

Adrian Drinking Water Supply Management Area Groundwater Protection Rule Summary

Groundwater, Nitrogen Fertilizer Management, and Nitrogen Loading Analysis



DWSMA

September 2026

Introduction

This document summarizes the Minnesota Department of Agriculture's (MDA) current understanding of the Adrian Drinking Water Supply Management Area (DWSMA), public well nitrate-nitrogen levels, and nitrogen management information. Also included is a summary of the MDA's analysis of nitrogen loss below cropland within this DWSMA. This summary outlines the information the MDA considered to determine whether the proposed list of nitrogen fertilizer best management practices (BMPs) and alternative management tools (AMTs) will be protective of groundwater.

DWSMA and Public Well Nitrate-Nitrogen Data

The DWSMA boundary defined by the Minnesota Department of Health (MDH) for the City of Adrian's public wells was updated in 2025. The previous DWSMA boundary was 1,865 acres with only 108 cropland acres defined as highly vulnerable and subject to the Groundwater Protection Rule (GPR). The new boundary includes 2,529 acres with 1,990 acres meeting the definition of cropland in the GPR. The MDH defines the groundwater below this DWSMA as high vulnerability (Figure 1). The GPR applies to the 1,990 acres of cropland within this DWSMA.

The MDA relies on water-quality data provided by the MDH to evaluate nitrate-nitrogen levels in the public water supply. Nitrate-nitrogen levels exceeded 8 mg/L in three of the Adrian public wells within the past 10 years (Figure 2). Adrian public well information is shown in Table 1.

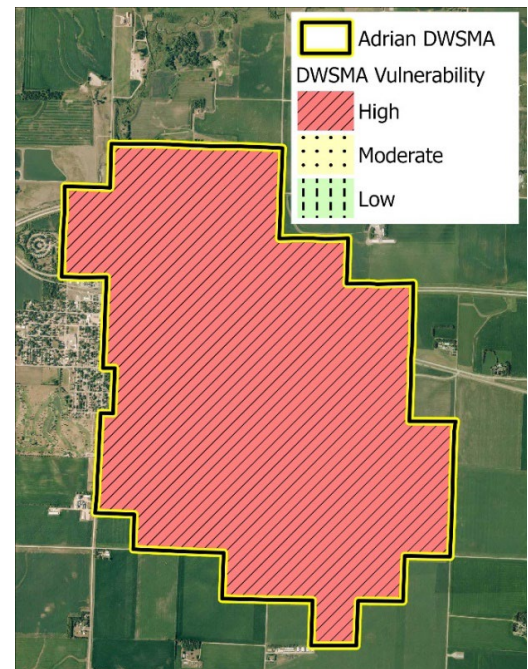


Figure 1. Adrian DWSMA Vulnerability Designated by the MDH

Figure 2. Adrian public well nitrate data through December 2025. See the supplemental data at the end of this summary for a table of the individual well nitrate data listed in this graph.

