Watershed

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# Upper Wapsipinicon River Watershed Restoration and Protection Strategy Report

MINNESOTA POLLUTION CONTROL AGENCY

CLEAN WATER LAND & LEGACY AMENDMENT

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# Key terms and abbreviations

**Assessment Unit Identifier (AUID):** The unique waterbody identifier for each river reach comprised of the U.S. Geological Survey (USGS) eight-digit HUC plus a three-character code unique within each HUC.

**Aquatic life impairment:** The presence and vitality of aquatic life is indicative of the overall water quality of a stream. A stream is considered impaired for impacts to aquatic life if the fish Index of Biotic Integrity (IBI), invertebrate IBI, dissolved oxygen, turbidity, or certain chemical standards are not met.

**Aquatic recreation impairment:** Streams are considered impaired for impacts to aquatic recreation if fecal bacteria standards are not met. Lakes are considered impaired for impacts to aquatic recreation if total phosphorus and either chlorophyll-a or Secchi disc depth standards are not met.

**Hydrologic Unit Code (HUC):** A HUC is assigned by the USGS for each watershed. HUCs are organized in a nested hierarchy by size. For example, the Minnesota River Basin is assigned a HUC-4 of 0702 and the Pomme de Terre River Watershed is assigned a HUC-8 of 07020002.

**Impairment:** Waterbodies are listed as impaired if water quality standards are not met for designated uses including aquatic life, aquatic recreation, and aquatic consumption.

**Index of Biotic Integrity (IBI):** A method for describing water quality using characteristics of aquatic communities, such as the types of fish and invertebrates found in the waterbody. It is expressed as a numerical value between 0 (lowest quality) to 100 (highest quality).

**MT/yr: Metric tons per year**

**Protection:** This term is used to characterize actions taken in watersheds of waters not known to be impaired to maintain conditions and beneficial uses of the waterbodies.

**Restoration:** This term is used to characterize actions taken in watersheds of impaired waters to improve conditions, eventually to meet water quality standards and achieve beneficial uses of the waterbodies.

**Source (or pollutant source):** This term is distinguished from ‘stressor’ to mean only those actions, places or entities that deliver/discharge pollutants (e.g., sediment, phosphorus, nitrogen, pathogens).

**Stressor (or biological stressor):** This is a broad term that includes both pollutant sources and non-pollutant sources or factors (e.g., altered hydrology, dams preventing fish passage) that adversely impact aquatic life.

**Total Maximum Daily Load (TMDL):** A calculation of the maximum amount of a pollutant that may be introduced into a surface water and still ensure that applicable water quality standards for that water are met. A TMDL is the sum of the wasteload allocation for point sources, a load allocation for nonpoint sources and natural background, an allocation for future growth (i.e., reserve capacity), and a margin of safety as defined in the Code of Federal Regulations.

# Executive summary

The State of Minnesota has adopted a watershed approach to address the state's 80 major watersheds (denoted by an 8-digit hydrologic unit code or HUC). This watershed 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. The scientific findings regarding water quality conditions and strategies for addressing them are incorporated into a Watershed Restoration and Protection Strategy (WRAPS) report. This WRAPS report addresses the Minnesota portion of the Upper Wapsipinicon River Watershed (UWRW), which spans 13 square miles in the south central area of the state.

The UWRW is a small headwater watershed located in rural Mower County adjacent to the Minnesota/Iowa state line. It is primarily in row crop agriculture and mostly comprised of human-made ditches and modified streams. The UWRW has a limited number of wetlands and has increased agricultural drainage, including field tiling and drainage ditches. Only a small portion of the greater Wapsipinicon Watershed (0.81%) lies within the state of Minnesota; the remainder is in Iowa. Several Iowa organizations are active in monitoring, planning and restoring the Wapsipinicon Watershed including Iowa Flood Center, UWRW Management Authority, Northeast Iowa Resource Conservation and Development and Iowa Department of Natural Resources (IADNR).

Information from multiple studies including water quality monitoring data, monitoring and assessment report, stressor identification (SID), Upper Wapsipinicon Watershed Hydrologic Assessment Report (IFC/IIHR) and Geographic Information Analysis (GIS) provide the foundation of this document and are discussed in Chapters 1 and 2. The general summary of this work indicates that waters in this small watershed are impaired for aquatic life (fish and invertebrates) and aquatic recreation (*Escherichia coli [E. coli]).*

Three stream assessment units in the watershed were assessed by the Minnesota Pollution Control Agency (MPCA) for aquatic recreation and/or aquatic life. One reach was evaluated for aquatic recreation and was found to not be meeting water quality standards due to high levels of bacteria. Of the three stream reaches evaluated for aquatic life, one is not meeting water quality standards and has impaired fish and macroinvertebrate communities. The remaining two stream reaches did not have sufficient data to assess for these uses. The most common stressors to aquatic life in the watersheds are nitrate, altered hydrology, and lack of habitat. Further monitoring of this watershed is recommended to establish trends, track changes in water quality and ensure no additional impairments exist.

The purpose of this WRAPS is to provide a foundation of technical information and a starting point to local governments, land owners and interest groups so they may determine:

1. The best strategies for making improvements to degraded waters; and
2. The best locations to focus on implementing practices.

Examples of strategies provided in this WRAPS report include nutrient management, feedlot runoff controls, septic system improvements, and others. Critical areas for restoration within the watershed focus around agricultural uses (row crops and feedlots) but also include residential areas.

Chapter 3 is the primary section of this report for local partner use or project starting points. It includes details and products that came from collaboration with watershed stakeholders and local government units (LGUs). A general summary of UWRW concerns are as follows:

- *E. coli* impairment
- Nitrogen stressor
- Degraded aquatic habitat
- Altered hydrology

This chapter concludes with a summary of restoration and protection strategies specific to the UWRW. Strategies to address *E. coli* and nitrogen focus around nutrient and general agricultural management practices. To improve aquatic habitat and offset impacts of altered hydrology, strategies focus around increasing the watershed's water storage capability.

## What is the WRAPS Report?


Minnesota has adopted a watershed approach to address the state's 80 major watersheds. The Minnesota watershed approach incorporates **water quality monitoring and assessment, watershed analysis, public participation, planning, implementation, and measurement of results** into a 10-year cycle that addresses both restoration and protection.

As part of the watershed approach, the MPCA developed a process to identify and address threats to water quality in each of these major watersheds. This process is called Watershed Restoration and Protection Strategy (WRAPS) development. WRAPS reports have two parts: impaired waters have strategies for restoration, and waters that are not impaired have strategies for protection.

Waters not meeting state standards are listed as impaired and Total Maximum Daily Load (TMDL) studies are developed for them. TMDLs are incorporated into WRAPS. In addition, the watershed approach process facilitates a more cost-effective and comprehensive characterization of multiple water bodies and overall watershed health, including both protection and restoration efforts. A key aspect of this effort is to develop and utilize watershed-scale models and other tools to identify strategies for addressing point and nonpoint source pollution that will cumulatively achieve water quality targets. For nonpoint source pollution, this report informs local planning efforts, but ultimately the local partners decide what work will be included in their local plans. This report also serves as the basis for addressing the U.S. Environmental Protection Agency's (EPA) Nine Minimum Elements of watershed plans, to help qualify applicants for eligibility for Clean Water Act Section 319 implementation funds.

**Purpose**

- Support local working groups and jointly develop scientifically-supported restoration and protection strategies to be used for subsequent implementation planning
- Summarize watershed approach work done to date including the following reports:
  - *Winnebago River and Upper Wapsipinicon River Watershed Monitoring and Assessment*
  - *Upper Wapsipinicon River Watershed Stressor Identification*
  - *Upper Wapsipinicon River Watershed Total Maximum Daily Load*

**Scope**

- Impacts to aquatic recreation and impacts to aquatic life in streams

**Audience**

- Local working groups (local governments, SWCDs, watershed management groups, etc.)
- State agencies (MPCA, DNR, BWSR, etc.)

# 1. Watershed background and description

The UWRW is a headwater drainage located entirely within Mower County in south central Minnesota. It begins as a group of small tributaries and ditches flowing south across the Minnesota/Iowa border. This watershed spans 13 square miles in Minnesota making up approximately 0.81% of the entire Wapsipinicon River Watershed (NRCS 2016). The greater Wapsipinicon River Watershed drains 991,980 acres of land across Minnesota and Iowa, eventually flowing into the Mississippi River near Clinton, Iowa. Three small ditched tributaries east of the Upper Wapsipinicon River flow across the Iowa border before joining the river's mainstem.


**Figure 1. Upper Wapsipinicon River Watershed (NRCS Rapid Watershed Assessment; NRCS 2016).**

## Geology/Soils

The watershed is located in the Minnesota Drift Plains portion of the Western Corn Belt Plains ecoregion where soils are defined as "silty and loamy mantled firm till plain," (NRCS 2016). This means there is a thick layer of silty material overlying loamy till before hitting sedimentary bedrock. Soils within this HUC are predominantly highly productive and well suited for agricultural uses. Across the greater UWRW, primary land covers are Row Crops (75.3%), Grass/Pasture/Hay (9.8%), Residential/Commercial Development (7.5%), Forest (3.6%), and Wetlands (3.4%). (NRCS 2016).

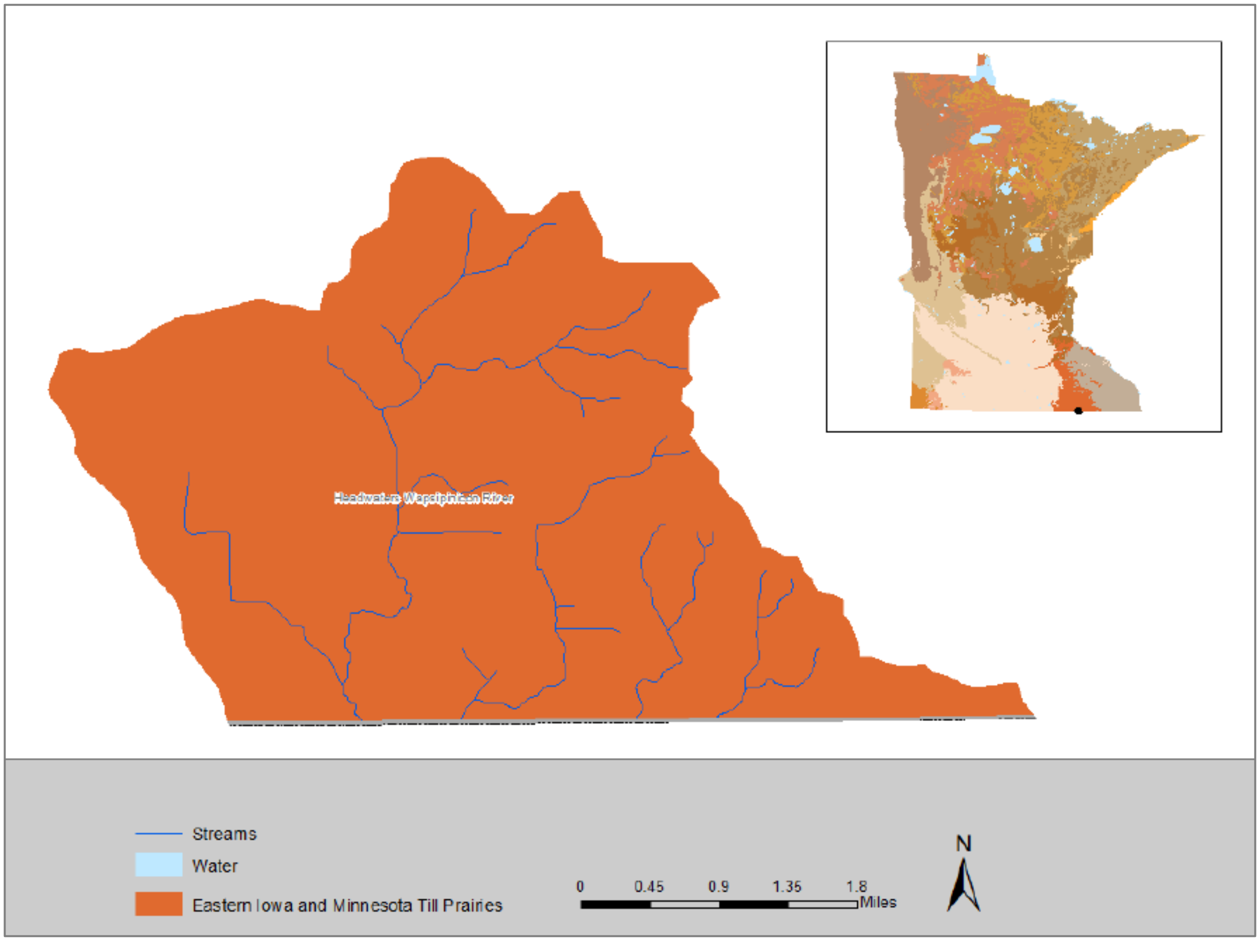


**Figure 2. Major Land Resources Areas in the Upper Wapsipinicon River Watershed.**

## Land use summary

Historically, the UWRW was covered by native prairie. Today, 91% of the Minnesota portion of the watershed has been converted to row crop agriculture (DNR 2015). Rangeland (pasture) makes up 3.2% of the land use and another 5.5% for general development.

### Additional Upper Wapsipinicon River Watershed resources

U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Rapid Watershed Assessment for the Wapsipinicon Watershed: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/mn/technical/dma/rwa/?cid=nrcs142p2_023619

Minnesota Department of Natural Resources (DNR) Watershed Health Assessment Framework (WHAF) for the Upper Wapsipinicon River Watershed: https://arcgis.dnr.state.mn.us/ewr/whaf2/

The Minnesota Nutrient Reduction Strategy (September 2014 [MPCA2014b]): https://www.pca.state.mn.us/sites/default/files/wq-s1-80.pdf

Lower Mississippi River Basin Fecal Coliform Implementation Plan (February 2007): https://www.pca.state.mn.us/sites/default/files/wq-iw9-02c.pdf

All other land use categories (forest and wetland) are less than 1% of the total watershed. Mower County, where the watershed is located, is ranked number seven in the state for crop production and number five in the state for hog production.

The Minnesota population within the UWRW is small; only 68 people reported in the 2010 census (DNR 2015). Combining areas of Minnesota and Iowa, the entire watershed contains 2,255 farms. Approximately 98% of the land is privately owned. Followed by County ownership with 1.1% (NRCS 2016).

As mentioned previously, the majority of the UWRW is located in Iowa. Across the entire watershed there are many conservation efforts to minimize the impact of flooding through a project funded by the U.S. Department of Housing and Urban Development; known as the Iowa Watershed Approach. According to the NRCS, over 50,000 acres are enrolled in the Conservation Reserve Program (CRP). Another nearly 24,000 acres are in the Environmental Quality Incentives Program. Mower County in Minnesota is actively working to promote conservation in the watershed. They offer resources to help protect both the land and the water. Practices currently implemented in the watershed is discussed in subsequent Chapter 3.

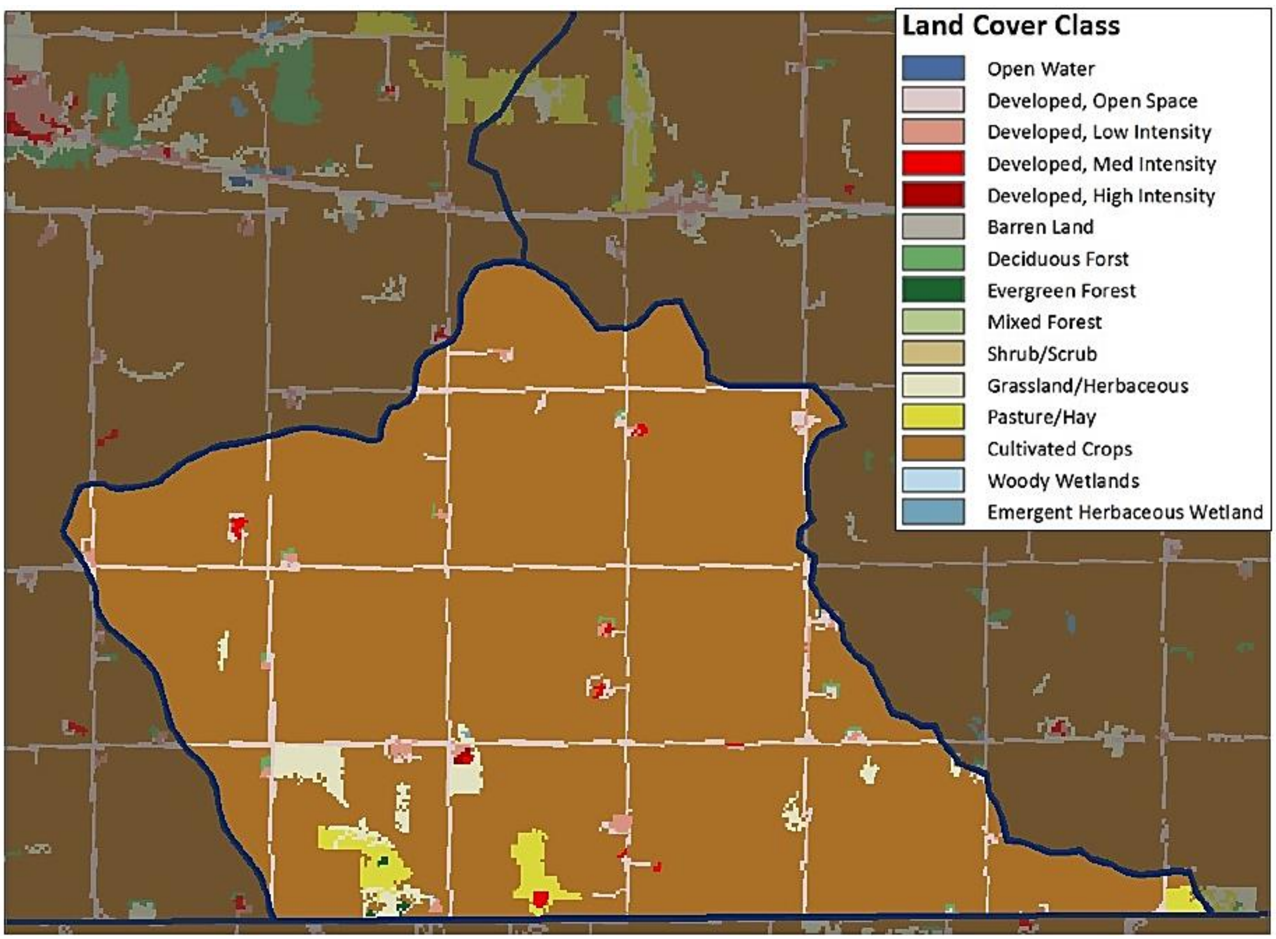


**Figure 3. Land cover in the Upper Wapsipinicon River Watershed.**

## Wetlands

There are a very limited number of designated wetlands in the UWRW; almost exclusively associated with stream networks. Approximately 21 acres of wetland (0.2% of watershed) currently exist. A majority of these wetland areas (18 acres) are types that include emergent vegetation.

