
		Input drainage table	DrainageTable070200090701	--		
		Input unfilled DEM	NewDEM070200090701	--		
		Input D8 flow accumulation raster	D8FlowAcc070200090701	--		
		Input D8 flow direction raster	D8FlowDir070200090701	--		
		Input gSSURGO raster	gSSURGO	--		
		Output bioreactors	--	Bioreactor070200090701		
		Input unfilled DEM	NewDEM070200090701	--		
		Input D8 Flow Direction raster	D8FlowDir070200090701	--		
		Input D8 Flow Accumulation raster	D8FlowAcc070200090701	--		

Impoundment Siting Tools	Nutrient Removal Wetland	Input Watershed Boundary	bnd_new070200090701	--	11 opportunities identified.	X
		Input Stream Reach (polyline) (optional)	Not included	--		
		Roads layer (polyline) (optional)	Included, Roads070200090701	--		
		Spacing (meters)	100	--		
		Wetland Impoundment Height (meters)	0.9	--		
		Wetland Buffer Height (meters)	1.5	--		
		Output Nutrient Removal Wetlands (polygon)	--	NRW070200090701		
		Output Drainage Areas for Nutrient Removal Wetlands (polygon)	--	NRWDrainageAreas070200090701		
	WASCOB	Input Field Boundary Feature Class	FB070200090701	--	81 opportunities identified.	X
		Input unfilled DEM	NewDEM070200090701	--		
		Input D8 Flow Accumulation raster	D8FlowAcc070200090701	--		
		Input D8 Flow Direction raster	D8FlowDir070200090701	--		
		Stream Reach (polyline)	StreamReach070200090701	--		
		Input Watershed Boundary	bnd_new070200090701	--		
		Embankment Height of WASCOB (meters)	1	--		
		Output WASCOBs	--	WASCOBs070200090701		
	WASCOB Basins	Input WASCOBs	WASCOBs070200090701	--		X
		Input Filled DEM	DEMFill070200090701	--		
		Input Flow Direction raster	D8FlowDir070200090701	--		
		Output WASCOB basins	--	WASCOBbasin070200090701		
		WASCOB basin depth raster (optional)	--	WASCOBdepthras070200090701		
Riparian Assessment Tools	Height Above Channel	Input unfilled DEM	NewDEM070200090701	--		X
		Input D8 Flow Direction raster	D8FlowDir070200090701	--		
		Input Stream Reach feature class (polyline)	StreamReach070200090701	--		
		Output D8 Adjusted Flow Direction raster	--	AdjFlowDir070200090701		
		Output Relative Elevation raster (optional)	--	RelElev070200090701		
		Output Height Above Channel raster	--	HAC070200090701		
	Generate Riparian Analysis Polygons	Input Stream Reach (polyline)	StreamReach070200090701	--		X
		Input Field Boundary feature class (polygon)	FB070200090701	--		
		Input Tile Drainage table	DrainageTable070200090701	--		
		Input Adjusted Flow Direction raster	AdjFlowDir070200090701	--		
		Output Riparian Analysis Polygons	--	RAP070200090701		
	Riparian Function Assessment	Input Riparian Analysis Polygons	RAP070200090701	--	Riparian Analysis Polygon Function: 1.9% Critical Zone 25% Deep Rooted Vegetation 15% Multi-Species Buffer 16.9% Stiff Stemmed Grasses 41.2% Stream Bank Stabilization	X
		Input Height Above Channel raster	HAC070200090701	--		
		Output Riparian Function table	--	RiparianFunction070200090701		
	Riparian Denitrifying Practices	Input Riparian Analysis Polygons (optional)	RAP070200090701	--	Riparian Analysis Polygons Suitable for Saturated Buffers = 52	X
		Input Stream Reach feature class	StreamReach070200090701	--		
		Input unfilled DEM	NewDEM070200090701	--		
		Input Slope raster	Slope070200090701	--		
		gSSURGO	gSSURGO	--		
		Soil Profile Table	SoilProfile070200090701	--		
		Input CDL Land Use raster	wsCDL2016	--		
		Minimum organic matter %	1.7	--		
		Minimum % of near stream soils (within 20 meters of stream) in which ALL soil conditions must be met	35	--		
		Minimum % of RAP that must consist of slopes between 2 and 8%	35	--		
		Maximum bank height (in feet)	8	--		
		Output Saturated Buffer table	--	RiparianPractice070200090701		