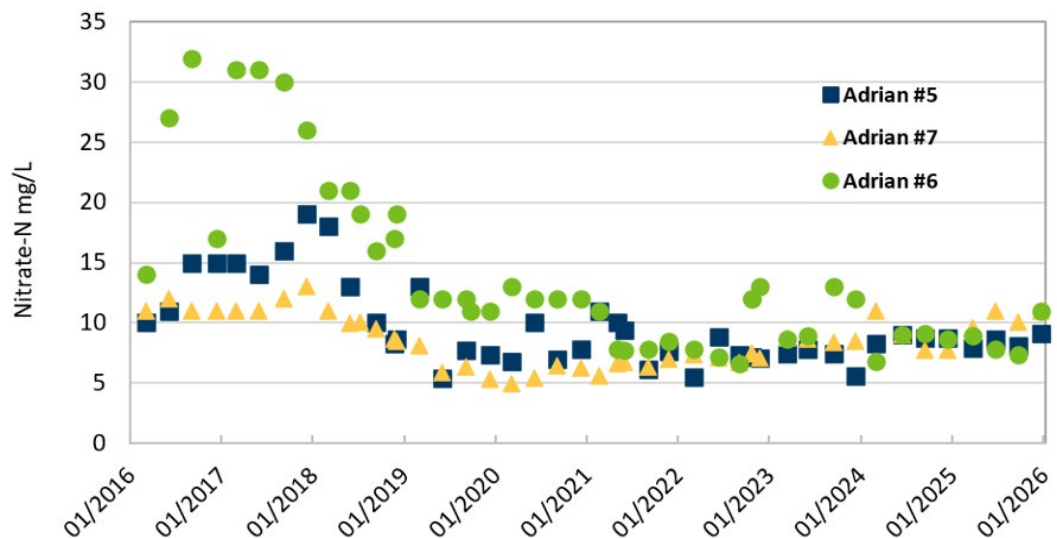


Table 1. City of Adrian public well information

Local Well ID	MDH Status	Casing Diameter (in)	Casing Depth (ft)	Well Depth (ft)	Date Constructed
Well #5	Primary	12	19	26	1984
Well #6	Primary	12	31	42	1985
Well #7	Primary	18	23	42	2006

DWSMA Land Use and Potential Nitrate-Nitrogen Point Source Consideration

The MDA conducted a detailed review of potential contaminant sources to determine whether a point source of nitrogen could be the cause of public wells exceeding the criteria for mitigation-level designation (Minnesota Statute 1573.0040, Subp. 3, C). In the Adrian DWSMA, the MDA review did not identify a point source for nitrate-nitrogen. With nitrate levels exceeding 8.0 mg/L within the past 10 years and without a point source contribution, this DWSMA was designated Mitigation Level 2 under Part 2 of the Groundwater Protection Rule in January 2020 (Minnesota Statute 1573.0040, Subp. 7, C, 2).

Part 2 of the GPR responds to DWSMAs with elevated nitrate. The goal is to take action to reduce nitrate in groundwater before a public well exceeds the health standard for nitrate, 10 mg/L. For DWSMAs, like Adrian designated at Level 2, the MDA works with a local advisory team (LAT), which includes local farmers, agronomists, and others to get input on agricultural practices that can reduce nitrate levels in groundwater.

The GPR defines cropland as land used primarily for the production or harvest of annual or perennial field, forage, food, fiber, or energy crops, including pasture but excluding forestland.

The evaluation of BMP adoption, to determine if a mitigation level change is needed, excludes soybean acres (Minnesota Statute 1573.0040, Subp. 7, A).

A review of the publicly available [USDA Cropland Data Layer](https://nass.usda.gov/Research_and_Science/Cropland/Release/index.php) (hosted on Crop Scape, nass.usda.gov/Research_and_Science/Cropland/Release/index.php) in the Adrian DWSMA shows that 79% of landcover is cropland (Figure 3). In addition to a review of cropping history, the MDA also surveyed agronomists and farmers to understand the nitrogen fertilizer management practices used in the Adrian area. The MDA was able to obtain farming information for most of the cropland acres across the DWSMA. Having current and accurate nitrogen fertilizer management data is critical to the discussion of protective agricultural management practices (i.e. BMPs and AMTs) appropriate for this DWSMA. Computer modeling tools allow the MDA to estimate nitrogen leaching under current fertilizer management and to assess how proposed management changes could reduce those losses. The farming practice information collected includes crop planting, harvest, tillage, and nitrogen fertilizer use data. Farmers within this DWSMA use both commercial nitrogen and manure to fertilize corn. Table 2 shows the cropland rotations present within the DWSMA.

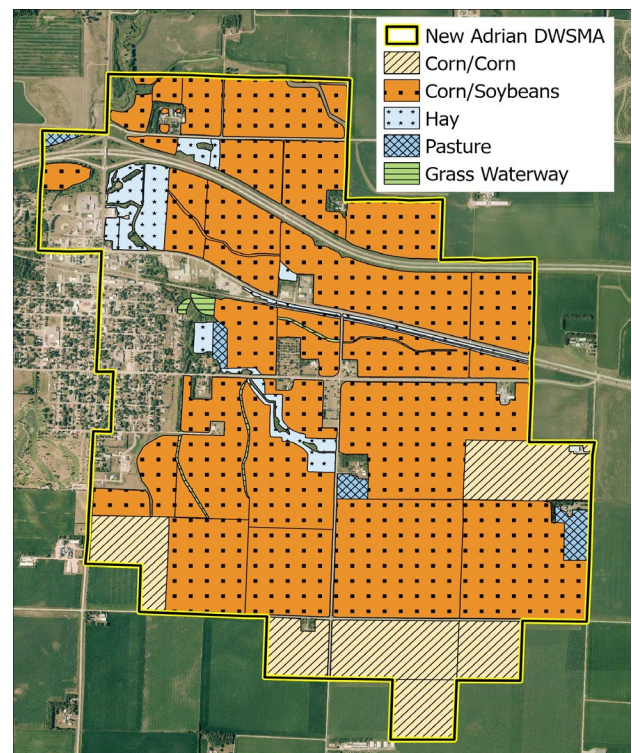


Figure 3. 2016-2025 average cropland rotations in the Adrian DWSMA based on the USDA Cropland Data Layer. See Table 2 for crop rotation details.