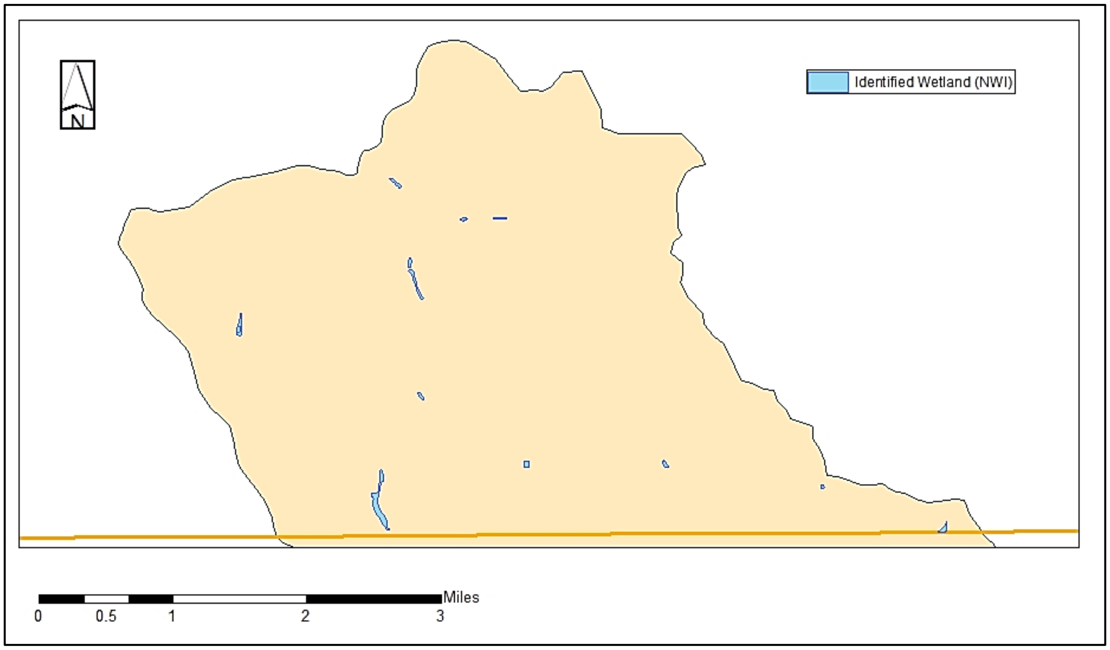


**Figure 4. Wetland inventory in the Upper Wapsipinicon River Watershed.**

Soils data was used to estimate historical wetland extent prior to European settlement and wetland changes following settlement. Significant actions were taken to make land within the UWRW more conducive to agriculture, including draining and converting wetlands. Analysis of Natural Resources Conservation Service digital soil survey (SSURGO) soil map units with drainage classes of either Poorly Drained or Very Poorly Drained suggest approximately 44.33% of the UWRW was covered by wetland prior to European settlement. Comparing estimated historic wetland to current wetland extent indicates that 99.43% of the historical wetlands are now non-wetland.

**Table 1. HGM Wetland Classification in the UWRW.**

| HGM Class Code | HGM Description | Wetland Plant Community Classes Present | Total acres | % Total |
|---|---|---|---|---|
| LSFLTH | Wetlands adjacent "fringing" to streams with inflow and outflow "through flow" hydrology | Hardwood Swamp and Seasonally Flooded Basin | 14.00 | 67% |
| TEFLOU | Inland wetlands in level landscapes "flats" with outflow hydrology | Seasonally Flooded Basin, Hardwood Swamp & Scrub | 2.58 | 12% |
| TEPDIS | Artificially flooded shallow open water pond | | 1.93 | 9% |
| TEFLIS | Inland wetlands in level landscapes "flats" surrounded by upland "isolated" hydrology | Seasonally Flooded Basin and Hardwood Swamp | 1.22 | 6% |
| TESLOU | Inland wetlands situated on slopes with outflow hydrology | Wet Meadow, Hardwood Swamp, and Scrub Shrub | 1.12 | 5% |

## Surface water hydrology

Most of the streams in the UWRW are altered; meaning they have been modified from their natural state. The watershed does have one small section of natural channel in the lower portion of the Upper Wapsipinicon River just above the Minnesota/Iowa border (Figure 5).

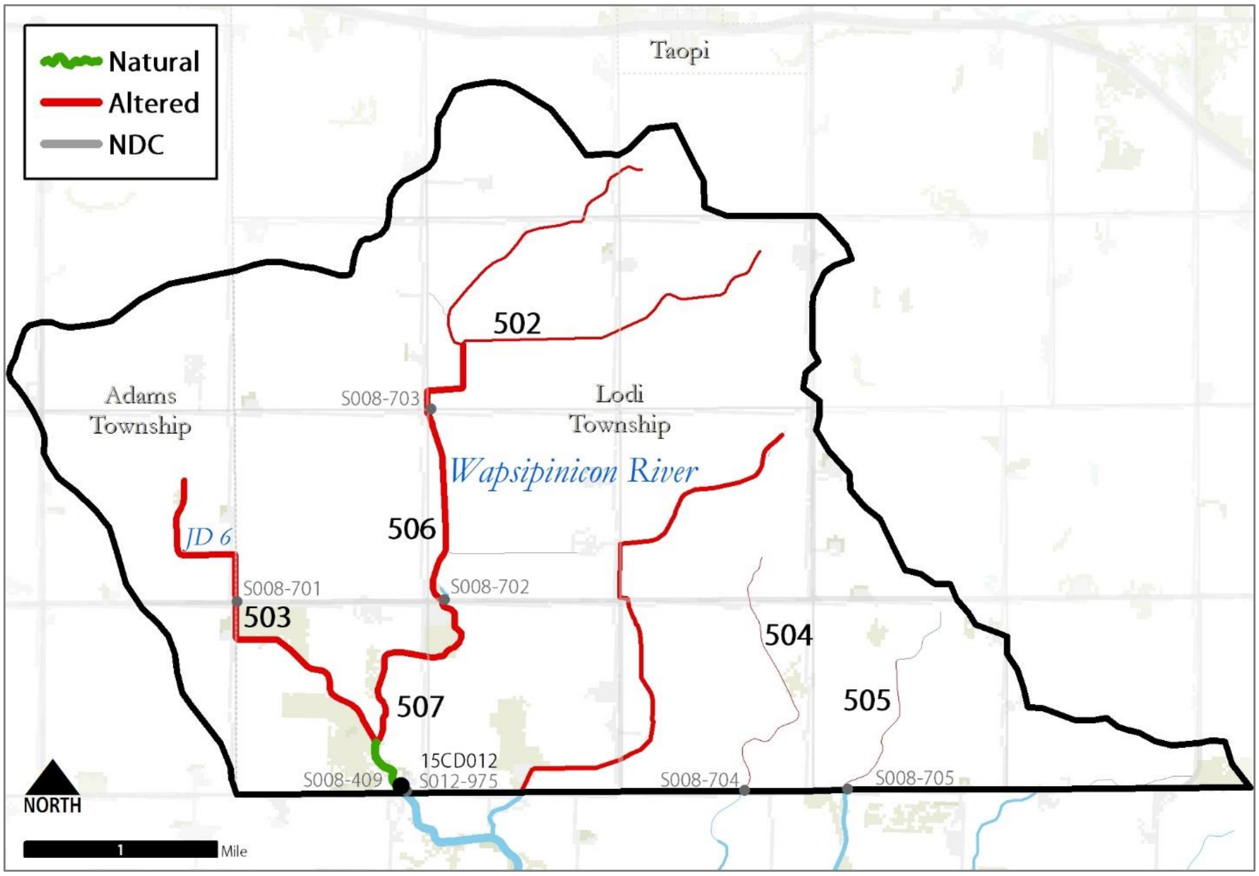


**Figure 5. Altered watercourses in the Upper Wapsipinicon River Watershed.**

Due to the high density of row crop agriculture in the watershed, there is also a high density of altered hydrology. The term "altered hydrology" includes agricultural drainage (field drain tiles and drainage ditches), culverts and bridge crossings. While benefits exist for altered hydrology (e.g. increased agricultural use and road access) it can negatively impact water quality by adding direct inputs of nutrients, excess sediment and introducing an increased volume of water to surface water systems. Major flooding has been reported in the downstream portions of the UWRW and is a high priority issue for the State of Iowa.

Once the Upper Wapsipinicon River crosses into Iowa, the geology changes and impacts the river's hydrology. In this area, karst features are more common, increasing the interface of ground and surface waters. The increased influence of springs and seeps impacts the water temperature of the Upper Wapsipinicon River in a way that allows for a coldwater stream designation (IADNR 2016). This is a drastic difference from the Minnesota headwaters section, which is designated as warmwater.

## Hydrogeology and groundwater quality

The UWRW lies within the eastern area of the Southeast hydrogeologic region (Region 5), dominated by glacial landforms and till. It also lies within Minnesota's South-Central Ground Water Province. This Province is characterized by having "thick clayey glacial drift overlying Paleozoic sandstone, limestone, and dolostone aquifers." (DNR 2017a). While the UWRW is surrounded by areas of karst, the watershed itself has very limited karst features (Figure 6). The UWRW in Minnesota is considered a covered karst area, meaning that it is underlain by carbonate bedrock but has more than 100 feet of sediment cover. Because of this sediment cover, the watershed has low sensitivity of near-surface materials. This means that there is a relatively low risk of contaminants infiltrating to groundwater. High risk areas shown in Figure 6 are likely hard surfaces that pose a higher risk of surface water contamination via runoff than to groundwater.

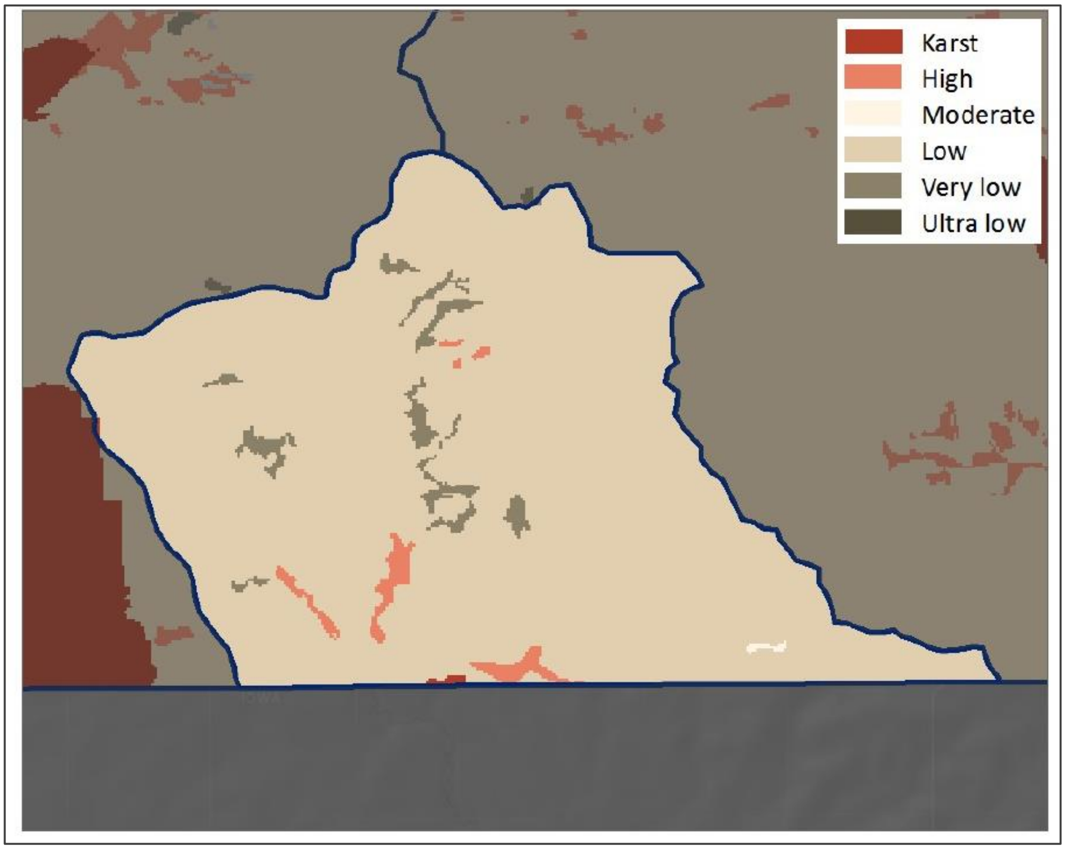


**Figure 6. Pollution sensitivity of near surface materials; DNR Watershed Context Report, September 2017.**

There are no public water supply wells or MPCA Ambient Groundwater Monitoring wells within the UWRW. From 1992 to 1996, the MPCA conducted statewide baseline water quality sampling and analysis of Minnesota's principal aquifers. This monitoring effort found that the groundwater quality in Paleozoic bedrock of the MPCA's Southeast Region 5 (including the UWRW) is considered good when compared to areas with similar aquifers. Geology present in the watershed causes a natural elevated concentration of trace elements including cadmium, lead and arsenic (MPCA 1999). While the UWRW has low to moderate groundwater sensitivity, additional measures are recommended to assess the effectiveness of clay-rich glacial deposits in protecting bedrock aquifers.

Minnesota Department of Health (MDH) new well construction program requires testing for arsenic, a naturally occurring but potentially harmful contaminant for humans. Recent monitoring (2008 through

2016) has indicated that 10.7% of all wells installed state-wide have arsenic levels above the maximum contaminant level (MCL) for drinking water of 10 micrograms per liter (µg/L). New well construction testing in the UWRW found that 3.4 % of new wells had concentrations exceeding the MCL. (MDH 2018a). The MPCA database notes at least 32 private drinking water wells currently exist in the watershed. Of these private wells one is located in an area defined as highly vulnerable. Two private wells monitored reported concentrations of 18.5 µg/L & 3.22 µg/L for arsenic and concentrations of 0.1 mg/L & 0.2 mg/L for nitrate. This limited data set indicates that surface water infiltration has a small likelihood of impacting drinking water wells tested. The Minnesota Department of Agriculture administers the statewide Township Testing Program to determine current nitrate-nitrogen concentrations in private wells. The UWRW lies within Adams and Lodi townships which are not reporting as participating in this program as of 2019.

Minnesota Department of Natural Resources (DNR) permits all high capacity water withdraw, both ground and surface waters, where the pumped volume exceeds 10,000 gallons/day (or one million gallons/year). The UWRW has two high capacity groundwater withdraw permittees that are allocated up to 5 million gallons each year for livestock watering. Only one permittee has been permitted long enough to report annual water usage, which was 1.8 million gallons. There are currently no surface water withdraws permitted in the watershed.

# 2. Watershed conditions

This section summarizes monitoring, assessment, SID, computer modeling and trend analysis work completed by MPCA and The University of Iowa's Iowa Flood Center and IIHR – Hydroscience and Engineering (IFC/IIHR). Additional information on watershed conditions can be found at NRCS's Rapid Watershed Assessment program and DNR's Watershed Health Assessment Framework.

## 2.1. Programs to Monitor Water Quality Conditions

Due to the small area and low density of water resources in the UWRW in Minnesota, there are a limited number of water quality monitoring programs administered in the watershed. The UWRW is and will continue to be monitored as part of Minnesota's Water Quality Monitoring Strategy (MPCA 2011). The MPCA programs consider data needs and additional monitoring throughout the watershed monitoring cycle. On-going monitoring programs not active in the UWRW include: Watershed Pollutant Load Monitoring Network, Citizen Stream and Lake Monitoring, Wetland Monitoring, Groundwater Monitoring and Mercury/PCB (Fish Tissue) Monitoring.

Intensive Watershed Monitoring (IWM) provided water quality data for the assessment of surface waters in the UWRW. This program collected water quality data in 2015 and 2016 from seven sites within the watershed. Detailed information about the monitoring process and conditions can be found in the Winnebago River and Upper Wapsipinicon River Watersheds Monitoring and Assessment Report. The second IWM (Cycle 2) began in the UWRW in 2019.

For more information about starting Citizen Stream monitoring for the UWRW, visit the MPCA's Citizen Water Monitoring Program webpage.

Although no wetland monitoring was done in this watershed, conclusions can be drawn from recent plant community studies (floristic quality) on wetlands within each of the three major ecoregions.

Wetlands in the Temperate Prairies Ecoregion, like those in the UWRW, are estimated to be in primarily poor or fair vegetative condition (Table 2). This means that conditions in the watershed exist such that invasive plants dominate native species, influencing the quality and performance of wetlands. It is also noteworthy that the UWRW has not only experienced degradation in wetland quality, but a vast reduction in wetland quantity.

**Table 2. Wetland vegetation condition by major ecoregions based on floristic quality (MPCA 2015).**

| ***Vegetation Condition in All Wetland Ecoregions*** | | | |
|---|---|---|---|
| ***Condition Category*** | **Mixed Wood Shield** | **Mixed Wood Plains** | **Temperate Prairies** |
| ***Exceptional*** | **64%** | **6%** | **7%** |
| ***Good*** | **20%** | **12%** | **11%** |
| ***Fair*** | **16%** | **42%** | **40%** |
| ***Poor*** | **0%** | **40%** | **42%** |

## 2.2. Condition Status

### Streams

Assessments of use support in Minnesota are made for individual waterbodies. The waterbody unit used for river systems, lakes and wetlands is called the "assessment unit." A stream or river assessment unit usually extends from one significant tributary stream to another or from the headwaters to the first tributary. Therefore, a stream or river is often segmented into multiple assessment units that are variable in length. Multiple assessment units are identified by assessment unit identification numbers (AUIDs).

Three AUIDs were assessed for aquatic life and aquatic recreation uses in the UWRW. All of these AUIDs make up the main channel of the Wapsipinicon River. AUID -507 (most downstream main channel of the Wapsipinicon River) was found to be non-supporting of both aquatic life and aquatic recreation (Table 3). Two headwater AUIDs (-503 and -506) did not have sufficient information to make an assessment for aquatic life and/or recreational uses.

Table 3 contains detailed information on the assessment of the UWRW including results of specific aquatic life indicators. The stream reach with impaired invertebrate and fish bio assessments was the focus of the Wapsipinicon River Watershed Stressor Identification Report (described in subsequent chapters).

**Table 3. Aquatic life and recreation assessments on stream reaches: Upper Wapsipinicon River Aggregated 12-HUC.**

| AUID (WID) *Reach name*, *Reach description* | Biological station ID | Reach length (miles) | Use class | Aquatic life indicators: Fish IBI | Invert IBI | Dissolved oxygen | TSS | Secchi Tube | Chloride | pH | Ammonia -$NH_3$ | Pesticides | Eutrophication | Aquatic Life | Aquatic Recreation (Bacteria) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **07080102-503** **Judicial Ditch 6,** Headwaters to Wapsipinicon River | -- | 2.11 | WWg | -- | -- | IF | -- | -- | -- | IF | -- | -- | -- | IF | -- |
| **07080102-506** **Wapsipinicon River,** Headwaters to -92.6732, 43.5073 | -- | 2.40 | WWg | -- | -- | IF | -- | -- | -- | MTS | -- | -- | -- | IF | -- |
| **07080102-507** **Wapsipinicon River,** -92.6732, 43.5073 to MN/IA border | 15CD012 | 0.61 | WWg | EXS | EXS | IF | IF | MTS | MTS | MTS | MTS | -- | IF | IMP | IMP |

Abbreviations for Indicator Evaluations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **MTS** = Meets criteria; **EXP** = Exceeds criteria, potential impairment; **EXS** = Exceeds criteria, potential severe impairment
Abbreviations for Use Support Determinations: **IF** = Insufficient Information, **IMP =** Impaired
Key for Cell Shading: = insufficient information to complete assessment; = new impairment; = full support of designated use.

The aquatic recreation use is non-supporting due to elevated *E. coli* concentrations. Bacteria issues are not only in the UWRW, but widespread in much of Southern Minnesota. Aquatic life use is non-supporting due to the lack of pollution-sensitive species in watershed. Stressors impacting aquatic life are elevated nitrates, altered hydrology and poor aquatic habitat. Of the invertebrates sampled, zero nitrate-intolerant species were found; all invertebrates collected can live in an environment with elevated nitrates.

