

Clear Lake and Haven Townships in Sherburne County Nitrogen Fertilizer Management Plan Summary

Groundwater, Nitrogen Fertilizer Management, and Nitrogen Loading Analysis

Updated: 12-17-2024

Introduction

This document summarizes the Minnesota Department of Agriculture's (MDA) current understanding of the nitrate-nitrogen levels in domestic (private) wells in Clear Lake and Haven townships in Sherburne County and the MDA's understanding of nitrogen management information. This summary provides the detail 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.

Project Area and Private Well Nitrate-Nitrogen Data

Groundwater protection is fundamental to the Nitrogen Fertilizer Management Plan (NFMP). The NFMP called for an assessment of nitrate conditions at the township scale. Accordingly, the MDA offered nitrate tests to private well owners in six townships in Sherburne County in 2014. Clear Lake and Haven townships had at least 10% of samples over the Health Risk Limit (HRL) of 10 mg/L nitrate-nitrogen. This threshold prompted the establishment of a Local Advisory Team made up of farmers, agronomists, and local conservation professionals working within these townships.

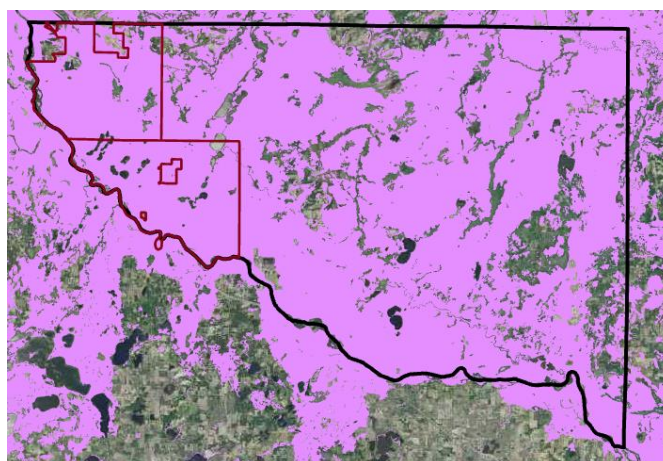


Figure 1. Sherburne County, Minnesota Coarse-textured soils (in pink). Clear Lake and Haven townships are outlined in red.

Table 1. Final Sherburne County Township Testing Private Well Dataset

Township	Number of Wells	Wells ≥ 10 mg/L Nitrate-N Count	Wells ≥ 10 mg/L Nitrate-N Percentage
Becker	379	20	5.3%
Big Lake	775	43	5.5%
Clear Lake	195	22	11.3%
Haven	224	31	13.8%
Palmer	302	26	8.6%
Santiago	118	7	5.9%
Total	1993	149	7.5%

The land within Clear Lake and Haven townships includes approximately 28,000 acres of cropland. Approximately 90% of this cropland is on coarse-textured soils. The cropland with coarse-textured soils is made up of 76% sandy loam, 12% loamy sand, and 3% sand and gravel. The remaining cropland is 1% loam soils and 9% that are mucky or frequently ponded.

Clear Lake and Haven Township Land Use

The NFMP designates Mitigation Level 2 for townships that have at least 10% of samples submitted from private wells over the Health Risk Limit (HRL) of 10 mg/L nitrate-nitrogen. Level 2 of the NFMP recommends the formation of a Local Advisory Team (LAT) including local farmers, agronomists, and others to get input on agricultural practices that can reduce nitrate losses below cropland.

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 Clear Lake and Haven townships shows that the land use is predominately cropland. The data illustrated in Figure 2 is from the Feb 2022 data release. Additionally, Table 2 shows the average number of acres of the primary crops grown in the two-township area from 2017-2022.