Table 2. Adrian DWSMA Cropland Rotations

Crop Rotation (2016-2025)	Acres	% Cropland (1,990 acres)
Corn/Soybean	1523	76.5%
Corn/Corn	325	16.3%
Hay	97	4.8%
Pasture	32	1.6%
Grass Waterways	13	0.7%

Due to the small number of cropland operators within this DWSMA, more detailed farming practice information cannot be included in this document. Minnesota's statute on Agricultural Data (Minnesota Statute 13.643 Subd. 7) protects the identities and location of producers who are cooperating with the MDA in an assessment of farm practices. If farm practice information could identify an individual, it is considered private information and cannot be shared by the MDA. General nitrogen management information is shared in this summary.

Based on the nitrogen fertilizer use information the MDA collected within the DWSMA, nitrogen rates are at or above current University of Minnesota guidelines. Nitrogen application rates on corn-soybean rotations ranged from 150-250 lbs./acre. Most corn acres receive a preplant application of nitrogen while only 6% of corn acres use split applications. Approximately 35% of the cropland receives manure applications. Almost 13% of cropland had fall applications of urea with an inhibitor prior to 2025 when a DWSMA boundary change expanded acres where fall nitrogen application is restricted. Cover crops are utilized on 8.5% of cropland. Most of the cropland in the DWSMA is highly productive with corn yields ranging from 200-250+ bushels per acre. All nitrogen sources are accounted for, and nitrogen credits from previous legume crops and manure are taken.

Within the Adrian DWSMA crops grown in 2025 included corn, soybeans, pasture, and hay (Table 3). The MDA also reviewed the USDA Cropland Data Layer over the past 10 years in Adrian's DWSMA. During this time, corn and soybeans were the primary crops grown. Pasture and hay made up 6-7% of cropland over the past 10 years (Table 4).

Table 3. 2025 Adrian DWSMA Cropland Cover

Crop Type	Acres	% of Cropland (588 acres)
Corn	1064	53.5%
Soybean	784	39.4%
Hay/Pasture/ Waterways	142	7.1%

Table 4. Adrian DWSMA Cropland Crop History 2016-2025

Year	Corn Acres	Corn % of Cropland	Soybean Acres	Soybean % of Cropland	Hay/Pasture Acres	Hay/Pasture % of Cropland	Fallow Acres	Fallow % of Cropland
2016	1179	58.5%	712	35.4%	123	6.1%	-	-
2017	1069	53.3%	809	40.3%	127	6.3%	-	-
2018	1139	56.6%	749	37.2%	125	6.2%	-	-
2019	1108	55.8%	586	29.5%	117	5.9%	175	8.8%
2020	1193	59.3%	675	33.5%	144	7.2%	-	-
2021	993	49.6%	870	43.5%	139	6.9%	-	-
2022	1153	57.6%	710	35.5%	139	6.9%	-	-
2023	913	45.8%	945	47.4%	136	6.8%	-	-
2024	1035	51.9%	817	41.0%	141	7.1%	-	-
2025	1064	53.5%	784	39.4%	142	7.1%	-	-

DWSMA Nitrate-Nitrogen Loss Below Cropland

Using a crop and soil computer simulation model called the Soil and Water Assessment Tool (swat.tamu.edu) the MDA estimated nitrogen loss below the root zone in the Adrian DWSMA, comparing nitrogen management practices used in the recent past with the nitrogen loss below alternative practices. Table 2 shows the crop rotations modeled within the Adrian DWSMA.

The MDA modeled nitrogen fertilizer BMPs applicable to the DWSMA that can reduce nitrogen loss below the root zone (Table 5). Applying nitrogen at or below the 0.10 high end of U of MN's corn nitrogen recommendations can reduce nitrogen leaching by 8.3%. The Groundwater Protection Rule prohibits fall applications of nitrogen fertilizer on cropland in Level 2 DWSMAs. MDA surveys indicated that 260 acres of corn were previously receiving fall applications of urea before the DWSMA was amended. Switching 260 acres from fall application to spring reduces nitrogen loss by 2.3%.