Dissolved oxygen (DO), TSS and eutrophication parameters did have enough data to make a complete assessment. Of the DO samples taken before 9 a.m., none exceeded the 5 mg/L standard. Daily DO minimums did not get lower than the 4 mg/L standard. Even though a lack of TSS data prevented a full assessment, none of the samples collected exceeded the 65 mg/L standard. Transparency readings using a secchi tube also showed that a majority of the samples met standards. Total phosphorus (TP) and two response variables (DO flux and pH) had data available, but like DO and TSS, not enough to qualify for a full assessment. The mean TP concentration looks to be below the 150 ug/L though a significant rainfall event (2.45 inches on August 24, 2016) may be skewing the data. Average DO flux and pH values are meeting the river nutrient standards. Although DO, TSS, and eutrophication do not appear to be stressing aquatic life, additional monitoring is needed to know for certain.

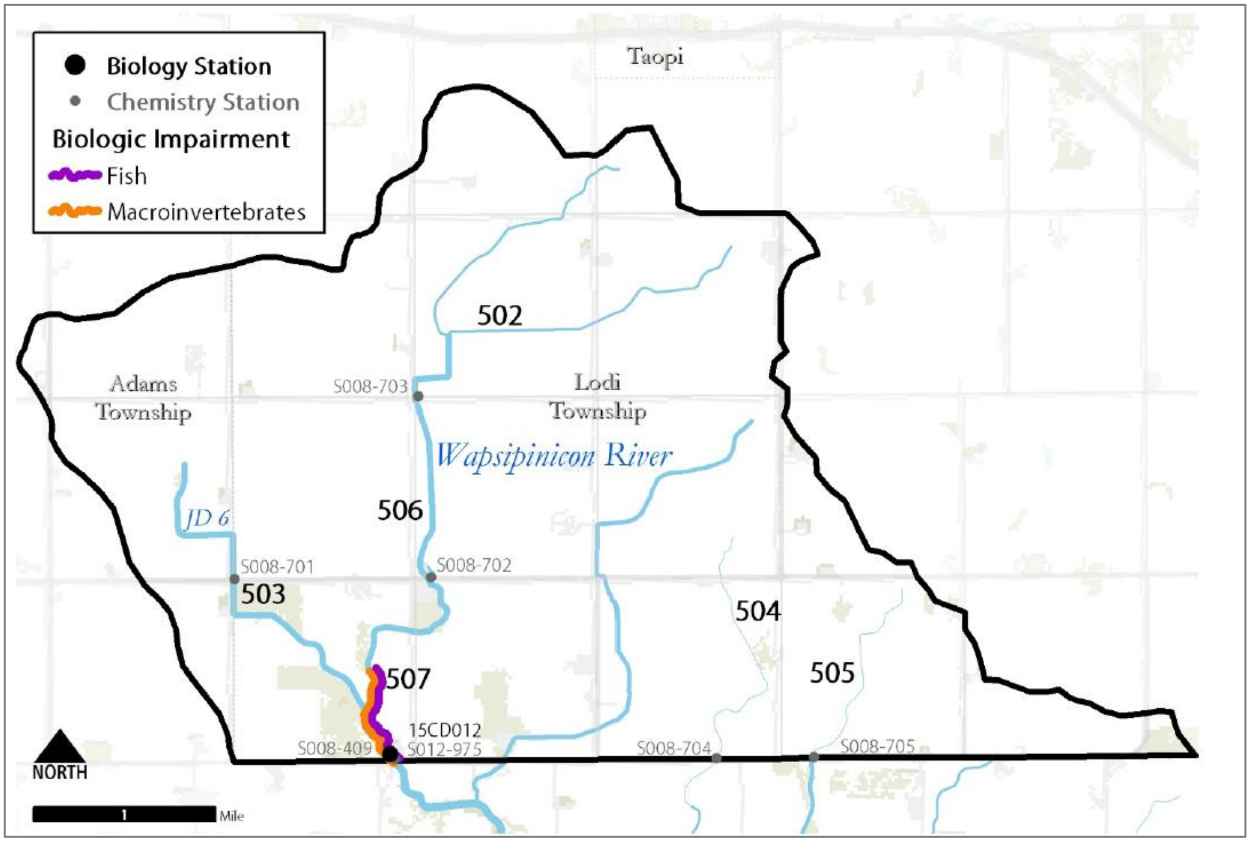


**Figure 7. Impaired waters in the Upper Wapsipinicon River Watershed.**
***AUIDs -503 and-506 did not have enough data to perform an assessment.***

The IADNR monitors and assesses the Iowa portion of the Upper Wapsipinicon River. Downstream of the Minnesota/Iowa border, Section “01-WPS-354” of the Upper Wapsipinicon River is considered impaired for *E. coli* and Fish IBI (Figure 8). This section of river is also documented as having historic fish kills. “01-WPS-354” has been assigned multiple designated uses in Iowa for recreational use (A1 and A2) and colder water trout fishery (BCW1), as water temperatures allow for stocking of brook, brown and rainbow trout. The “SID for the Wapsipinicon River Mitchell County, Iowa,” (IADNR 2016) finds that stressors related to the *E.-coli* and fish impairments include excessive sedimentation, embedded rock substrates, decreased aquatic macro-habitat complexity, decreased DO and increased temperature. Increased concentration of ammonia was identified as a potential secondary stressor. A lack of evidence failed to support a conclusion that ammonia significantly degraded biological conditions of the Upper Wapsipinicon River studied by IADNR.

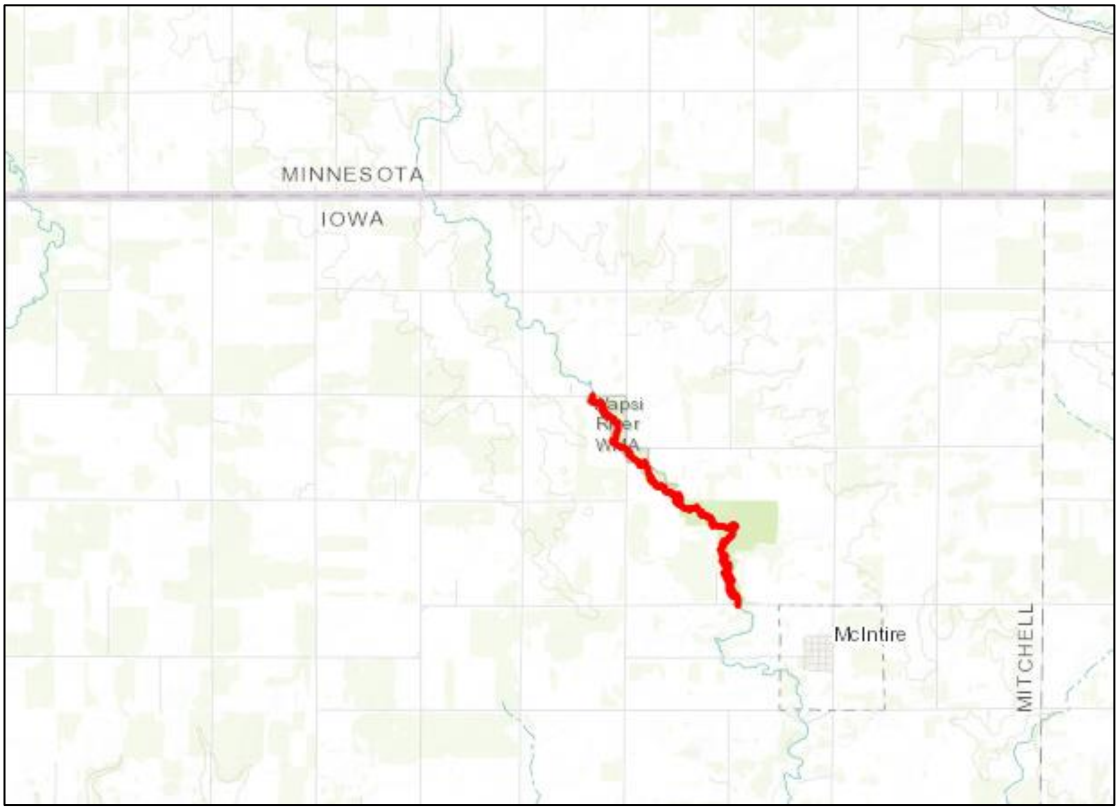

**Figure 8. Section "01-WPS-354" of the Upper Wapsipinicon River listed as impaired by IADNR.**

Iowa State Agencies, The UWRW Management Authority and Northeast Iowa Resource Conservation and Development, are currently developing a Comprehensive Watershed Plan for the Iowa portion of the UWRW. For additional information on the goals, strategies and objectives of Iowa's watershed plan for the Upper Wapsipinicon, refer to the Northeast Iowa Resource Conservation and Development.

### Mercury

As mentioned previously, no fish tissue samples were collected for mercury analysis. For more information on mercury impairments, see the statewide mercury TMDL at: http://www.pca.state.mn.us/index.php/water/water-types-and-programs/minnesotas-impaired-waters-and-tmdls/tmdl-projects/special-projects/statewide-mercury-tmdl-pollutant-reduction-plan.html.

## 2.3. Water quality trends

Because of the limited water quality data set of the UWRW, there is an insufficient amount of data available to establish water quality trends. Continued monitoring of this watershed will allow for the identification of water quality changes and trend establishment.

Neighboring watershed data were combined to examine changes in water withdrawal as reported to DNR via their water use permitting program. Groundwater withdrawal trends for the region show a significant increase ($p<0.01$) from 1996 to 2015 (MPCA 2018). More data from annual water use reports exclusively from the UWRW can be used to further establish this trend. Continued monitoring of water withdrawal will determine whether groundwater withdrawal may be significantly impacting aquatic habitat and hydrology.

The State of Iowa notes an increasing trend in heavy precipitation and flood events in several watersheds including in the UWRW. From 2011 to 2013, Iowa suffered 8 Presidential Disaster Declarations encompassing 73 counties and more than 70% of the state (IFC 2019). In 2016, the U.S. Department of Housing and Urban Development awarded $97 million to the State of Iowa for their project, "The Iowa Watershed Approach for Urban and Rural Resilience." A partnership known as the UWRW Management Authority was formed and is comprised of 30 cities, counties and SWCDs, working together to reduce flooding and improve water quality in the watershed.

## 2.4. GHOST Modeled Conditions

IFC/IIHR model "Generic Hydrologic Overland-Subsurface Toolkit (GHOST)" provided simulated flows for the UWRW in Minnesota. This information was used for both TMDL development and development of watershed strategies. Flow projections were obtained from IFC/IIHR since no flow data exist for the Minnesota portion of the watershed. Because addressing flood risks is a top local priority, IFC/IIHR is currently using the GHOST model to identify areas of the greater UWRW (including the Minnesota portion) with high surface runoff potential and quantify the impact of flood mitigation projects and consequences of heavy downpours. These simulated flows do not pinpoint areas of the UWRW that need certain practices, rather they offer insight into the impact this small watershed can make should practices be adopted. Discussion of these practices is included in Section 3.

## 2.5. Stressors and Sources

The MPCA has increased the use of biological monitoring and assessment as a means to determine and report the condition of the state's rivers and streams. This approach uses fish, aquatic macroinvertebrate communities and related habitat conditions throughout a major watershed. Using these data, an index of biological integrity (IBI) score is developed, providing a measure of overall community health. In cases of an aquatic life use impairment, stressors and pollutant sources impacting the aquatic community must be identified and evaluated. Stressors are determined by further examining streams that show low IBI values for fish and macroinvertebrates, with a focus on linking the biotic communities to probable stressors. For example, if an invertebrate community sampled in a given stream reach is composed primarily of nitrate-tolerant species and the stream shows high nitrate values in baseflow, a likely conclusion is that nitrate is a stressor to the invertebrate biota. The results of this examination are reported in a SID Repot.

> A **stressor** is something that adversely impacts or causes fish and macroinvertebrate communities in streams to become unhealthy.
>
> **Pollutant source** assessments are completed where a biological SID process identifies a pollutant as a stressor, as well as for typical pollutant impairment listings such as TSS. Pollutants to lakes and streams include point sources or nonpoint sources.

### 2.5.1. Stressors of biologically-impaired stream reaches

In the UWRW, the only AUID assessed is currently impaired for aquatic life and aquatic recreation (Table 4).

**Table 4. Biologically impaired AUID in the Upper Wapsipinicon River Watershed.**

| | | | Impairments | |
|---|---|---|---|---|
| **Stream Name** | **AUID #** | **Reach Description** | **Biological (Aquatic Life)** | **Water Quality (Aquatic Recreation)** |
| **Wapsipinicon River** | **507** | **-92.6732, 43.5073 to MN/IA border** | **Fish and Invertebrates** | **Bacteria** |

After examining many candidate causes for the biological impairment, probable stressors of aquatic life are: nitrate, habitat and flow alteration (Table 5).

**Table 5. Summary of stressor to aquatic life in the Upper Wapsipinicon River Watershed.**

| | | | | | Stressors | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Waterbody** | **AUID** | **Stations** | **Biological Impairment** | **Class** | **Temperature** | **Nitrate** | **Eutrophication** | **DO** | **TSS** | **Habitat** | **Fish Passage** | **Flow Alteration** |
| Wapsipinicon River | 507 | 15CD012 | Fish and Invertebrates | 2B | | • | ○ | ○ | ○ | • | ○ | • |

(• = stressor, ○ = inconclusive stressor, blank = not a stressor)

Nitrate is a pollutant-linked stressor, but the State of Minnesota does not have a nitrate standard for warmwater streams (such as AUID -507). Therefore, nitrate load reductions are not addressed in a TMDL, but rather are addressed through this WRAPS report as reduction goals and strategies. Non-pollutant stressors (habitat and flow alteration) are not subject to load quantification and also do not require TMDLs. Even though flow alteration and degraded habitat stressors are not addressed by the TMDL, they are still a priority for restoration. Refer to the MPCA's UWRW SID Report for a more detailed discussion of the impairments examined.

### 2.5.1.1. Habitat

The invertebrate community in the UWRW is impacted by a lack of aquatic habitat. Lack of habitat means there are reduced areas available for feeding, refuge and reproduction. Altered hydrology is likely contributing to the lack of habitat by introducing fine sediment and causing variable stream flows. It is noteworthy to mention that DNR conducted geomorphology work at station 15CD012 (AUID-507). This reach exists in the only un-altered portion of the UWRW watershed. NDNR classified this reach as an E5 stream type, meaning it has "very high sensitivity to disturbance, good recovery potential, moderate sediment supply, high streambank erosion potential, and are very reliant on riparian vegetation to retain stability," (DNR 2017a). AUID-507 was noted as having "quality riffle and pool habitat" and has a high likelihood to respond to restoration efforts. Although the DNR identified good channel stability, fine substrate and variable flows appear to be impacting the quality and availability of habitat in the Wapsipinicon River. Restoration efforts in the watershed should focus on the upper watershed channelized areas to reduce fine sediment from impacting the lower section. Efforts should also focus on maintaining the quality riffle and pool habitats present at Station 15CD012 as well as retaining the floodplain connectivity and riparian vegetation. Strategies to support these efforts are offered in Section 3.

### 2.5.1.2. Altered Hydrology

Both fish and invertebrate communities in the UWRW are impacted by altered hydrology. Hydrology is impacted by several factors including wetland drainage, agricultural drainage, ground water withdraw, precipitation, land use, dams and impervious land surface. Altered hydrology can create difficult living conditions for fish and bugs by affecting the quantity and quality of water. With highly altered hydrology in a watershed, streams experience higher peak and lower base flows, impacting the amount and quality of available aquatic habitat.

Stream flow variation is the result of other hydrologic alterations, including increases in precipitation and decreases in evapotranspiration (ET), as well as residence time on the landscape. Decreases in ET and residence time are linked to loss of wetlands, changes in vegetative cover (prairie to row crop), agricultural drainage, and increased impervious surfaces. A study of southern Minnesota watersheds (Schottler et al. 2013) found human-caused changes, including agricultural drainage and crop changes, as the primary cause of increased flows. This study also estimated that in agriculturally-dominated watersheds, such as the UWRW, more than 50% of the increase in flow between the mid and late 20$^{th}$ century was caused by changes in agricultural drainage (Figure 9).

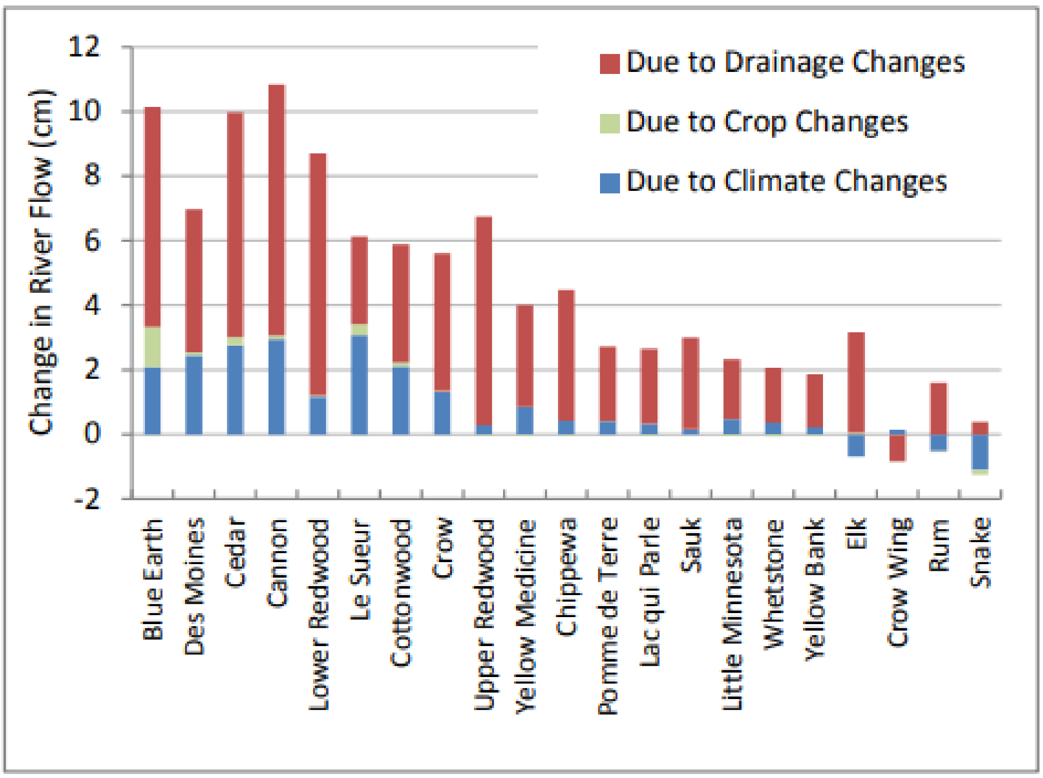


**Figure 9. Causes of changes in river flow. Schottler et al 2013.**

Figure 10 depicts an estimate of the density of field drain tile in the UWRW according to the 2009 U.S. Department of Agriculture (USDA) crop data layer, United States Geological Survey (USGS) National Elevation Dataset, and Soil Survey Geographic Database (SSURGO) soil drainage class. Combining these data layers, it is estimated that roughly 38% of the watershed is tiled. It should be noted that watershed boundaries are not a cut-off for drain tiles, meaning that drain tiles outside of the UWRW could be connected to tile lines inside the watershed and vice-versa. Understanding the agricultural drainage network within the watershed is key to properly managing altered hydrology.