Table 2. Five-Year Cropland Acres

Crop	Acres (5-yr Ave)	% Cropland
Corn	12,274	43.6%
Soybeans	6,455	22.9%
Grass/pasture	4,041	15.0%
Potatoes	2,711	9.6%
Small Grains	855	3.1%
Alfalfa	598	2.1%
Edible Beans	373	1.3%
Other Crops	619	2.2%

The number of acres and percentages are estimates from the USDA's Crop Scape tool. The MDA 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. Within the two-township area, the most common annual crops are corn, soybeans, potatoes, and edible beans. In 2017-2022, these crops accounted for 77% of the total cropland. Perennials—pasture, alfalfa, and grass hay—have covered an average of 17% of the cropland over the five-year timeframe.

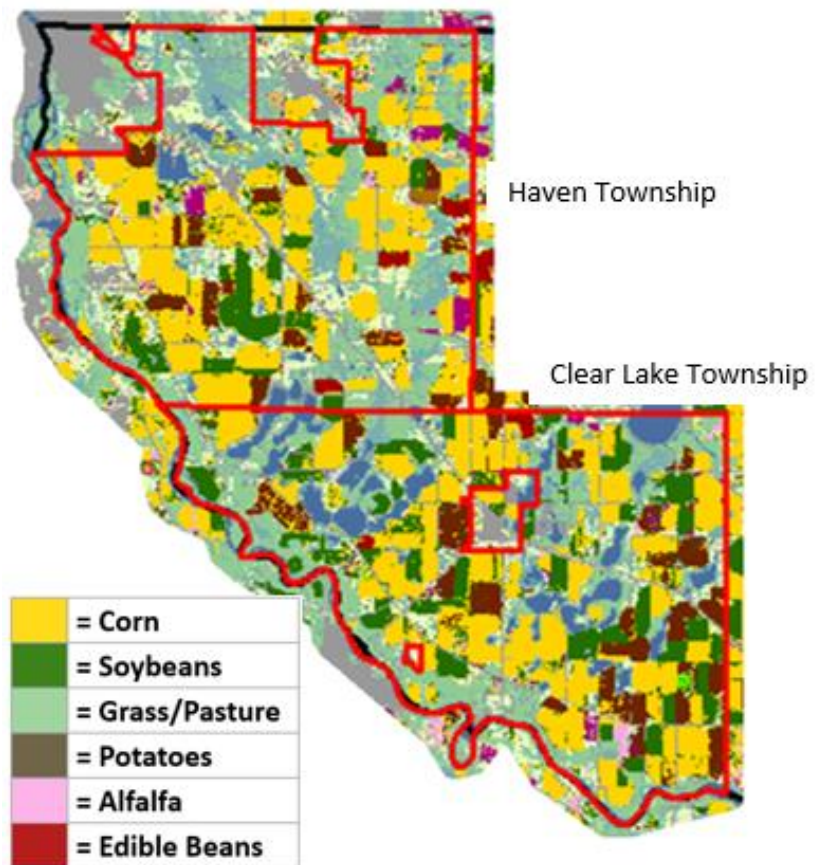


Figure 2. 2022 Cropland in Clear Lake and Haven Townships based on the USDA Cropland Data Layer

The MDA surveyed agronomists and farmers to understand the nitrogen fertilizer management practices used in the two-township area. Having current and accurate nitrogen fertilizer management data is critical to the discussion of BMPs and AMTs. The management information collected includes crop planting, harvest, and nitrogen fertilizer use information.

Nitrogen fertilizer BMPs are widely used within Clear Lake and Haven townships. Surveys indicate that splitting nitrogen fertilizer applications on corn, edible bean, and potatoes is a common practice. Additionally, that accounting for all nitrogen sources, crediting for manure applications and previous crops, and avoiding fall applications of nitrogen fertilizer are practices followed on most of the cropland.

In 2018, the MDA surveyed four fertilizer dealers about nitrogen fertilizer BMP use in Clear Lake and Haven townships, and dealers provided updated nitrogen rates for corn in a follow-up survey in 2022. Nitrogen rates provided in the 2022 survey are shown Table 3.