Table 5. MDA modeling estimates of nitrate-nitrogen loss following the adoption of listed BMPs compared to current nitrogen management practices.

Management Change	Affected Acres within DWSMA	Nitrogen Loss Reduction	Notes
Apply nitrogen for corn acres at or below the 0.10 high end	915	8.3%	Current U of MN corn rates at the 0.10 high end are 160 lbs N/ac for corn following soybeans and 200 lbs N/ac for corn following corn.
Change Fall application of urea to spring	260	2.3%	The Groundwater Protection Rule prohibits fall application of commercial nitrogen.

The MDA turned to modeling additional practices and AMTs to explore options that could provide additional reductions in nitrogen loss below the root zone. If these practices were adopted, modeling shows potential reductions in nitrogen leaching below the root zone, as shown in Table 6. Working with local farmers, the MDA will promote this list and, when possible, identify funding to support adoption of these practices.

Table 6. Adrian DWSMA modeled nitrogen loss below additional practices and AMTs considered by the Adrian LAT.

Management Change	Additional Acres within DWSMA	Nitrogen Loss Reduction	Notes
Use a nitrification inhibitor with preplant nitrogen on urea, anhydrous ammonia, and liquid hog manure	1484	4.9%	This would apply to all corn acres in the DWSMA that currently do not use a nitrification inhibitor.
Spit applications of nitrogen	965	2.6%	1/3 of nitrogen sidedress in season on applicable corn acres.
Cover crops after soybeans on 25% of the acres	234	3.2%	Cereal rye with good establishment 3 out of 5 years. Cover crops are currently used on 8.5% of the cropland acres.

MDA Recommended Nitrogen Fertilizer Best Management Practices for the Adrian DWSMA

In consultation with the local advisory team that includes farmers and agronomists managing cropland within the DWSMA, the MDA developed the following list of BMPs to protect groundwater. View a more detailed list of these BMPs at [Adrian DWSMA](https://mda.state.mn.us/adrian-dwsma) (mda.state.mn.us/adrian-dwsma).

- Apply nitrogen to dryland corn at or below the 0.10 price ratio range in the University of Minnesota's nitrogen fertilizer application guidelines.
- For all other crops grown within the DWSMA nitrogen rates must follow the current University of Minnesota guidance applicable to that crop.
- Account for all nitrogen sources when calculating nitrogen rate.
- Take appropriate credits for previous legume crops and manure used in the crop rotation.
- On coarse textured soils use split applications of nitrogen fertilizer or a spring preplant application with a nitrification inhibitor or use ESN (polymer coated urea) on labeled crops.

The MDA will conduct an evaluation in this Level 2 DWSMA to determine whether these nitrogen fertilizer BMPs were implemented on 80% of the cropland, excluding soybeans. The evaluation will occur no sooner than three growing seasons after the BMP list is published.

Conclusion

In the Adrian DWSMA, the MDA reviewed the cropping history, surveyed nitrogen management practices, and modeled nitrogen loading estimates below existing nitrogen fertilizer management practices and alternative practices.

Based on our farmer and fertilizer dealer survey, the current nitrogen rates applied on corn in the DWSMA are at or above current University of Minnesota guidelines. All nitrogen sources are considered and nitrogen credits from legumes and manure are counted.

Modeling of nitrogen loss below nitrogen rates at or below the high end of the 0.10 price ratio range shows an 8.3% reduction of nitrogen below the root zone. The adoption of additional practices and AMTs within the DWSMA offer options that can further reduce nitrogen loss below the crop root zone. These options were developed in consultation with the LAT. Specific acres have not been identified for other additional practices, but the LAT acknowledges the groundwater protection these practices could provide if adopted. The next steps in this DWSMA are to review these practices with individual landowners and explore funding opportunities to support their adoption.

Based on the information above, the MDA believes the recommended nitrogen management practices for the Adrian DWSMA are appropriate, and that the use of these practices—along with the adoption of AMTs and additional practices—will reduce nitratenitrogen loss below cropland over the long term. Promotion and funding to support the establishment of these practices within the Adrian DWSMA will be a priority.

Supplemental Data

The following table is supplemental information for the Adrian DWSMA Groundwater Protection Rule Summary. The data included below is presented as a graph (Figure 2) in the summary document.