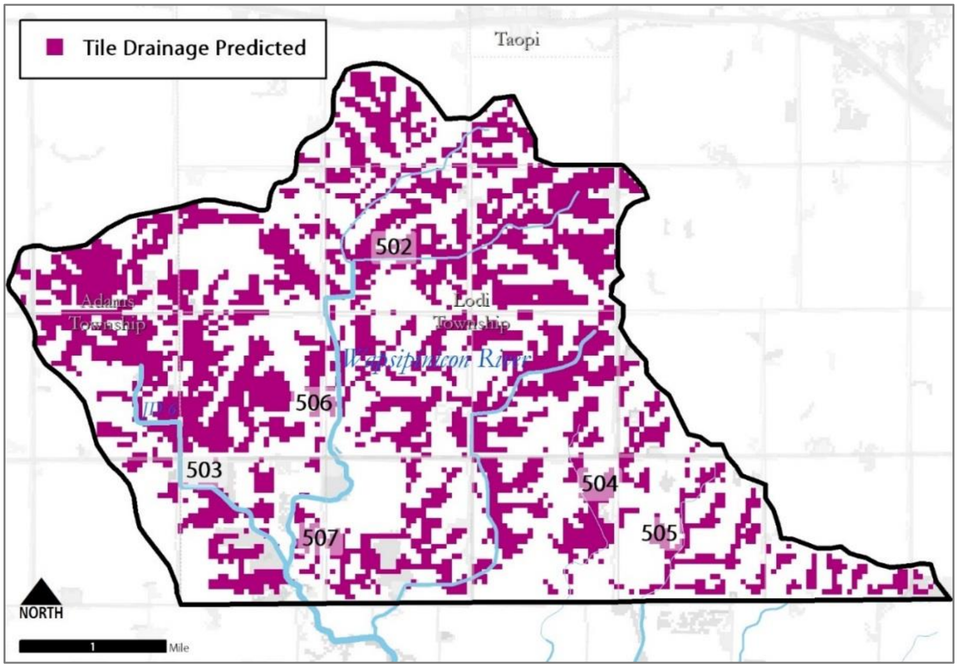


**Figure 10. Estimated density of agricultural drainage in the Upper Wapsipinicon River Watershed.**

Inadequate flow (low base flow) is also a consequence of altered hydrology and is impacting aquatic habitat availability. These low base flows could be linked to low DO levels but at this time that conclusion is not sufficiently supported by available data. Low base flows are linked to soils being too dry and water tables being too low; consequences of excess water drainage from the landscape. These sources are unable to provide water to streams during dry times of the year when base flow is the only source of inflow. As noted in Section 2.3, a notable trend in the UWRW is the increase of groundwater withdrawals. Further study of whether inadequate flow is a consequence of this activity would be prudent.

## 2.5.2. Pollutant Source Identification

Because the UWRW is entirely rural, non-point pollution sources are the most likely pollutant contributors. No NPDES-permitted point sources with waste load allocations, such as wastewater treatment plants or Municipal Separate Storm Sewer Systems (MS4s), exist in the watershed. Non-point pollution sources come from many diffuse sources are introduced into waters by precipitation or snowmelt. The non-point pollutants of highest concern in the UWRW are nitrogen/nitrate and bacteria (*E. coli*).

### 2.5.2.1. Nitrogen

The State of Minnesota has diligently studied nitrogen and its impact to the environment.

Minnesota's Nutrient Reduction Strategy (NRS), as called for in the 2008 Gulf of Mexico Hypoxia Action Plan, was completed in 2014. Minnesota contributes the sixth highest nitrogen load to the Gulf and is 1 of 12 member states serving on the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. The scientific foundation of information for the nitrogen component of the NRS is represented in the 2013 report, "Nitrogen in Minnesota Surface Waters" (The Nitrogen Study). This document is useful as the MPCA and other state and federal organizations further their nitrogen-related work, and also as local governments consider how high nitrogen levels might be reduced in their watersheds. Minnesota's statewide nitrogen reduction goals are 20% by 2025 and 45% by 2040. Modeling conducted for the NRS estimated that the UWRW has a current nitrogen load of 80.4 MT/yr. and a reduction goal of 16.1 MT/yr.

The Nitrogen Study and the NRS state that cropland nitrogen losses through agricultural tile drainage and agricultural groundwater (leaching loss from cropland to local groundwater) make up the majority of nitrogen sources in Minnesota (Figure 11). These conclusions are critical when considering appropriate tools and strategies for managing nitrogen.

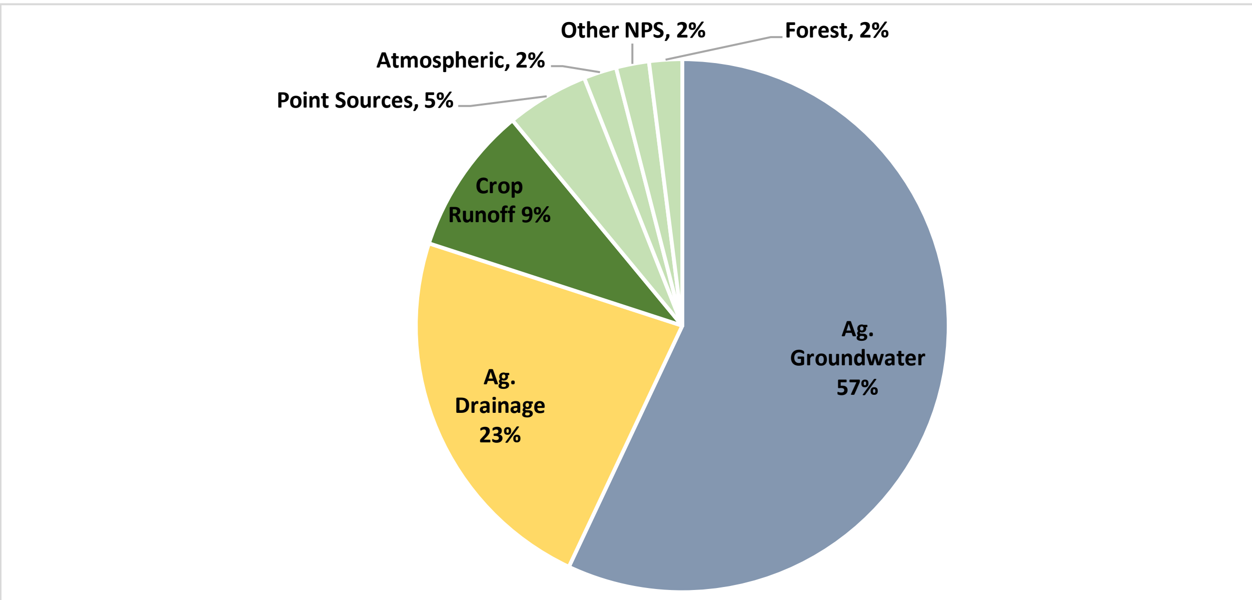


**Figure 11. Estimated nitrogen sources to surface waters from the Minnesota contributing areas of the Lower Mississippi River Basin (avg. precipitation year); MPCA 2013.**

Nitrogen exists in the environment and water in numerous forms, including ammonia, nitrite and nitrate. Organic nitrogen exists naturally in the environment as soil organic matter and/or decaying plant residue. The nitrogen cycle is the process in which nitrogen changes from one form to another; allowing particular forms of nitrogen to move easier within the environment. Nitrate is the form of nitrogen of most concern in water. Nitrates pose risks to humans in drinking water such as the risk of methemoglobinemia (i.e., “blue baby syndrome”) in infants and susceptible adults, are toxic to aquatic life in large quantity, and have contributed to low oxygen, or hypoxic conditions, in coastal areas such as the Gulf of Mexico. Transformations among the different forms of nitrogen occur constantly in the water cycle. Because of this constant cycle, nitrogen it is often considered in totality as “total nitrogen” (TN).

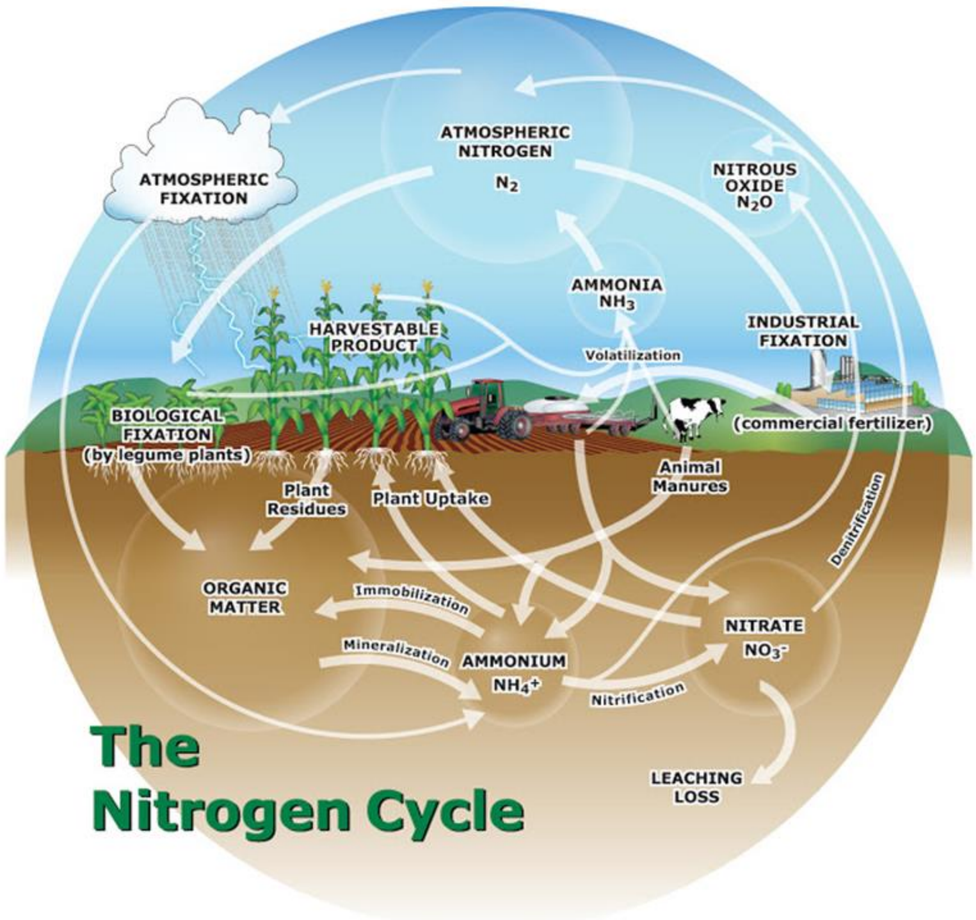


**Figure 12. The nitrogen cycle; Cates 2019.**

### Nitrogen Sources in the Upper Wapsipinicon River Watershed

The dominant land use in the UWRW is agriculture. Within the boundaries of the 13 square mile watershed, 93% of the watershed is under cultivation; dominated by corn and soybeans (Figure 13).

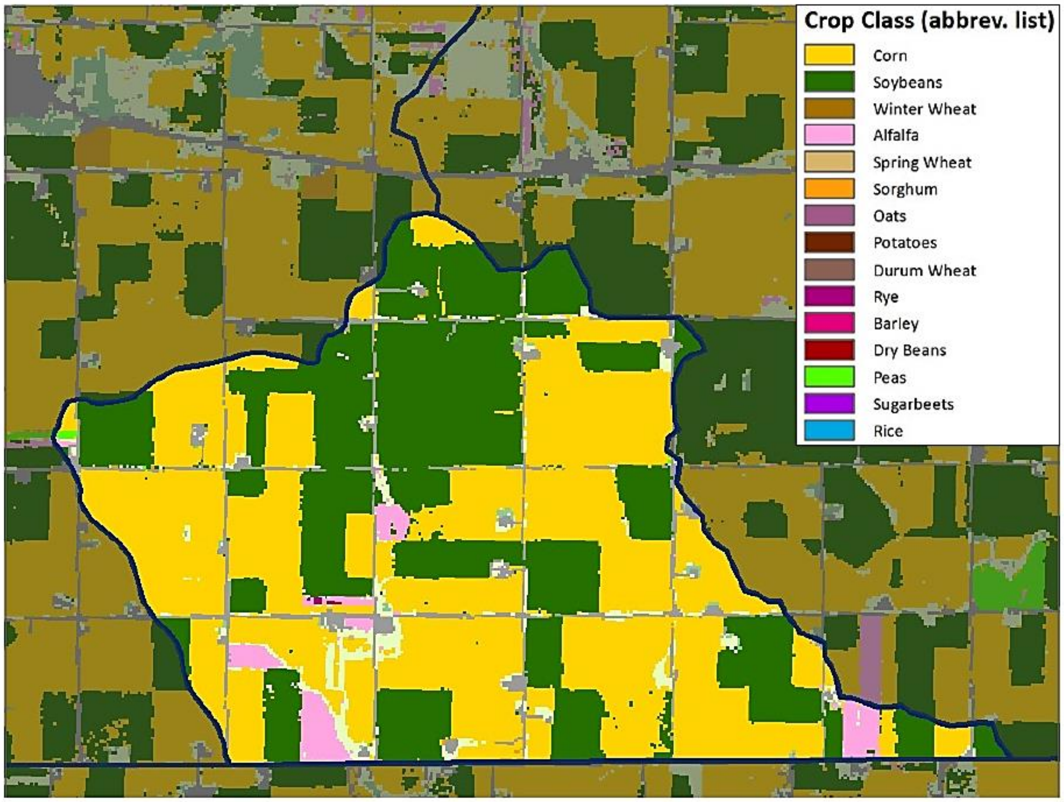


**Figure 13. USDA 2016 Crop Data Layer for Upper Wapsipinicon River Watershed.**

Nitrogen from cropland groundwater, drainage and runoff comes from a variety of sources (Figure 14). Assessing nitrogen sources statewide, the MPCA (2013) determined that commercial fertilizer represents the largest source of nitrogen (N) that is added to soil. Manure, legumes, and atmospheric deposition are also significant sources, and when added together provide similar N amounts as the fertilizer additions. Soil organic matter mineralization is not a nitrogen source in itself, but rather a process that mobilizes large quantities of N from the soil bank. While mineralization is an ongoing natural phenomenon, the increase in tile drainage has resulted in an increase transport of this N to surface waters. Septic systems, lawn fertilizers and municipal biosolids add comparatively small amounts of N to soils statewide (less than 1% of added N).

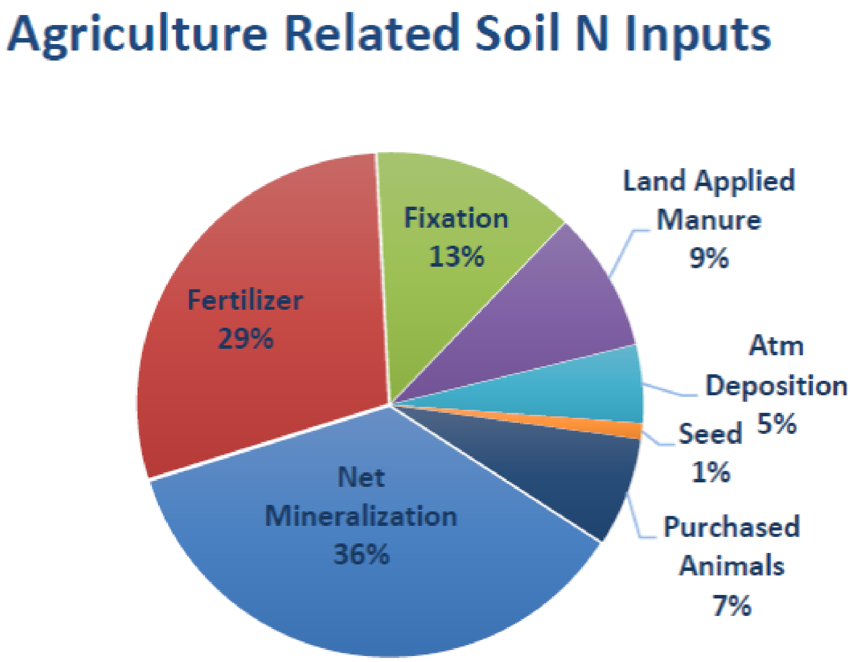


**Figure 14. Nitrogen inputs to agricultural soils (state-wide); MPCA 2019.**

The State of Minnesota regulates animal manure by using land application rate recommendations and location restrictions though Minn. R. ch. 7020. Commercial nitrogen fertilizer has recently been regulated in Minnesota through the Department of Agriculture's Groundwater Protection Rule. The Rule contains two parts aiming to promote nitrogen fertilizer BMPs to reduce nitrate in groundwater. Part 1 focuses on restrictions of fall applied nitrogen fertilizer in vulnerable groundwater areas or Drinking Water Supply Management Areas (DWSMAs) with high nitrate levels. Part 2 responds to DWSMAs with elevated nitrate levels by incorporating voluntary and regulatory actions based on nitrate concentrations of groundwater and the use of BMPs. The UWRW does not contain vulnerable groundwater areas or DWSMAs and, therefore, MDA's requirements for commercial nitrogen fertilizer do not apply in this watershed. For more information about the Groundwater Protection Rule, refer to MDA's Pesticide and Fertilizer program.

As previously noted, there is significant amount of agricultural tile which provides a pathway for the N to reach streams. In the greater Cedar River Basin (which the UWRW is a part of) 51% of the nitrate reaches surface waters through cropland tile drainage.

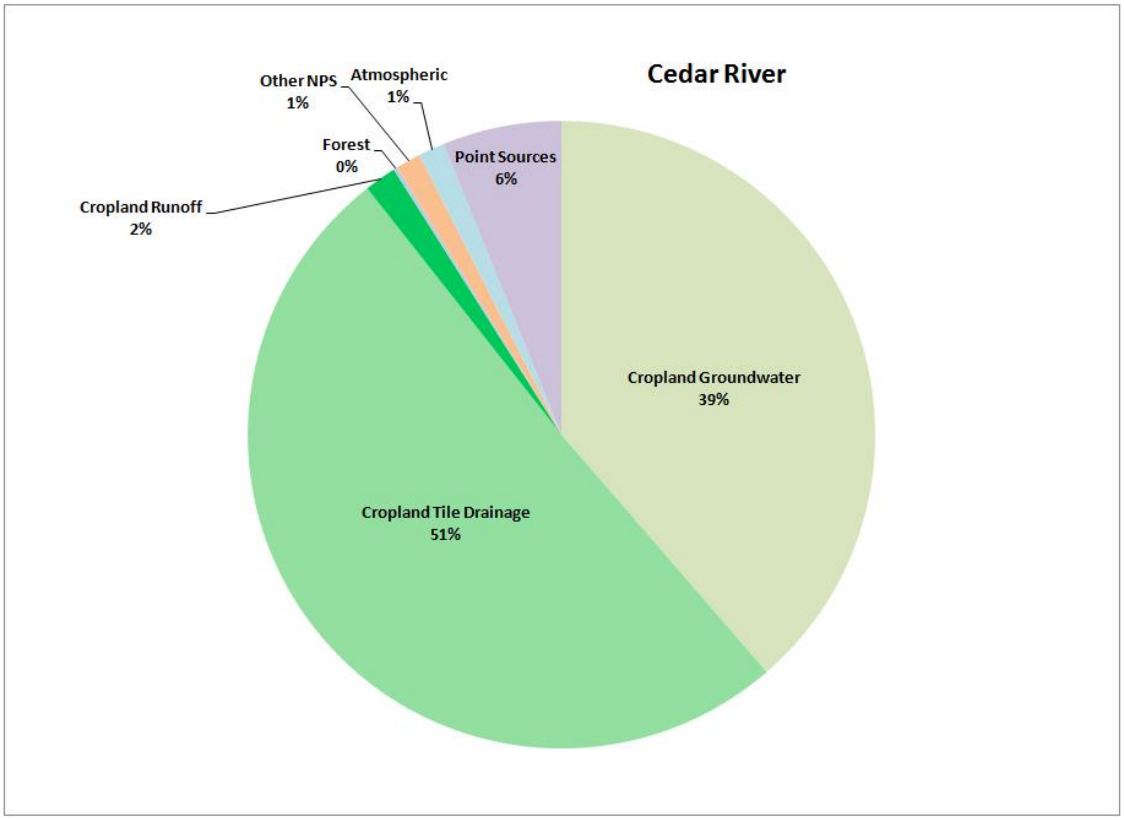


**Figure 15. Nitrogen sources in the Cedar River Basin; MPCA 2019.**

The monitoring station on AUID 07080201-507 (S008-409) was sampled for N concentrations during 2015 and 2016 IWM using a Nitra-tax sonde. Ninety-three percent of sample events had N-concentrations over the drinking water standard (10 mg/L). Figure 16 shows the fluctuation of nitrate concentration in the Upper Wapsipinicon River throughout 2015 and 2016 growing seasons. This fluctuation is the result of seasonal nitrogen applications, plant (crop) N uptake and natural N volatilization. Corn uses only 10% of its total N need prior to the V5 growth stage (early June) and peaks in N uptake at R2 growth stage (mid-July) (Abendroth et al. 2011). Nitrate concentrations rebounding following harvest and climbing until peak corn N uptake may imply that nitrogen inputs have a likelihood of impacting the water quality in UWRW.

