Rockwood Estates DWSMA Groundwater Protection Rule Summary

Groundwater, Nitrogen Fertilizer Management, and Nitrogen Loading Analysis

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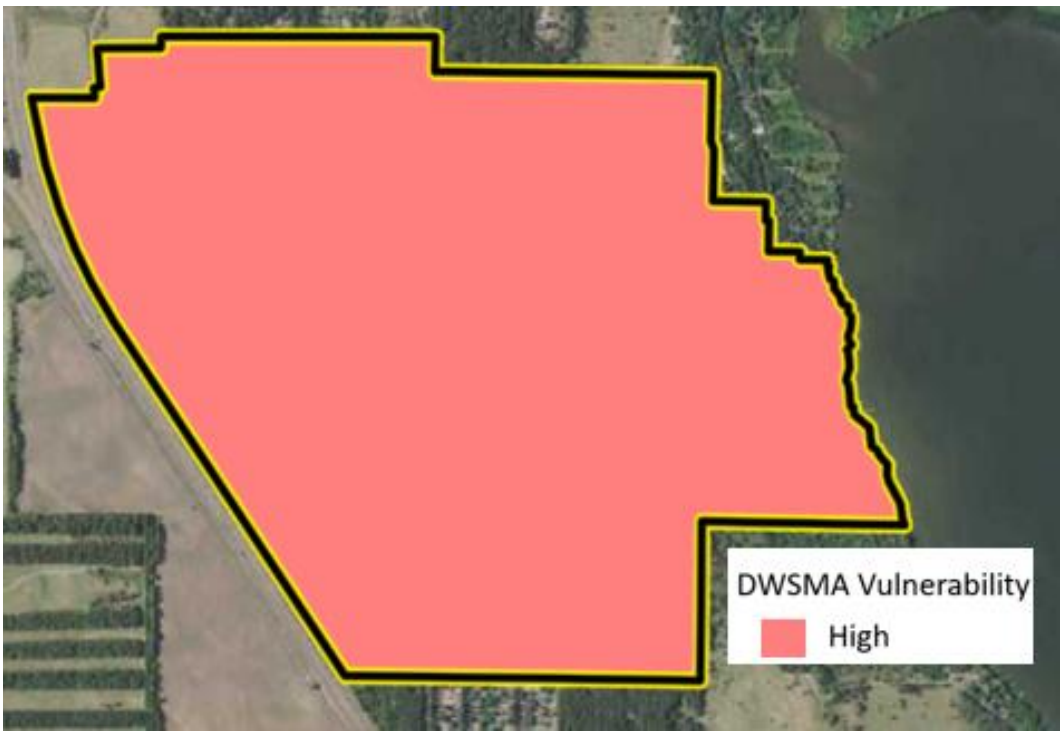
Introduction

This document summarizes the Minnesota Department of Agriculture's (MDA) current understanding of the Rockwood Estates 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 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.

DWSMA and Public Well Nitrate-Nitrogen Data

The DWSMA boundary defined by the Minnesota Department of Health (MDH) for the Rockwood Estates mobile home park public well includes 838 acres. The MDH defines the groundwater below this DWSMA as high vulnerability. Of the 838 acres in the DWSMA, 331 acres meet the definition of cropland in the Groundwater Protection Rule (GPR). The GPR applies to the 331 acres of cropland within this DWSMA.

Figure 1. Rockwood Estates DWSMA Vulnerability Designated by the MDH.



The MDA relies on the water quality data provided by the MDH to evaluate nitrate-nitrogen levels in the public water supply (Figure 2). Nitrate data received from the MDH in 2022 included a nitrate trend analysis for the Rockwood Estates DWSMA projecting nitrates to exceed 10 mg/L within 10 years (Figure 3).

Figure 2. Rockwood Estates public well nitrate data through February 2024. See Table 10 for specific well information.