Table 3. 2022 Corn Nitrogen Fertilizer Rates in Clear Lake and Haven Townships

Crop Rotation	Acres	Percent of Corn Acres	Nitrogen Rate (lbs. N per acre)
Corn following corn-dryland	1,900	15%	160-175
Corn following soybean-dryland	1,221	9%	130-140
Corn following corn or potatoes-irrigated	3,100	24%	210-245
Corn following soybean-irrigated	1,800	14%	170-220
Seed corn following soybeans or potatoes-irrigated	3,500	27%	160-170
Corn receiving manure	1,406	11%	Unknown

Nitrate-Nitrogen Loss Below Cropland

Using a crop and soil computer simulation model called the [Environmental Policy Integrated Climate model \(EPIC\)](https://epicapex.tamu.edu/epic/) (<https://epicapex.tamu.edu/epic/>) the MDA has estimated the nitrogen loss below soils and weather conditions that are similar to Clear Lake and Haven townships. This provides a reference that we can consider here. Based on this model a reduction from 220 lbs. N/acre to 195 lbs. N/acre (currently the high end of the University of Minnesota's 0.10 nitrogen rate range) on irrigated corn following soybean can reduce nitrogen loss by 18% on each acre this rate reduction is adopted. This estimate of nitrogen loss is based on a preplant nitrogen application along with two in-season (split) nitrogen applications. Nitrogen fertilizer dealership survey and review with the local advisory team indicates that this nitrogen application timing is most common for the irrigated corn-soybean rotation acres within these townships.

Based on the same EPIC model, nitrogen leaching estimates for irrigated corn following corn show that a reduction from 245 lbs. N/acre to 225 lbs. N/acre (currently the high end of the University of Minnesota's 0.10 nitrogen rate range) can reduce nitrogen leaching by up to 29% on each acre this change is adopted. This estimate of nitrogen loss is also based on nitrogen application timing that includes a preplant nitrogen application along with two in-season (split) nitrogen applications.

Fertilizer dealerships were able to provide total nitrogen rate information for 89% of the corn acres in these townships. Based on this, the nitrogen rate thresholds listed above would reduce the nitrogen rate applied to 29% of irrigated corn receiving only commercial nitrogen. The EPIC model results noted above illustrate the nitrogen loss reduction (18-29%) that reduced nitrogen rates can have.

Currently the common practice within these townships is to apply nitrogen pre plant and twice in-season on irrigated corn acres. Based on EPIC model estimates of nitrogen leaching below similar soils and weather conditions adding a third in-season (split) application of nitrogen while remaining at or below 195 lbs. N/acre for irrigated corn-soybean and 225 lbs. N/acre for irrigated corn-corn could result in an additional 1.4 and 1.6% nitrogen leaching reduction, respectively. Additional split applications of nitrogen in smaller amounts can reduce the risk of loss compared with fewer applications in larger amounts. However, based on this model estimate, the benefit of a third in-season application of nitrogen on irrigated corn may not greatly reduce nitrogen leaching over the long term.

MDA Recommended Nitrogen Fertilizer Best Management Practices for Clear Lake and Haven Townships

In consultation with the Local Advisory Team that includes farmers and agronomists operating cropland within the Clear Lake and Haven townships, the MDA has developed the following list of BMPs to protect groundwater.

- Apply nitrogen to irrigated corn in a corn-corn or corn-soybean rotation at or below the high end of the 0.10 nitrogen rate range in the University of Minnesota's nitrogen fertilizer application guidelines.
- Apply nitrogen to dryland corn in a corn-corn or corn-soybean rotation at or below the 0.10 Maximum Return to Nitrogen (MRTN) in the University of Minnesota's nitrogen fertilizer application guidelines.
- Account for all nitrogen sources when calculating nitrogen rate.

- Take appropriate credits for previous legume crops and manure used in the crop rotation.
- Split applications of nitrogen fertilizer.
- Use a nitrogen rate for potatoes based on variety, harvest date, and realistic yield goals.