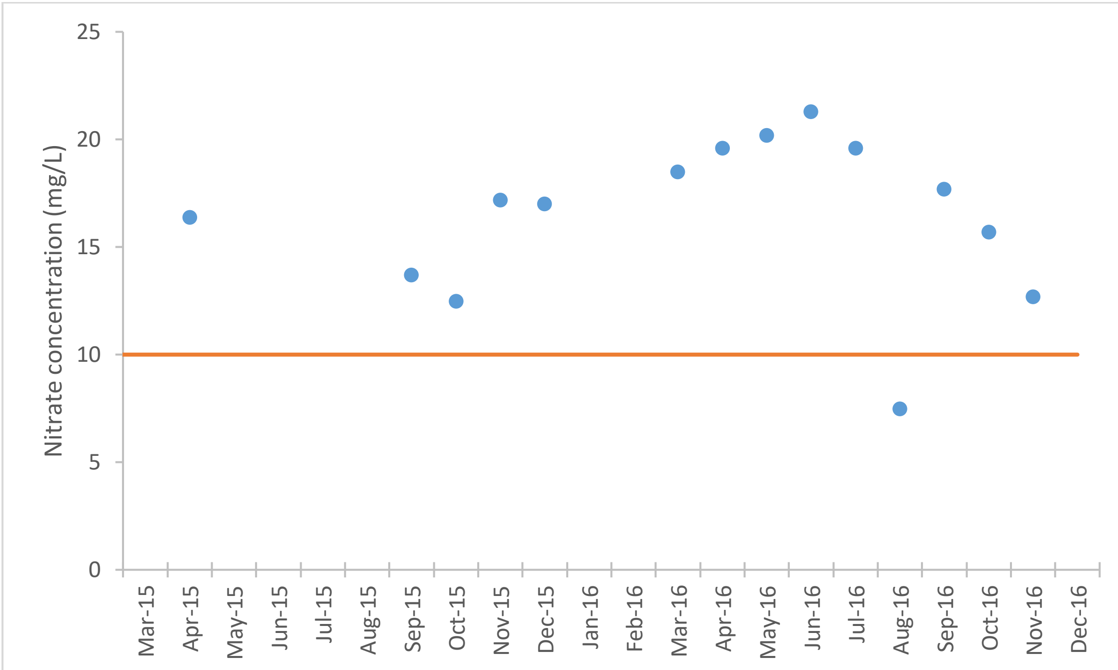


**Figure 16. Nitrate concentrations for UWRW monitoring station S008-409, 2015 - 2016.**

Field and plot-scale work by the University of Minnesota (UMN) has sampled subsurface tile water to determine nitrate-nitrogen loading rates for various cropping systems. Over the four years spent monitoring, a continuous corn rotation showed the highest N-loading rate while perennial cover (CRP) showed the lowest; approximately 50 times lower when compared to continuous corn (Figure 17).

Effect of CROPPING SYSTEM on drainage volume, $NO_3$-N concentration, and N loss in subsurface tile drainage during a 4-yr period (1990-93) in MN.

| Cropping System | Total discharge | Nitrate-N Conc. | Nitrate-N Loss |
|---|---|---|---|
| | Inches | ppm | lb/A |
| Continuous corn | 30.4 | 28 | 194 |
| Corn – soybean | 35.5 | 23 | 182 |
| Soybean – corn | 35.4 | 22 | 180 |
| Alfalfa | 16.4 | 1.6 | 6 |
| CRP | 25.2 | 0.7 | 4 |

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**Figure 17. Effect of cropping system on nitrogen loss (UMN).**

Another important consideration when discussing nitrogen is how it moves in the watershed. As discussed in Section 1, the UWRW has a substantial amount of acreage drained by subsurface tiling. While drain tile has multiple benefits for crop production, it creates a conduit for nitrogen to enter surface waters. This is especially important when tiled fields are also under a cropping system conducive to increased risk of N-leaching. Nitrogen application, timing, rate and field drainage design are important tools in reducing nitrogen introduction to surface waters.

Nitrogen comes from many sources within the UWRW, but all likely sources are non-point in nature. Row cropped acres that dominate the watershed landscape are the most likely significant contributor of nitrogen to surface waters. Identifying critical areas and strategies in an effort to address nitrogen are contained in Section 3 of this report.

### 2.5.2.2. Bacteria: Fecal coliform/*E. coli*

Fecal coliform and *E. coli* are two bacterial indicator parameters used to determine the presence of disease-producing organisms (pathogens). Fecal coliform comes exclusively from the intestinal tracts of mammals. *E. coli* is a sub-group of fecal coliform and is almost always present with fecal coliform. Currently, the State of Minnesota has two standards for *E. coli*: a monthly average standard (geomean) and a maximum concentration standard. The concentration of fecal coliform and *E. coli* have a complex relationship with land use and precipitation but can be linked to certain factors (Table 6).

**Table 6. Factors associated with bacterial presence (MPCA 2015).**

| **Strong** relationship to fecal bacterial contamination in water | **Weak** relationship to fecal bacterial contamination in water |
|---|---|
| • High storm flow (the single most important factor in multiple studies)<br>• % rural or agricultural areas greater than % forested areas in the landscape (entire watershed area)<br>• % urban areas greater than % forested riparian areas in the landscape<br>• High water temperature<br>• Higher % impervious surfaces<br>• Livestock present<br>• Suspended solids | • High nutrients<br>• Loss of riparian wetlands<br>• Shallow depth (bacteria decrease with depth)<br>• Amount of sunlight (increased UV-A deactivates bacteria)<br>• Sediment type (higher organic matter, clay content and moisture; finer-grained)<br>• Soil characteristics (higher temperature, nutrients, organic matter content, humidity, moisture and biota; lower pH)<br>• Stream ditching (present or when increased)<br>• Epilithic periphyton (plants and microbes that grow on stones in a stream) present<br>• Presence of waterfowl or other wildlife<br>• Conductivity |

The following text, which provides an overview of nonpoint sources of fecal coliform and *E. coli* bacteria and associated pathogens, is excerpted and adapted with new information from the Revised Regional TMDL Evaluation of Fecal Coliform Bacteria Impairments in the Lower Mississippi River Basin in Minnesota (MPCA 2006). At the time the 2006 MPCA study was conducted, Minnesota's water quality standard was based on fecal coliform as indicators of fecal pathogens; the standard has since changed and is now based on *E. coli* counts.

> *The relationship between land use and fecal coliform concentrations found in streams is complex, involving both pollutant transport and rate of survival in different types of aquatic environments. Intensive sampling at numerous sites in southeastern Minnesota shows strong positive correlations among stream flow, precipitation, and fecal coliform bacteria concentrations. In the Vermillion River watershed, storm-event samples often showed concentrations in the thousands of organisms per 100*

*mL, far above non-storm-event samples. A study of the Straight River watershed divided sources into continuous (failing subsurface sewage treatment systems, unsewered communities, industrial and institutional sources, wastewater treatment facilities) and weather-driven (feedlot runoff, manured fields, urban stormwater) categories. The study hypothesized that when precipitation and stream flows are high, the influence of continuous sources is overshadowed by weather-driven sources, which generate extremely high fecal coliform concentrations. However, the study indicated that during drought, continuous sources can generate high concentrations of fecal coliform. Besides precipitation and flow, factors such as temperature, livestock management practices, wildlife activity, fecal deposit storage, and channel and bank storage also affect fecal bacterial concentrations in runoff (Baxter-Potter and Gilliland 1988).*

Fine sediment particles in the streambed can serve as a substrate harboring fecal coliform bacteria. "Extended survival of fecal bacteria in sediment can obscure the source and extent of fecal contamination in agricultural settings" (Howell et al. 1996). Sadowsky et al. (2010) studied reproduction and survival of *E. coli* in ditch sediments and water in the Seven Mile Creek Watershed; their work concluded that while cattle are likely major contributors to fecal pollution in the sediments of Seven Mile Creek, it is also likely that some *E. coli* strains reproduce in the sediments and thus some sites probably contain a mixture of newly acquired and resident strains.

A study by Chandrasekaran (2011) found a correlation between precipitation/stream flow and sources likely causing elevated *E. coli* concentrations. In times of heavy precipitation and high flows, *E. coli* transport via land surface runoff has a higher probability of explaining increased *E. coli* concentrations in surface water. In times of drought/low flow, chronic *E. coli* sources (e.g. leaking septic systems) have a higher probability of contributing to elevated *E. coli* concentrations. *E. coli* levels in the UWRW were extremely elevated in June, July, and August during the monitoring seasons of 2015 and 2016 (Figure 18). Although there is only projected stream flow data available for the UWRW, by applying the principles above, there is a strong likelihood elevated *E. coli* concentrations are related to land surface runoff. Adding stream flow monitoring would allow conclusions to be made regarding *E. coli* concentrations and stream baseflow; providing additional support in identifying *E. coli* sources.

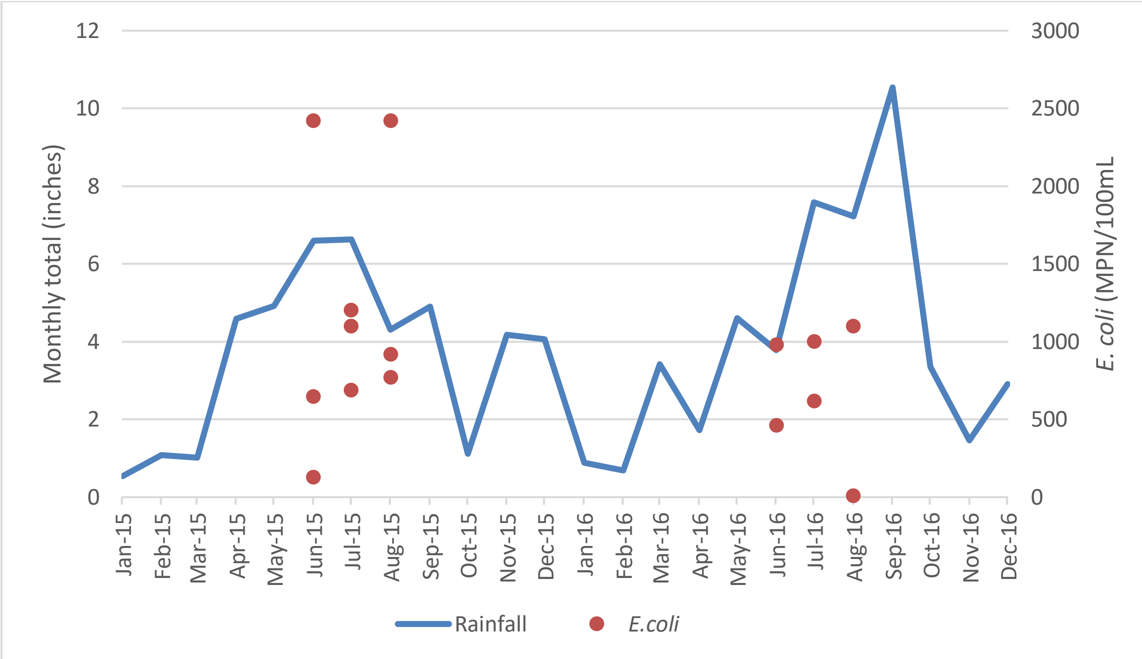



**Figure 18. Monthly precipitation totals and *E. coli* concentrations in the Upper Wapsipinicon River Watershed.**

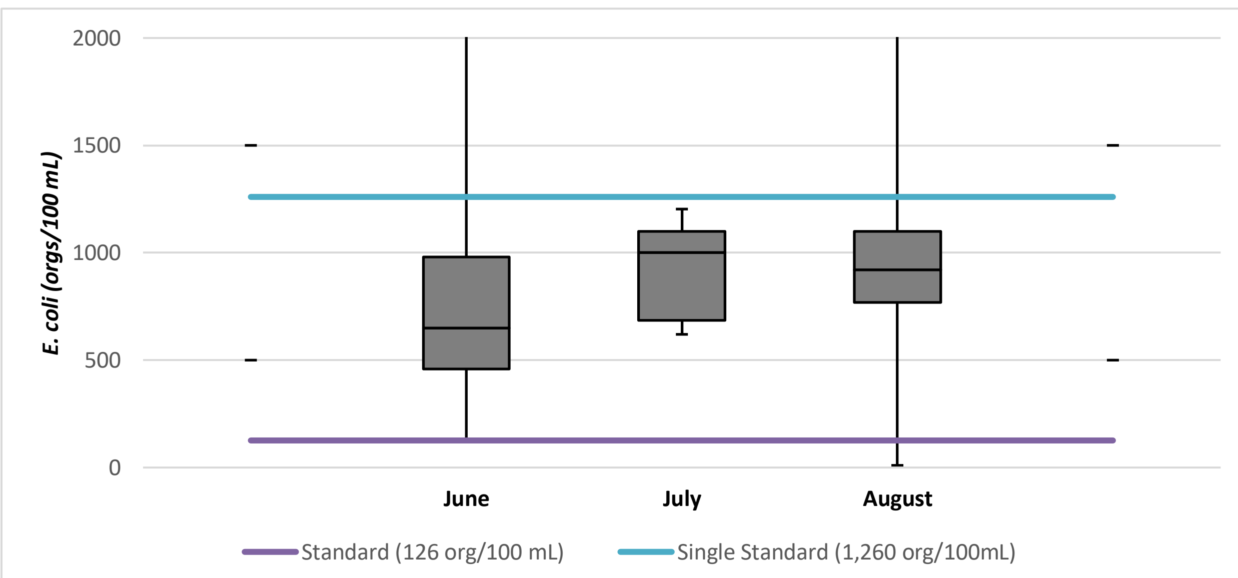



**Figure 19. *E. coli* concentrations sampled in the UWRW.**

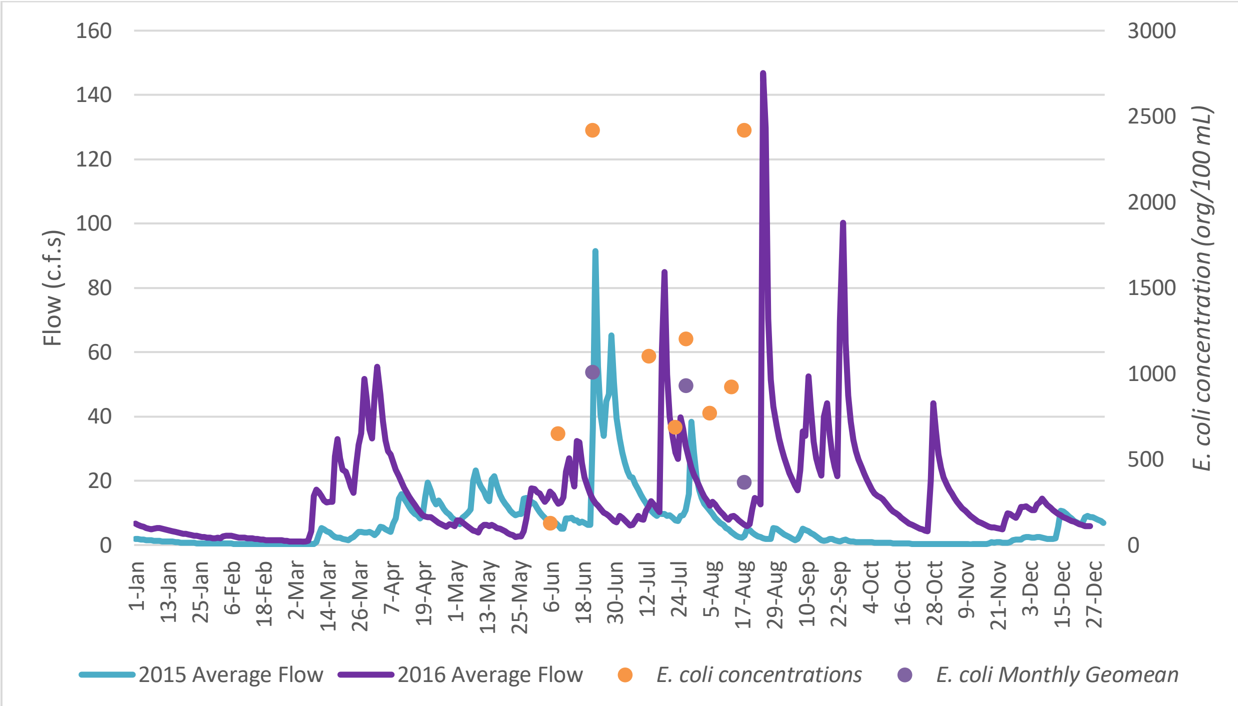



**Figure 20. *E. coli* concentrations and monthly geomean in relation to projected flows of the Upper Wapsipinicon River. *Projected flows provided by IFC.**

Despite the complexity of the relationship between sources and in-stream concentrations of fecal coliform, the following can be considered major source categories in the UWRW.

### Individual Septic Treatment Systems

Nonconforming septic systems are an influential source of fecal coliform bacteria, particularly during periods of low precipitation and runoff when this continuous source may dominate bacteria loads. Unsewered or under-sewered communities include older individual systems that are generally failing, and/or collection systems that discharge directly to surface water. This may result in locally high concentrations of wastewater contaminants in surface water, including fecal coliform bacteria, in locations close to population centers where risk of exposure is relatively high. Mower County is responsible for administering the septic program within this watershed to ensure compliance of existing septic systems as well as proper design and installation of new septic systems.

The UWRW includes an estimated 26 locations where septic systems are likely present. Of these 26; Mower County has issued a Certificate of Compliance for eight systems. This means that eight systems have been confirmed as meeting Individual Septic Treatment System (ISTS) requirements and 18 remain with an unknown compliance status. Based on a recent review of another watershed and statistics, Mower County expects at least 50% of the remaining 18 may not pass a compliance inspection if one was completed.

### Feedlot Facilities and Manure Application

Animal feeding operations (AFOs) can also contribute *E. coli* to surface waters through runoff leaving facilities. AFOs vary in management styles depending on the types of animals housed. Outside, unroofed areas (open lots) are typically used for dairy and beef operations while total confinement is traditionally used on swine and poultry facilities. Because open lot facilities are exposed to rain events and snow melt, they have an increased risk of discharging *E. coli*-contaminated runoff. All animal feedlots are subject to State feedlot rules, which include provisions for registration, manure management, facility inspection, permitting, and discharge standards. Much of this work is accomplished through a delegation of authority from MPCA to LGUs. On-site feedlot inspections are conducted by compliance staff to verify open lot discharge compliance. Open lot facilities located in shoreland and/or floodplain are considered highest risk areas for bacterial runoff.