Well Number	Collection Date	Nitrogen Test Levels in mg/L
5	2016-03-14	10
5	2016-06-14	11
5	2016-09-14	15
5	2016-12-20	15
5	2017-03-08	15
5	2017-06-07	14
5	2017-09-19	16
5	2017-12-19	19
5	2018-03-13	18
5	2018-06-06	13
5	2018-09-19	10
5	2018-12-04	8.3
5	2018-12-10	8.6
5	2019-03-13	13
5	2019-06-11	5.4
5	2019-09-17	7.7
5	2019-12-18	7.3
5	2020-03-17	6.8
5	2020-06-16	10
5	2020-09-14	7
5	2020-12-16	7.8
5	2021-03-01	11
5	2021-05-11	10
5	2021-06-08	9.4
5	2021-09-13	6.1
5	2021-12-06	7.6
5	2022-03-16	5.5
5	2022-06-21	8.8
5	2022-09-13	7.3
5	2022-11-02	7.2
5	2022-11-02	7.2
5	2022-12-05	7.1
5	2023-03-21	7.4
5	2023-06-14	7.8

Well Number	Collection Date	Nitrogen Test Levels in mg/L
5	2023-09-27	7.4
5	2023-12-21	5.6
5	2024-03-12	8.3
5	2024-06-26	9
5	2024-09-25	8.7
5	2024-12-23	8.7
5	2025-03-31	7.9
5	2025-06-30	8.6
5	2025-09-30	8.1
5	2025-12-30	9.1
6	2016-03-14	14
6	2016-06-14	27
6	2016-09-14	32
6	2016-12-20	17
6	2017-03-08	31
6	2017-06-07	31
6	2017-09-19	30
6	2017-12-19	26
6	2018-03-13	21
6	2018-06-06	21
6	2018-07-18	19
6	2018-09-19	16
6	2018-12-04	17
6	2018-12-10	19
6	2019-03-13	12
6	2019-06-11	12
6	2019-09-17	12
6	2019-10-03	11
6	2019-12-18	11
6	2020-03-17	13
6	2020-06-16	12
6	2020-09-14	12
6	2020-12-16	12
6	2021-03-01	11

Well Number	Collection Date	Nitrogen Test Levels in mg/L
6	2021-05-11	7.8
6	2021-06-08	7.7
6	2021-09-13	7.8
6	2021-12-06	8.5
6	2022-03-16	7.8
6	2022-06-21	7.2
6	2022-09-13	6.6
6	2022-11-02	12
6	2022-11-02	12
6	2022-12-05	13
6	2023-03-21	8.6
6	2023-06-14	8.9
6	2023-09-27	13
6	2023-12-21	12
6	2024-03-12	6.8
6	2024-06-26	9
6	2024-09-25	9.1
6	2024-12-23	8.6
6	2025-03-31	8.9
6	2025-06-30	7.8
6	2025-09-30	7.3
6	2025-12-30	11
7	2016-03-14	11
7	2016-06-14	12
7	2016-09-14	11
7	2016-12-20	11
7	2017-03-08	11
7	2017-06-07	11
7	2017-09-19	12
7	2017-12-19	13
7	2018-03-13	11
7	2018-06-06	9.9
7	2018-07-18	10
7	2018-09-19	9.5

Well Number	Collection Date	Nitrogen Test Levels in mg/L
7	2018-12-04	8.6
7	2018-12-10	8.5
7	2019-03-13	8.1
7	2019-06-11	5.9
7	2019-09-17	6.3
7	2019-12-18	5.3
7	2020-03-17	4.9
7	2020-06-16	5.4
7	2020-09-14	6.4
7	2020-12-16	6.2
7	2021-03-01	5.6
7	2021-05-11	6.6
7	2021-06-08	6.7
7	2021-09-13	6.3
7	2021-12-06	7
7	2022-03-16	7.3
7	2022-06-21	7.1
7	2022-09-13	6.7
7	2022-11-02	7.4
7	2022-11-02	7.4
7	2022-12-05	7.1
7	2023-03-21	8.7
7	2023-06-14	8.6
7	2023-09-27	8.4
7	2023-12-21	8.5
7	2024-03-12	11
7	2024-06-26	9
7	2024-09-25	7.7
7	2024-12-23	7.7
7	2025-03-31	9.6
7	2025-06-30	11
7	2025-09-30	10
7	2025-12-30	11

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