A complete list of the MDA recommended BMPs is available on the [Clear Lake and Haven Townships](http://www.mda.state.mn.us/clearlake-haven-twps) webpage (www.mda.state.mn.us/clearlake-haven-twps)

Alternative Management Tools (AMTs) and Additional Practices for Clear Lake and Haven Townships

In addition to BMPs, other practices, including AMTs, can be protective of groundwater. The LAT acknowledges that the following list of practices can be protective of groundwater. While BMPs are applicable to most cropland acres, AMTs and some additional practices tend to be less universal but very appropriate in select situations or fields. At a township scale, even small improvements in nitrogen management can reduce nitrogen loss below cropland and over the long term reduce nitrate levels in groundwater. AMTs or additional practices implemented can further reduce nitrogen loss beyond the impact of BMPs alone.

Approved AMTs

- Minnesota Ag Water Quality Certification Program
- Land Conservation Programs
- Increasing Continuous Cover: Perennial Vegetation
- Increasing Continuous Cover: Cover Crops
- On-Farm Nitrogen Rate Trials
- Precision Nitrogen Management
- Intermediate Wheatgrass (Kernza)

In the future AMTs will be added to this approved list and posted on the [Approved AMTs](http://www.mda.state.mn.us/pesticide-fertilizer/approved-amts) webpage (www.mda.state.mn.us/pesticide-fertilizer/approved-amts). Once posted online the new approved AMTs will be applicable in these townships.

Additional practices

- Keep records of nitrogen use, including rates, crediting of nitrogen sources, timing, placement, and source.
- Attend educational activities approved by the MDA.
- Field testing to determine nitrogen requirements for specific crops.
- Test manure using a lab approved or certified by the MDA.
- Develop irrigation, fertilizer chemigation, water, manure, or nutrient management plans with a qualified professional.
- Schedule irrigation according to crop needs (evapotranspiration information) and soil water holding capacity and apply only enough to fill the effective crop root zone to avoid leaching.
- Manage irrigation in a way that there is always some room left in the root zone for possible precipitation.

In addition to the items listed above, the MDA acknowledges the use of manure on the cropland within these townships. Careful manure management is critical to make efficient use of this resource and avoid practices with inherently higher risk of nitrogen loss below the crop root zone. Careful crediting of nitrogen available from manure is fundamental. In addition to crediting, the promotion and support for manure testing, applicator calibration, and improvements to manure application equipment and storage facilities can all improve the crop utilization of nitrogen available from manure and reduce the amount of nitrogen available for loss below the crop root zone.

Conclusion

In Clear Lake and Haven townships, the MDA has reviewed the cropping history, surveyed nitrogen management practices, and discussed current practices with the LAT. The cropland in perennial cover including grass hay, alfalfa, and pasture accounts for a considerable amount of cropland within the two-township area. Over the past five years, perennials have accounted for an average of 16% of the cropland. Maintaining and increasing this type of perennial land use is important to minimizing nitrate leaching.

The current University of Minnesota nitrogen fertilizer timing, placement, and product BMPs are already being widely used within Clear Lake and Haven townships. Adoption of these BMPs on all cropland acres would have water quality benefits. However, MDA modeling suggests that fine-tuning nitrogen rates can be the most effective practice to reduce nitrate leaching from cropland. Limiting nitrogen rates on irrigated corn to the University of Minnesota's 0.10 ratio range would reduce nitrate leaching and have positive water quality impacts. Similarly, the use of precision nitrogen management or on-farm rate trials can help identify the optimal nitrogen rate and protect groundwater.

Alternative Management Tools have great potential to reduce nitrate leaching losses. The LAT acknowledges the additional groundwater protection AMTs could provide if adopted. Where possible, maintaining or increasing perennial cover is encouraged. Funding to support the adoption of these practices would help increase adoption.

Based on the understanding and information provided above, the MDA believes that the recommended nitrogen management practices within Clear Lake and Haven townships are appropriate and that maximizing use of these practices over the long-term will prevent nitrogen loss below cropland from increasing. These recommendations can be found on the [Clear Lake and Haven Townships](http://www.mda.state.mn.us/clearlake-haven-twps) website (www.mda.state.mn.us/clearlake-haven-twps). Additionally, further reductions to nitrogen loss are possible with the increased use of Alternative Management Tools where they are practicable and economical. Promotion and additional funding to support the establishment of Alternative Management Tools within the Clear Lake and Haven townships is needed to increase their adoption.