Twenty registered and active animal feedlots (Figure 21) exist in the watershed; nine swine facilities, seven beef and four dairy. One of the 20 feedlots is a CAFO operating under a NPDES Feedlot General Permit. Two feedlot facilities are located within shoreland areas of the UWRW; one dairy facility, the other swine. Of the 20 feedlots in the watershed, half are documented as having open lots. During the revision of Minn. R. ch. 7020 in 2000, MPCA administered a program called the Open Lot Agreement, offering feedlot operators enforcement exemptions if open lot improvements were made within a specific time frame. No feedlots in the UWRW have been enrolled in this program.

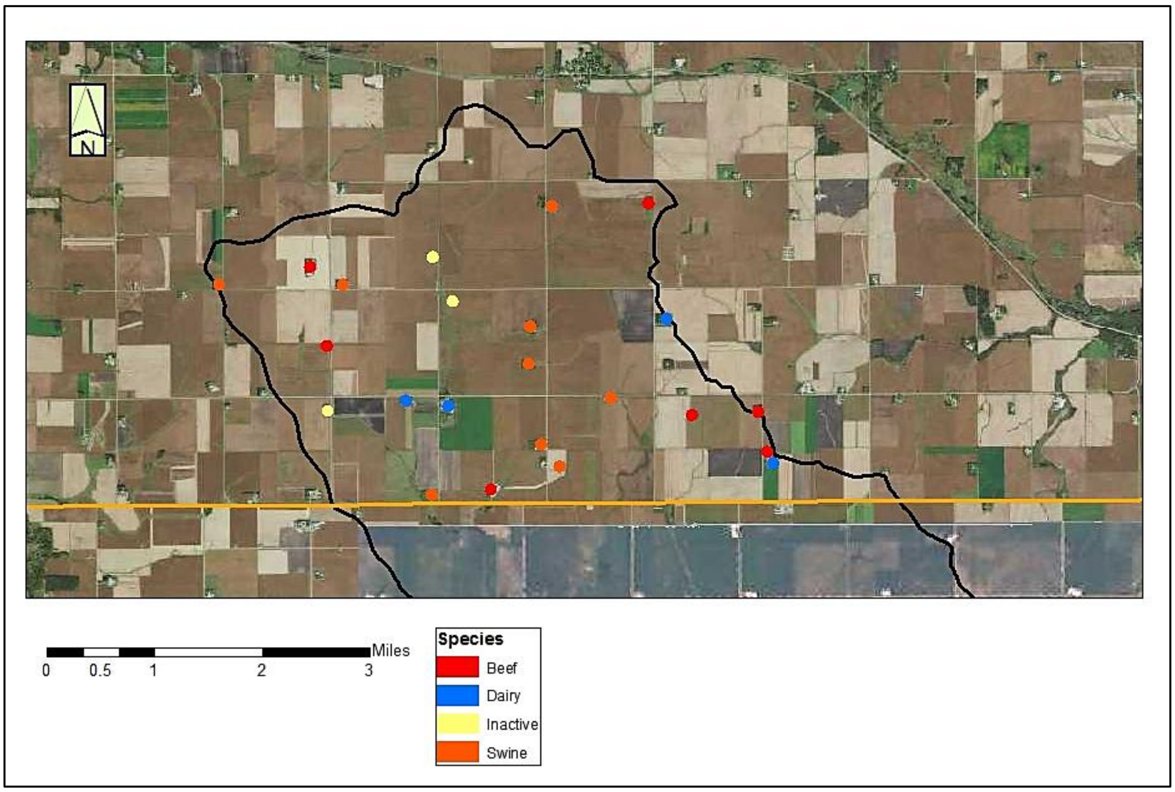



**Figure 21. Registered animal feedlots and primary species within the Upper Wapsipinicon River Watershed.**

The NPDES-permitted facility is required to meet a "zero discharge to waters" standard including during land application of manure. Annual reports from NPDES-permitted feedlots are submitted to the MPCA documenting any facility changes, discharges and manure application records. It is important to point out that not all manure produced at these operations is required to be applied within the watershed. However, it is highly likely that the land application of manure occurs within a relatively close range of the facility where it originated. This highlights the importance of properly managing manure when land applying to reduce surface water contamination. Thirteen of the twenty (65%) active feedlots within the UWRW have been inspected in the last five years. Of those inspected required to maintain land application of manure records, 64% (7) were found to be compliant; 36% (4) were not meeting standards.

The land application of manure can also present an increased risk of *E. coli* runoff into surface and ground waters. Minn. R. ch. 7020 requires application setback distances, winter application restrictions and incorporation requirements for spreading manure in close proximity to sensitive features (Figure 22).

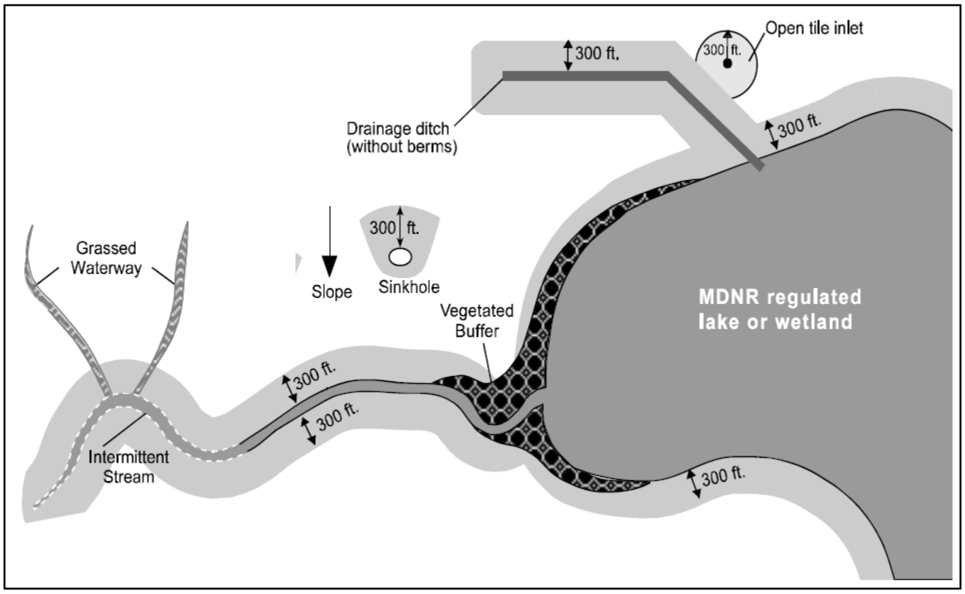



**Figure 22. Manure application setback distances around sensitive landscape features. MPCA 2011.**

Thirteen of the twenty (65%) active feedlots within the UWRW have been inspected in the past five years. Of those inspected, all facilities were found to be meeting facility discharge requirements. While a majority of these feedlots are also meeting land application of manure requirements, there are approximately seven facilities in non-compliance or not inspected. Non-compliant facilities are required to take corrective action to return to compliance.

#### 2.5.2.2. Phosphorus

While phosphorus has not been conclusively linked to an impairment in the UWRW, there are phosphorus reduction goals for all HUC-8 watersheds in order to meet the NRS. Modeled phosphorus loads leaving the UWRW is estimated at 2.8 MT/yr. In order to meet a 45% reduction by 2040, an annual reduction of 0.3 MT needs to occur. Examples of practices and levels of implementation to meet 12% reduction in phosphorus by 2025 is provided in Section 3.

## 2.6. TMDL summary

The UWRW TMDL report includes one TMDL for an *E. coli* impairment. This TMDL report is expected to be approved by EPA in 2020. Because there are no permitted point sources with an *E. coli* waste load allocation in the UWRW, sources of bacteria most likely come from non-point sources.

**Table 7. Upper Wapsipinicon River *E. coli* TMDL.**

- **303(d) listing year or proposed year: 2018**
- **Baseline year: 2012**

| **TMDL parameter** | | **Flow zones** | | | | |
|---|---|---|---|---|---|---|
| | | **Very high** | **High** | **Mid-range** | **Low** | **Very low*** |
| **Sources** | | ***E. coli* load (billion orgs/day)** | | | | |
| **Wasteload** | Construction/Industrial SW | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Total WLA** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Load** | **Total LA** | 266.21 | 70.91 | 14.50 | 3.433 | 0.00** |
| **MOS** | | 29.57 | 7.87 | 1.61 | 0.38 | 0.00** |
| **Total load** | | 295.78 | 78.78 | 16.11 | 3.81 | 0.00 |
| **Maximum Monthly Geomean (org/100 mL)** | | 891.6 | | | | |
| **Overall estimated percent reduction** | | 86% | | | | |

* Very low flow is equivalent to no flow.
** Load calculated as zero.

The load duration curve in Figure 23 confirms that *E. coli* loads exceed the allowable loads during high to mid-range flows. For more detailed information, reference the UWRW TMDL report on the Upper Wapsipinicon webpage.

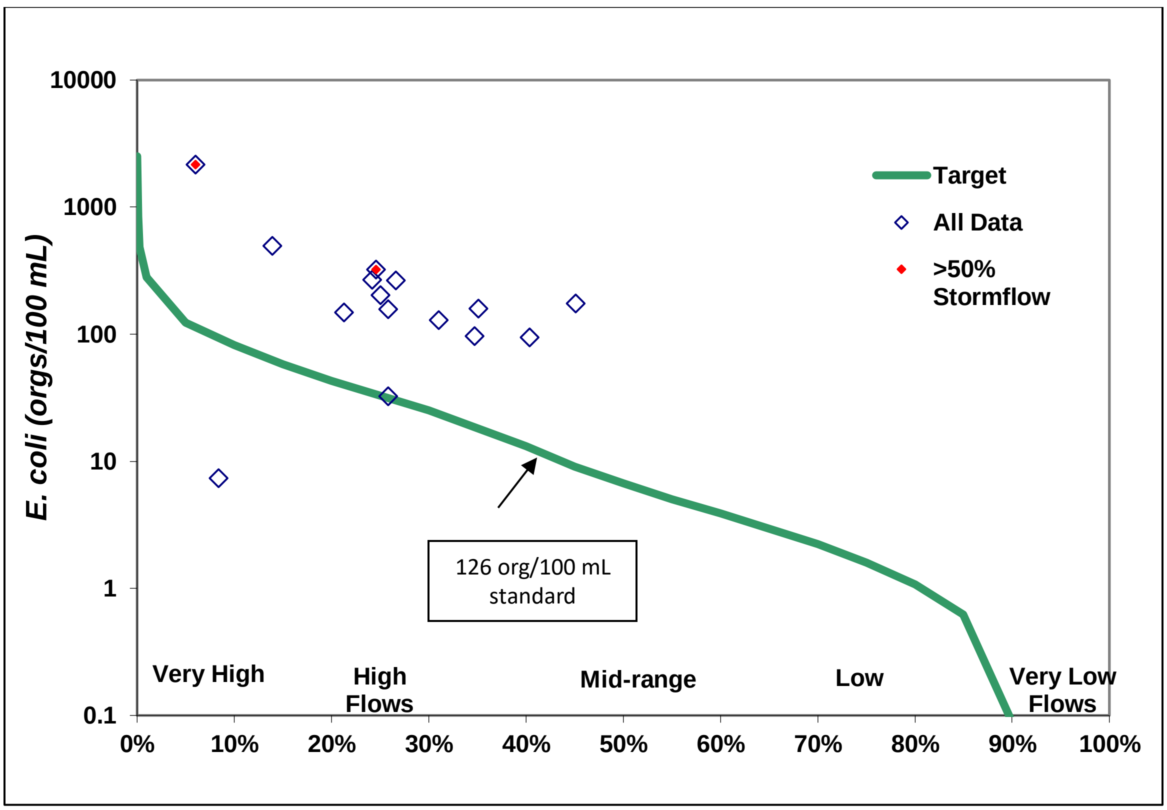



**Figure 23. *E. coli* load duration curve, Upper Wapsipinicon River (07080102-507).**

# 3. Prioritizing and implementing restoration and protection

The Clean Water Legacy Act (CWLA) requires that WRAPS reports summarize tools and information for use in targeting actions to protect and improve water quality. WRAPS can also include an implementation table of strategies and actions that are capable of cumulatively achieving needed pollution load reductions for point and nonpoint sources.

This section of the report includes tools and information that can be used in prioritization and strategy development. Because many of the nonpoint source strategies outlined in this section rely on voluntary implementation by landowners, land users, and residents of the watershed, it is imperative to create social capital (trust, networks and positive relationships) with those who will be needed to voluntarily implement best management practices.

The implementation strategies, including associated scales of adoption and timelines, provided in this section are the result of modelled projections and professional judgment based on what is known at this time and, thus, should be considered approximate. Furthermore, many strategies are predicated on needed funding being secured. As such, the proposed actions outlined are subject to adaptive management—an iterative approach of implementation, evaluation and course correction.

## 3.1 Targeting of geographic areas

**Scientifically-supported strategies:**

IFC/IIHF's GHOST model was used to identify areas with high runoff potential and run simulations to help understand impacts of flood mitigation and consequences of heavy rain events. The draft "Upper Wapsipinicon Watershed Hydrologic Assessment Report" (IFC/IIHR 2019), published in October 2019, contains useful information to reference for this watershed. Flow projections for the UWRW were used to identify high runoff potential areas (Figure 24). The Minnesota portion of the UWRW has a runoff coefficient of 35% to 36%, meaning that when rain falls, approximately 35% to 36% runs off of the landscape.

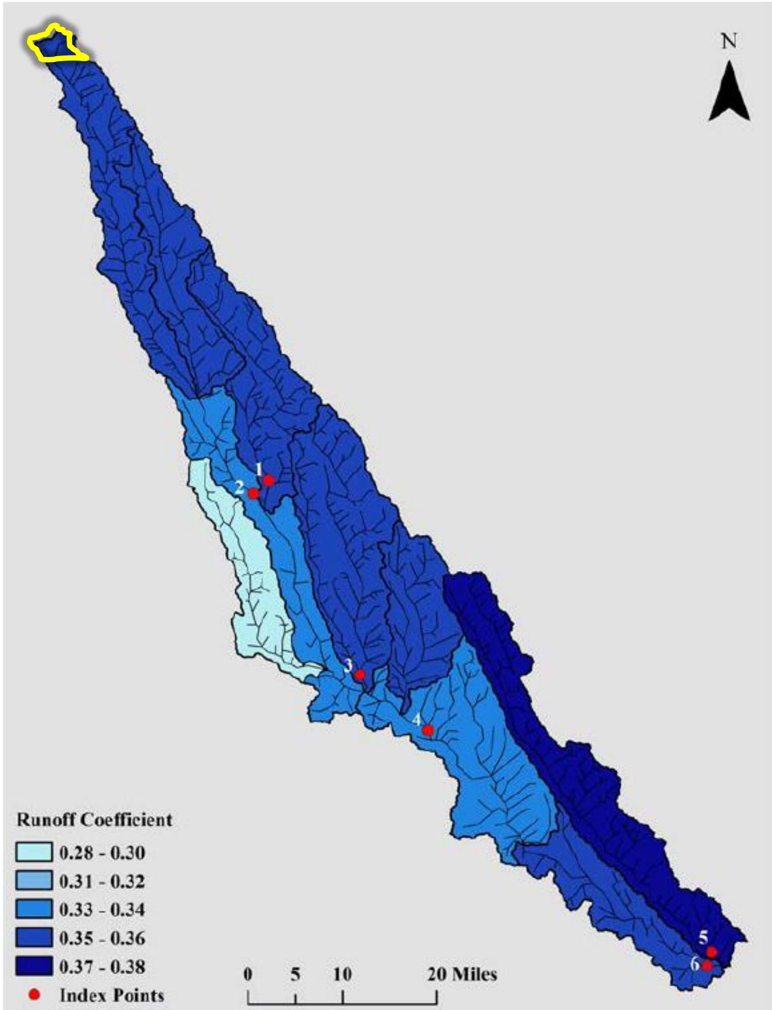



**Figure 24. Index points and runoff coefficient analysis for the Upper Wapsipinicon Watershed. IFC/IIHR 2019**
***MN portion of the UWRW outlined in yellow.**

Because UWRW is the headwaters of the larger Wapsipinicon Watershed, retaining as much water in the watershed as possible may result in diminished flood potential downstream. To illustrate this, IFC/IIHR modeled three different scenarios to predict what may happen should certain practices be used on the landscape: Scenario #1 Replacing all current row crop acres with native tall grass prairie; Scenario #2 Planting cover crops and using no till on all agricultural areas; and Scenario #3 Installing water and sediment control basins (WASCOBs) in select areas. It is not expected that implementation of practices will be done at the rate modelled (all agricultural areas), but conclusions drawn from the scenarios show the impact to flood reduction using these practices.

Model projections show the following potential for reducing annual peak flows:

| Scenario | Resulting annual peak flow |
| --- | --- |
| #1. Replacing all current row crop acres with native tall grass prairie | - (53%) |
| #2. Planting cover crops and using no till on all agricultural areas | - (22%) |
| #3. Installing WASCOBs in select areas. | - (5%) |

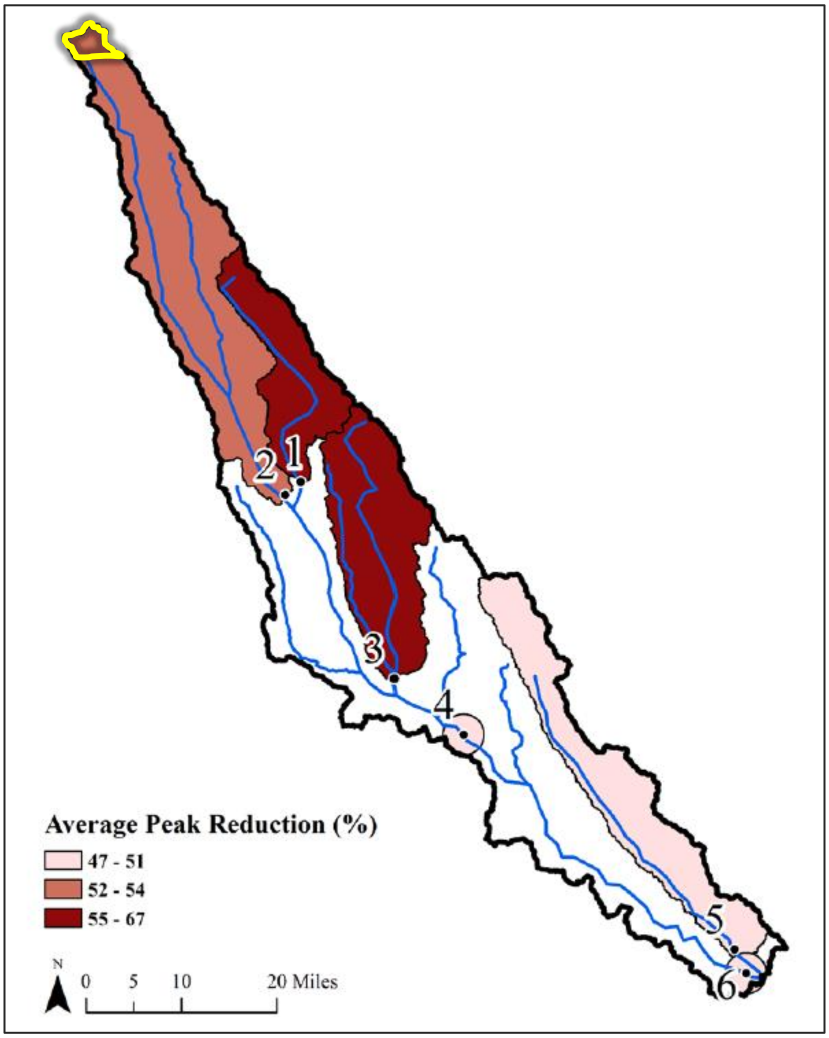



**Figure 25. Average peak discharge reduction (%) for the UWRW native vegetation scenario. IFC/IIHR 2019. *MN portion of the UWRW outlined in yellow.**

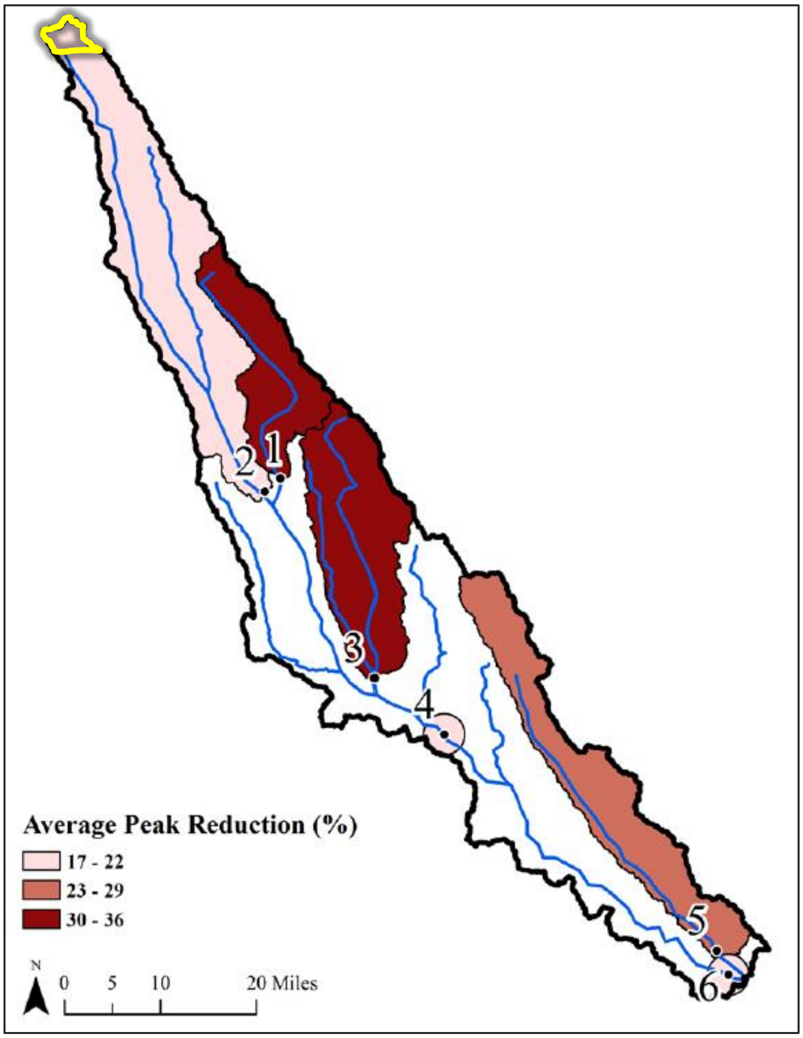



**Figure 26. Average peak discharge reduction (%) for the UWRW cover crop/no till scenario. IFC/IIHR 2019.**
***MN portion of the UWRW outlined in yellow.**

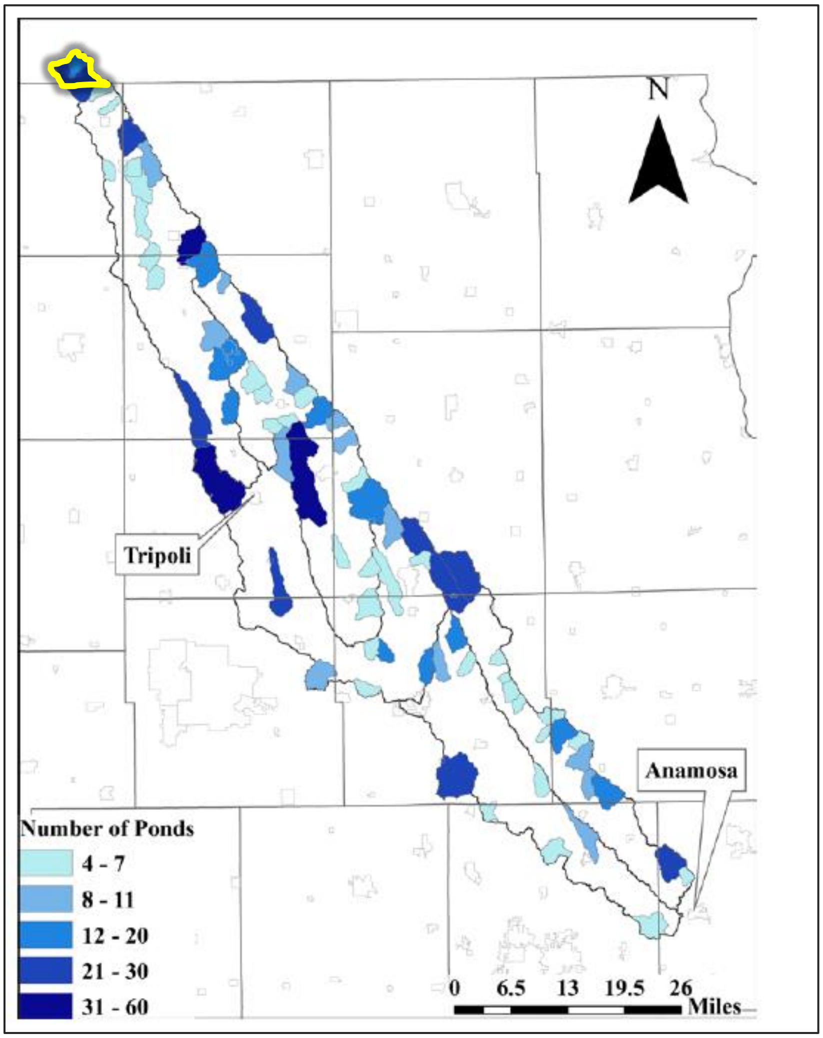



**Figure 27. WASCOB placement modelled for the UWRW. IFC/IIHR 2019.**
***MN portion of the UWRW outlined in yellow.**

The final scenario (WASCOBs) identified how many storage ponds could be installed in general areas of the UWRW and what their impact on peak runoff would be. It was estimated that 12 to 20 ponds could be installed in the northeastern portion of the UWRW and 21 to 30 ponds could be installed in the southwestern portion (Figure 27). This estimate is based off of a design that includes 12-inch pipe outlet, 10-foot emergency spillway and flood storage of 20 acres-feet. While there are clear benefits for installing WASCOBs, the GHOST model did not estimate a substantial reduction in peak runoff as compared to the other scenarios. Ponds should not be interpreted as ineffective BMPs, rather, that using them in combination with other practices may provide more measureable benefit.

**Local Partner-supported strategies:**

Different management scenarios for the UWRW were developed in consultation with Mower County SWCD staff. Scenarios discussed focused on managing nitrogen, bacteria, aquatic habitat (sediment) and altered hydrology. Table 8 lists potential scenarios that could be implemented in the UWRW.

**Table 8. Suitable practices to address water quality impairments in the UWRW.**

| | Impairment Addressed: | | | |
|---|---|---|---|---|
| Practice | Nitrate | Habitat | Altered Hydrology | *E. coli* |
| Corn acres receiving MRTN | X | | | |
| N – inhibitor | X | | | |
| Switching to Spring app of N (no Fall app) | X | | | |
| Switch to Spring app & sidedressing | X | | | |
| Wetland Restoration | X | X | X | |
| Tile line Bioreactors | X | X | X | |
| Controlled Drainage | | X | X | |
| 50 ft buffers (includes drainage ditches exempt of buffer law) | | X | | X |
| Rye cover crop on Corn/Soybean | X | X | X | |
| Rye cover crop on short season crop (Peas) | X | X | X | |
| Perennial crop on < 60% CPI | X | X | X | |
| Feedlot runoff reduction/treatment | | | | X |
| Feedlot manure storage/addition | X | | | X |
| Septic System improvements (101) | | | | X |
| Alternative tile intake/ Perforated riser pipe (171M) | | X | X | X |
| Side Inlet Tile Structure | | X | X | |
| Conservation tillage (>30% residue) | | X | X | |
| Road raises (flood reduction/water storage) | | X | X | |
| WASCOBs | | X | X | |
| Strip Till | | X | X | |
| Sediment Basins | | X | X | |
| Terrace (600) | | X | X | |
| Grassed waterways | | X | X | X |
| Filter strips | | X | X | X |

Additionally, strategies to achieve watershed nitrogen and phosphorus goals were discussed with local partners. Strategies most likely to be adopted in the watershed were given a higher implementation rate as described in the following Section 3.3.

### Priorities from Cedar 1W1P:

At the writing of this report, a comprehensive watershed plan containing the UWRW, known as the Cedar River 1W1P, was nearly complete. Top priorities for the 1W1P are addressing sedimentation and erosion, surface water quality degradation, excessive flooding and groundwater contamination. The plan allocates approximately $105,000.00 to fund 10 water quality projects in the UWRW over the span of 10 years. These projects aim to address surface water quality impairments and reduce flooding in the watershed. For more information, see the Mower County SWCD webpage for the Cedar 1W1P.

### Current Structural BMP Inventory

Practices are in place within the UWRW to protect soil stability and water quality. Mower County SWCD reports that 33.2 acres are currently enrolled in the CRP as grassed waterways and vegetative filter strips. Iowa State University has conducted aerial LiDAR analysis of the UWRW and recorded the presence of agricultural best management practices including: Terraces, WASCOBs, Grassed Waterways, Pond Dams, Contour Strip Cropping and Contour Buffer Strips. As of August 24, 2016, there were 19 grassed waterways reported for the watershed (Figure 28). Fifteen WASCOBs were reported within the UWRW. More information about this mapping project can be found on ISU’s GIS department’s webpage (https://www.gis.iastate.edu/). This information confirms the work completed to date and provides guidance regarding focus areas for new BMPs as well as potential BMP maintenance/cleanout needs.

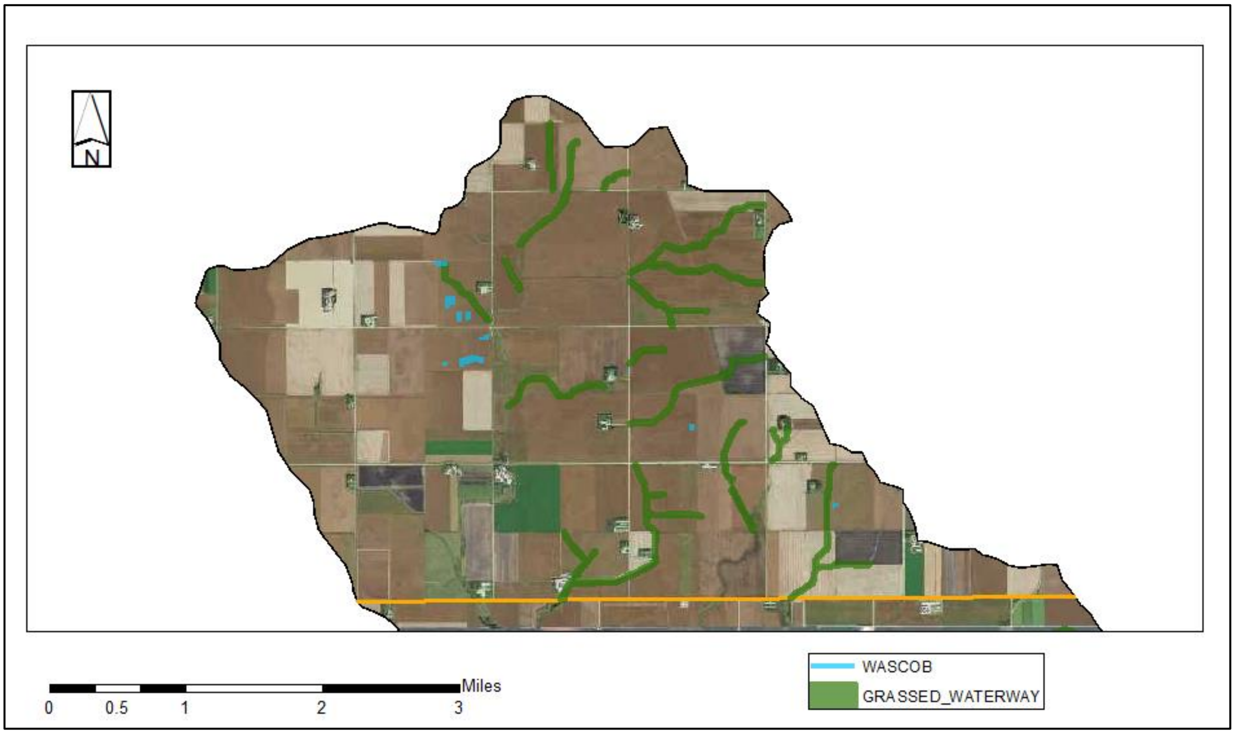
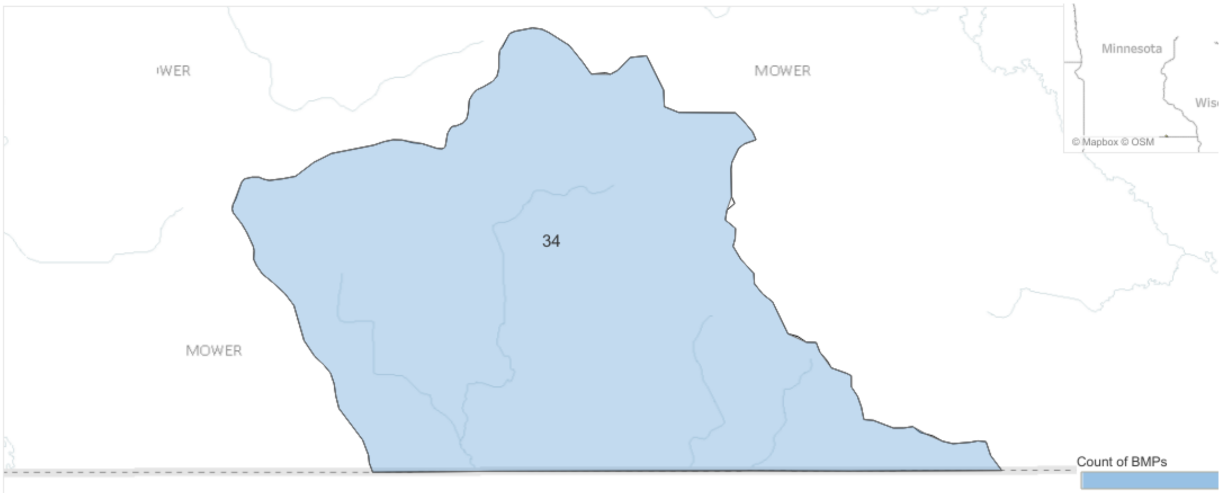



**Figure 28. Agricultural BMPs in the Upper Wapsipinicon River Watershed; Iowa State University.**

The MPCA tracks the number of BMPs implemented in each HUC-8 watershed through its Healthy Watersheds webpage (https://www.pca.state.mn.us/water/healthier-watersheds). According to this source, 34 BMPs have been implemented in the UWRW since 2004 (see Figure 29).




## Upper Wapsipinicon River watershed

### Reducing pollution from nonpoint sources

Best Management Practices (BMPs) are designed to reduce nonpoint sources of pollution from agricultural and urban runoff.

BMPs are installed to help protect high quality lakes and streams, prevent pollution downstream, and restore impaired waters. This report provides information for BMPs funded through federal and state programs that have been reported to the MPCA as of December 31, 2018.

#### Definitions

**Strategy –** category of BMP types proposed in Watershed Restoration and Protection Strategies (WRAPS) to meet water-quality goals.

**Practice Description –** specific BMP type installed by landowners in subwatersheds (HUC12).

| Strategy | Practice Description | Total BMPs | Number of BMPs (by unit) | Installed Amount (by unit) | Units |
|---|---|---|---|---|---|
| Designed erosion control | Grassed Waterway | 7 | 7 | 28 | Acres |
| Tillage/residue management | Residue and Tillage Management, No-Till | 3 | 3 | 294 | Acres |
| | Residue and Tillage Management, Reduced Till | 3 | 3 | 294 | Acres |
| Nutrient management (cropland) | Nutrient Management | 5 | 2 | 167 | Acres |
| | | | 3 | 3 | Count |
| Converting land to perennials | Critical Area Planting | 3 | 3 | 11 | Acres |
| Lliving cover to crops in fall/spri.. | Cover Crop | 1 | 1 | 83 | Acres |
| Tile inlet improvements | Subsurface Drain | 1 | 1 | 16,080 | Feet |
| Septic System Improvements | Septic System Improvement | 1 | 1 | 1 | Count |
| Other | Mulching | 6 | 6 | 14 | Acres |
| | Composting Facility | 2 | 2 | 2 | Count |
| | Underground Outlet | 1 | 1 | 3,201 | Feet |

**Figure 29. BMPs implemented in the UWRW from 2004 - 2018 as reported by MPCA's Healthier Watersheds.**

**Table 9: Additional Tools Available for Restoration and Protection of Waters within the UWRW.**

| Tool | Description | How can the tool be used? | Notes | Link to information and data |
|---|---|---|---|---|
| **Ecological ranking tool (Environmental Benefit Index - EBI)** | This dataset consists of three Geographic Information System (GIS) raster data layers including soil erosion risk, water quality risk, and habitat quality. The 30-meter grid cells in each layer contain scores from 0-100. The sum of all three scores is the EBI score (max of 300). A higher score indicates a higher priority for restoration or protection. | The three layers can be used separately, or the sum of the layers (EBI) can be used to identify priority areas for restoration or protection projects. The layers can be weighted or combined with other layers to better reflect local values. | These data layers are available on the Board of Water and Soil Resources (BWSR) website.<br>In addition, a GIS data layer that shows the 5% of each 8-digit watershed in Minnesota with the highest EBI scores is available for viewing in the MPCA 'water quality targeting' web map, and download from MPCA. | BWSR<br>MPCA Web Map<br>MPCA download |
| **Zonation** | This tool serves as a framework and software for large-scale spatial conservation prioritization, and a decision support tool for conservation planning. The tool incorporates values-based priorities to help identify areas important for protection and restoration. | Zonation produces a hierarchical prioritization of the landscape based on the occurrence levels of features in sites (grid cells). It iteratively removes the least valuable remaining cell, accounting for connectivity and generalized complementarity in the process. The output of Zonation can be imported into GIS software for further analysis. Zonation can be run on very large data sets (with up to ~50 million grid cells). | The software allows balancing of alternative land uses, landscape condition and retention, and feature-specific connectivity responses. (Paul Radomski, DNR, has expertise with this tool.) | Software<br>Examples |
| **Restorable wetland inventory** | A GIS data layer that shows potential wetland restoration sites across Minnesota. Created using a compound topographic index (CTI) (10-meter resolution) to identify areas of ponding, and U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO) soils with a soil drainage class of poorly drained or very poorly drained. | Identifies potential wetland restoration sites with an emphasis on wildlife habitat, surface and ground water quality, and reducing flood damage risk. | The GIS data layer is available for viewing and download on the Minnesota 'Restorable Wetland Prioritization Tool' website. | Restorable Wetlands |
| **National Hydrography Dataset (NHD) and Watershed Boundary Dataset (WBD)** | The NHD is a vectorGIS layer that contains features such as lakes, ponds, streams, rivers, canals, dams and stream gages, including flow paths. The WBD is a companion vector GIS layer that contains watershed delineations. | General mapping and analysis of surface-water systems. These data have been used for fisheries management, hydrologic modeling, environmental protection, and resource management. A specific application of this data set is to identify riparian buffers around rivers. | The layers are available on the USGS website. | USGS |
| **Light Detection and Ranging (LiDAR)** | Elevation data in a digital elevation model (DEM) GIS layer. Created from remote sensing technology that uses laser light to detect and measure surface features on the earth. | General mapping and analysis of elevation/terrain. These data have been used for erosion analysis, water storage and flow analysis, siting and design of best management practices (BMPs), wetland mapping, and flood control mapping. A specific application of the data set is to delineate small catchments. | The layers are available on the Minnesota Geospatial Information Office (MGIO) website. | MGIO |

## 3.2 Civic engagement and Partner Participation

Mower County SWCD has been the lead local partner for the UWRW. Participation of the SWCD has resulted in the identification of high priority strategies for the watershed, feasible implementation goals for select strategies, and public participation approaches.

**Table 10. UWRW WRAPS and TMDL meetings.**

| Date | Title/Topic | Attendees |
|---|---|---|
| January 3, 2019 | UWRW WRAPS Kickoff meeting | Mower Co SWCD/MPCA |
| February 11, 2019 | Suitable BMPs for the UWRW | Mower Co SWCD/MPCA |
| March 18, 2019 | Priority areas in UWRW and public engagement approach | Mower Co. SWCD/MPCA |
| April 16, 2019 | Wapsi Update to Cedar 1W1P Ad. Committee | Cedar River 1W1P Advisory Committee Members |
| June 19, 2019 | Postcard mailings to watershed residents and landowners informing them of water quality conditions and invitation to participate in WRAPS/TMDL review. | 64 residents/landowners |

### Accomplishments and ongoing efforts

Implementation of the Cedar River 1W1P is expected in 2020 and will include a number of efforts in UWRW including:

- Develop monitoring plan for critical stressors (e.g., nutrients, sediment, bacteria, biological impairments);
- Continue to monitor water quality of select waterbodies;
- Develop models for Wapsipinicon River;
- Develop inventory to quantify extent of soil health practices used in the watershed (e.g., cover crops, perennial vegetation);
- Promote the use of BMPs focused on soil health through education and outreach;
- Cooperate with agricultural producers to develop site-specific nutrient management plans;
- Increase public awareness and promote the use of vegetated buffers and runoff reduction practices through education and outreach;
- Develop and maintain inventory of critical streambank erosion areas in the watershed for prioritized response.

IWM will also occur in 2019 for AUID -507; conducted in coordination with Mower County SWCD. This second cycle of IWM will be used to verify assessments, establish water quality trends, and offer opportunities to refine water quality goals. Assessment for cycle 2 is expected in 2020.

## Public notice for comments

An opportunity for public comment on the draft WRAPS report was provided via a public notice in the *State Register* from December 16, 2019 to January 15, 2020. There were no comments received and responded to as a result of the notice.

# 3.3 Restoration and protection strategies

As previously discussed, data and models indicate that a combination of BMP strategies are necessary to bring waters in the UWRW into supporting status. These strategies address a "fair share" obligation to reduce pollutant loading in pursuit of downstream goals (i.e. Gulf Hypoxia). Table 11 below outlines practices that could be implemented to reach nitrogen reduction goals (45% by 2040 with interim goal of 20% by 2025) taken from Minnesota's NRS (MPCA 2014b). Achieving the 20% goal for the nitrate-stressed section of the Upper Wapsipinicon River would mark a significant improvement (nitrate toxicity standards are in development and as such there is at this time no defined numeric goal for warmwater streams).

Consultation with Mower County SWCD was provided for the development of Tables 11 and 12. The selected BMPs and estimated scales of adoption for nitrogen have been supported as attainable watershed goals. Strategies deemed most acceptable or likely to be implemented within the UWRW were given a higher implementation rate. It is noted that this report does not require this level of implementation to occur, rather, summarizes the level of effort needed to achieve a 20% reduction in nitrogen.

**Table 11. BMP Tool spreadsheet output for Nitrogen reduction.**

| Nitrogen (N) BMPs | % Adoption (Acres treated) |
|---|---|
| **Corn acres receiving target N rate, no inhibitor or timing shift** | **70% (2,510 ac)** |
| **Fall N target rate acres receiving N inhibitor** | **90% (310 ac)** |
| **Fall N applications switched to Spring** | **50% (20 ac)** |
| **Fall N switch to split Spring/sidedressing** | **50% (20 ac)** |
| **Restored wetlands** | **20% (120 ac)** |
| **Tile line bioreactors** | **20% (70 ac)** |
| **Controlled drainage** | **20% (70 ac)** |
| **Saturated buffers** | **20% (70 ac)** |
| **Riparian buffers 50 feet wide** | **60% (80 ac)** |
| **Rye cover on Corn/Soybean acres** | **70% (4,740 ac)** |
| **Short season crops planted to a rye cover crop** | **90% (230 ac)** |
| **Perennial crop % of marginal corn & soybean acres** | **20% (60 ac)** |

Implementation levels of nitrogen BMPs were kept the same to estimate reduction of phosphorus using the PBMP tool. In addition to N BMPs are reduced tillage practices and injecting/incorporating animal manure practices. The percent adoption of practices in Table 12 would result in a 32% reduction in phosphorus for the UWRW, far exceeding the NRS goal of 12%.

**Table 12. BMP Tool spreadsheet output for Phosphorus reduction.**

| Phosphorus (P) BMPs | % Adoption (Acres treated) |
|---|---|
| **Adopt U of MN Recommended P2O5 rate** | **35% (2,520 ac)** |
| **Switch fall corn & wheat P-fertilizing to Spring** | **50% (100 ac)** |
| **Use reduced tillage on corn, bean & small grain (>2% slope)** | **70% (1,990 ac)** |
| **50 ft buffers on permanent and intermittent streams** | **25% (80 ac)** |
| **Replace marginal corn & soybean ground with perennial vegetation** | **20% (60 ac)** |
| **Established cereal rye cover crop on corn and soybean acres** | **70% (4,790 ac)** |
| **Establish cereal rye cover crop on short season crops** | **90% (230 ac)** |
| **Install controlled drainage** | **20% (70 ac)** |
| **Install alternative tile intakes** | **20% (330 ac)** |
| **Inject or incorporate animal manure** | **90% (430 ac)** |

In the Strategies Table below (Table 13), pollutant/stressor-specific suites of strategies apply watershed-wide. Because 93% of the watershed is in row crop agriculture, these strategies apply mostly to agricultural lands. However, there are additional suites of strategies specifically for watershed residents since rural residences have specific concerns and opportunities (septic system compliance). Where possible, these strategies were derived through quantitative methods. In other cases, there wasn't enough information available to establish potential available acres or estimated reductions. This is true for many of the Biota Non-pollutant Strategies. Additional monitoring will enable the modelling of these strategies to establish potential reduction of sediment. This initiative is planned within the Cedar 1W1P.

The primary goal of providing this information is to inform and empower local planning. By providing a list of actions needed to meet water quality goals over a period of time, local partners can prioritize actions for their shorter-term planning cycle. Restoration practices detailed in this report focus on addressing pollutant issues (*E. coli,* nitrate, sediment) as well as non-pollutant issues (altered hydrology and aquatic habitat). The practices included in the strategy table below target nonpoint sources because there are no permitted point sources in the watershed. It is also important to point out that even though practices are only listed once for each impairment or stressor, many have benefits that address multiple issues. For example, perennial vegetation can address nitrate by increasing N-uptake but also promotes soil health which increases water storage in the soil profile.

### Protection considerations

The lower portion of the UWRW (Station 15CD012) has been noted as the only section of river characterized as a natural channel. This section has quality riffle and pool habitat as well as good floodplain connectivity and riparian vegetation. Protection of these natural conditions can be accomplished by implementing example BMPs outlined below.

**Table 13: Strategies and actions proposed for the Upper Wapsipinicon River Watershed.**

| Waterbody and Location | | | Water Quality (see text for interim targets and timeframes) | | | Strategies to Achieve Final Water Quality Goal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HUC-10 Subwatershed | Waterbody (ID) | Location and Upstream Influence Counties | Pollutant/ Stressor | Current WQ Conditions (conc. / load / biota scores) | Final WQ Goal (% / load to reduce / biota score target) | Strategy Type | EXAMPLE Best Management Practice (BMP) Scenario: BMP | Amount | Unit | Est'd reduction (lbs/yr) | Notes |
| Upper Wapsipinicon River (0708010202) | All | Mower | Bacteria /*E. coli* | 891.6 org/100 mL | Monthly geometric mean < 126 cfu/100mL | Feedlot runoff controls | Feedlot runoff reduction/treatment (635, 784) | up to 7 | facilities | Unknown | Amount of units with unverified compliance. Actual strategy implementation will be based on facility compliance. |
| | | | | | | Septic system improvements | Septic System Improvement [126M] | up to 9 | systems | Unknown | |
| | | | Biota Pollutant stressors: Nitrogen /nitrate | 16.0 mg/L (avg) | 20% load reduction per Nutrient Reduction Strategy | Nutrient management (cropland) | Nutrient Management (fertilizer, soil, manure) [590] | 2,510 | Acres | 10,000 lbs (8.4%) | |
| | | | | | | | Add N inhibitor to Fall N Applications | 310 | Acres | 1,000 lbs (0.9%) | |
| | | | | | | | Switch Fall N to split spring/sidedressing | 20 | Acres | 1,000 lbs (0.7%) | |
| | | | | | | Agricultural tile drainage water treatment/storage | Saturated buffers [604] | 70 | Acres treated | 0.30% | |
| | | | | | | | Wetland Restoration or Creation for treatment [657, 658] | 120 | Acres | 1,000 (0.7%) | |
| | | | | | | | Controlled tile drainage water management [554] | 200 | Acres treated | 0.20% | |
| | | | | | | Add cover crops for living cover in fall/spring | Cover Crops with Corn & Soybeans [340] | 4,740 | Acres | 9,000 lbs (7.5%) | |
| | | | | | | Converting land to perennials | Perennial crops for regular harvest | 60 | Acres | 1,000 lbs (0.7%) | |
| | | | | | | Buffer & Filters - field edge | *Riparian Buffers, 50+ ft (perennials replace tilled) (390, 391, 327) | 80 | Acres treated | 1,000 lbs (0.9%) | |
| | | | | | | | | | **Total lbs reduced** | **24,000 lbs (20% reduction)** | |
| | | | Biota Non-pollutant stressors: altered hydrology, habitat | MIBI: 36.2 - 47.4 (No N intolerant taxa) Fish IBI: 51 - 65 | MIBI = 43 Fish IBI = 55 12% Phosphorus Reduction (NRS) | Mitigating flow extremes (high or low) | Irrigation Management | TBD | TBD | Unknown | See Cedar 1W1P water storage goal of 0.25 inches (9,600 acre-ft) |
| | | | | | | | Alternative tile intake - Perforated riser pipe [171M] | 330 | Acres treated | | |
| | | | | | | Tillage/residue management | Conservation tillage - >30% residue cover [345, 346, 329B] | 2,000 | Acres | 4.9% P reduction | |
| | | | | | | Designed erosion control and trapping | Water and Sediment Control Basin (cropland) [638] | TBD | Acres draining to | Reduce sediment loading in watershed by 710 tons/year (see Cedar 1W1P) | HSPF modelling needed for the UWRW to establish pollutant yields and reductions. |
| | | | | | | | **Stripcropping (585) | TBD | Acres | | |
| | | | | | | | Sediment Basin (350) | TBD | Acres draining to | | |
| | | | | | | | **Terrace (600) | TBD | Acres draining to | | |

| Waterbody and Location | | | Water Quality (see text for interim targets and timeframes) | | | Strategies to Achieve Final Water Quality Goal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HUC-10 Subwatershed | Waterbody (ID) | Location and Upstream Influence Counties | Pollutant/ Stressor | Current WQ Conditions (conc. / load / biota scores) | Final WQ Goal (% / load to reduce / biota score target) | Strategy Type | EXAMPLE Best Management Practice (BMP) Scenario | | | | Notes |
| | | | | | | | BMP | Amount | Unit | Est'd reduction (lbs/yr) | |
| | | | | | | | **Grassed waterway (412) | TBD | Acres draining to | | |
| | | | | | | | *Filter Strips (386) | TBD | Acres draining to | | |
| | | | | | | | **Contour Buffer Strips (332) | TBD | Acres | | |
| | | | | | | See Nitrogen strategies for Buffers, Nutrient Management, Cover crops and Perennial cover | | | | 16% P reduction | |

## 3.4 Interim targets and timeframes

One of the required elements of WRAPS is a timeline for achieving water quality targets and interim milestones within 10 years of strategy adoption. It is the intent of the implementing organizations in this watershed to make steady progress in terms of pollutant reduction. As a very general guideline, progress benchmarks are established for each impairment in the watershed.

**Table 14. Timelines for meeting UWRW restoration goals.**

| Impairment | Goal | Benchmark Timeline |
|---|---|---|
| ***E. coli*** | **Monthly geometric means less than 126 cfu/100 mL** | **2029** |
| **Nitrate** | **20% reduction in watershed load** | **2025** |
| | **45% load reduction** | **2040** |
| **Altered Hydrology and Habitat** | **MIBI score of 43** | **2029** |
| | **FIBI score of 55** | **2029** |
| | **12% phosphorus load reduction** | **2025** |

Table 14 indicates general guidelines. Factors that may mean slower progress include limits in funding, landowner acceptance, challenging fixes and unfavorable climatic factors. Conversely, there may be faster progress for some impairments, especially where high-impact fixes are slated to occur.

# 4. Monitoring

Monitoring is a critical component to comprehensive watershed management because water quality data can tell us whether our waters are changing; for better or for worse. Currently, there is a very limited amount of water quality data available for the UWRW. To make better assessments of the watershed and to establish water quality trends, additional monitoring is needed. This need presents an excellent opportunity for local partners to be involved in monitoring efforts.

IWM (Cycle 2) for the UWRW will occur in 2019 thru 2020. Simultaneously, the watershed will begin implementing the Cedar River One Watershed, One Plan (1W1P). As Cycle 2 monitoring for the UWRW is conducted, progress towards targets outlined in this report can be assessed and new targets can be created.

It is recommended that future monitoring efforts consider targeting DO, eutrophication (phosphorus/chlorophyll-a/secchi), total suspended solids and fish passage. These parameters did not have sufficient information to make assessments in the first intensive water monitoring cycle. Of the parameters above, investigating low DO and elevated DO flux would be recommended as a priority. Although the DO regime was found to be suitable for warmwater aquatic communities, additional data should be collected to validate this assessment. Fish kills and downstream DO impairments further highlight the need for additional DO investigation. The relationship between low base flow and water withdraw could also be an opportunity for monitoring.

The Cedar 1W1P includes plans for continued water quality monitoring to evaluate Plan progress and fill water quality data gaps. By filling data gaps, hydrologic and hydraulic modelling can be completed for this section of the UWRW. Additional water quality data will also allow for the study of water quality trends in the watershed. It is highly recommended that future monitoring also include the monitoring of implemented practices. This effort will provide information for assessing the progress of 1W1P and the connection between practice implementation and water quality.

## Upper Wapsipinicon River Watershed Reports

All UWRW reports referenced in this watershed report are available at the UWRW webpage: https://www.pca.state.mn.us/water/watersheds/upper-wapsipinicon-river

# 5. References


Abendroth, L.J., R.W. Elmore, M.J. Boyer, and S.K. Marlay. 2011. Corn Growth and Development. Iowa State University Extension. PMR 1009.

Cates, Anna, 2019. University of Minnesota Extension, MN Crop News. *Will soil microbes deliver nitrogen to my crop? Yes, but not in a predictable way.* https://blog-crop-news.extension.umn.edu/2019/04/will-soil-microbes-deliver-nitrogen-to.html

Chandrasekaran, R. (2011). Population structure and persistence of Escherichia coli in ditch sediments and water in the Seven Mile Creek Watershed. Retrieved from https://conservancy.umn.edu/handle/11299/108879

Iowa Flood Center / IIHR — Hydroscience & Engineering. 2019. *Draft Upper Wapsipinicon Watershed Hydrologic Assessment Report.* https://iowawatershedapproach.org/wp-content/uploads/2019/10/Upper-Wapsipinicon-River-Watershed_Hydrologic-Assessment_OCT2019.pdf

Iowa Department of Natural Resources (IADNR) 2016. *Stressor Identification for the Wapsipinicon River Mitchell County, Iowa.*

Iowa State University, 2016. BMP Mapping Project: "Statewide Best Management Practices Inventory 2007 – 2010 HUC 12 Watershed Status." https://www.gis.iastate.edu/gisf/projects/conservation-practices

Minnesota Department of Health (MDH). 2018. Arsenic in Private Wells: Facts & Figures. https://apps.health.state.mn.us/mndata/arsenic_wells

Minnesota Department of Natural Resources (DNR). 2013. *Watershed Health Assessment Framework.* http://www.dnr.state.mn.us/whaf/index.html (accessed February 2018).

Minnesota Department of Natural Resources (DNR). 2015. Watershed Report Card: Wapsipinicon River. Division of Ecology and Water Resources, Department of Natural Resources, St. Paul, Minnesota. http://files.dnr.state.mn.us/natural_resources/water/watersheds/tool/watersheds/ReportCard_Major_47.pdf

Minnesota Department of Natural Resources (DNR). 2017. Watershed Context Report: Wapsipinicon River. Division of Ecology and Water Resources, Department of Natural Resources, St. Paul, Minnesota. http://files.dnr.state.mn.us/natural_resources/water/watersheds/tool/watersheds/context_report_major_47.pdf

Minnesota Pollution Control Agency (MPCA). 1999. Baseline Water Quality of Minnesota's Principal Aquifers - Region 5, Southeast Minnesota. https://www.pca.state.mn.us/sites/default/files/baselinese-sum.pdf
Minnesota Pollution Control Agency (MPCA). 2005. Applying manure in sensitive areas. wq-f6-37.

Minnesota Pollution Control Agency (MPCA). 2011. *Minnesota's Water Quality Monitoring Strategy 2011 to 2021.* https://www.pca.state.mn.us/sites/default/files/p-gen1-10.pdf

Minnesota Pollution Control Agency (MPCA). 2013. Nitrogen in Minnesota Surface Waters. http://www.pca.state.mn.us/index.php/view-document.html?gid=19622).

Minnesota Pollution Control Agency (MPCA). 2014. Minnesota's Nutrient Reduction Strategy. https://www.pca.state.mn.us/sites/default/files/wq-s1-80.pdf.

Minnesota Pollution Control Agency (MPCA). 2015. Le Sueur River WRAPS Report. https://www.pca.state.mn.us/sites/default/files/wq-ws4-10a.pdf

Minnesota Pollution Control Agency (MPCA). 2018. Winnebago River and Upper Wapsipinicon Monitoring and Assessment Report. https://www.pca.state.mn.us/sites/default/files/wq-ws3-07080203b.pdf

Minnesota Pollution Control Agency (MPCA). 2019. Cedar River Watershed Restoration and Protection Strategy Report. https://www.pca.state.mn.us/sites/default/files/wq-ws4-59a.pdf

National Resource Conservation Service (NRCS). 2016. *Rapid Watershed Assessment: Upper Wapsipinicon River (MN/IA) HUC: 07080102.* NRCS. USDA. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_021576.pdf

Schottler et al. 2013. "Twentieth Century Drainage More Erosive Rivers." http://onlinelibrary.wiley.com/doi/10.1002/hyp.9738/abstract

RESPEC. 2017. *Documentation of the BMP Database Available in the Scenario Application Manager.* Draft Topical Report RSI-2742. Prepared for the MPCA.