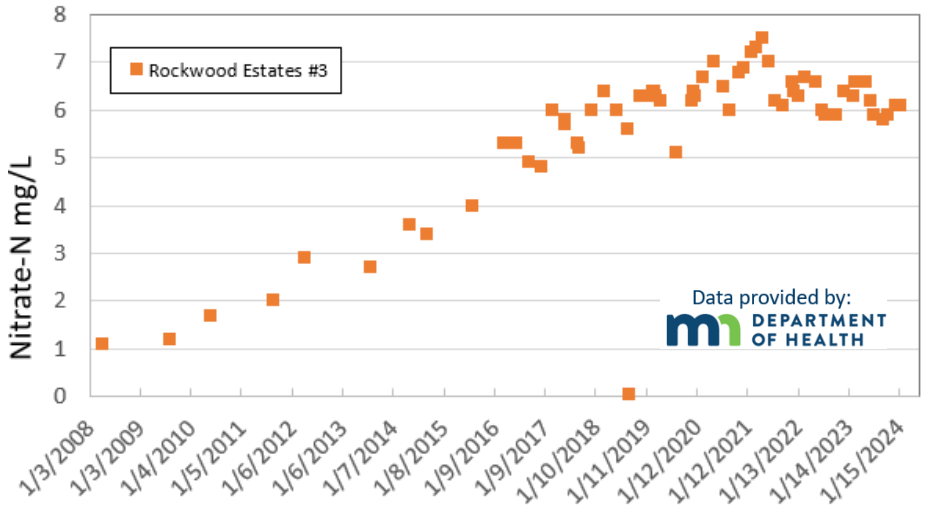


Figure 3. Nitrate trend analysis of Rockwood Estates public well nitrate data collected January 2012 through April 2022. See Table 11 for specific well information.

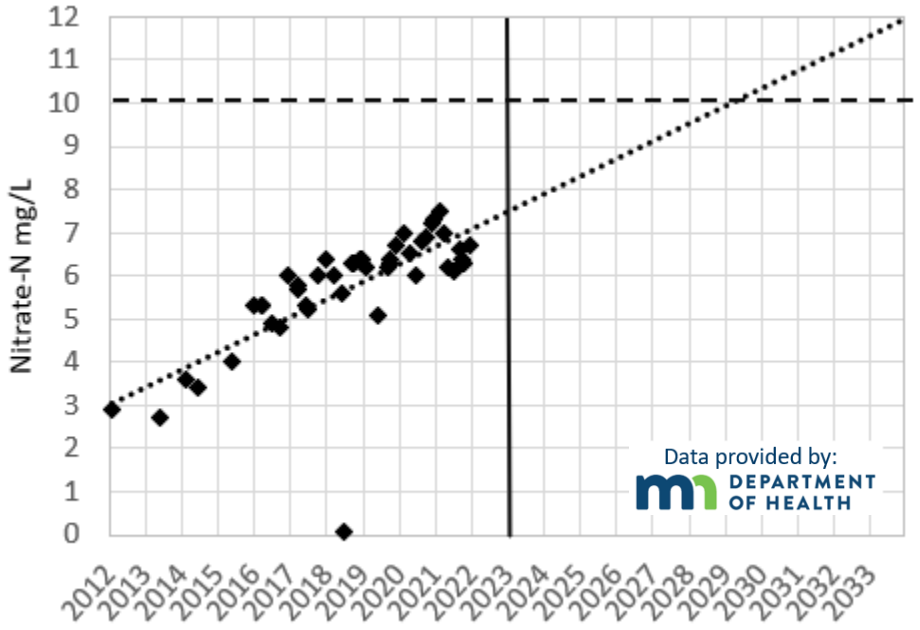


Table 1. City of Rockwood Estates public well information.

Local Well ID	MDH Status	Casing Diameter (in)	Casing Depth (ft)	Well Depth (ft)	Date Constructed
Well #3	Primary	8	129	137	2003

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 the public well exceeding the criteria for mitigation level designation (Minnesota Statute 1573.0040, Subp. 3, C). In the Rockwood Estates DWSMA, the MDA review did not identify a point source for

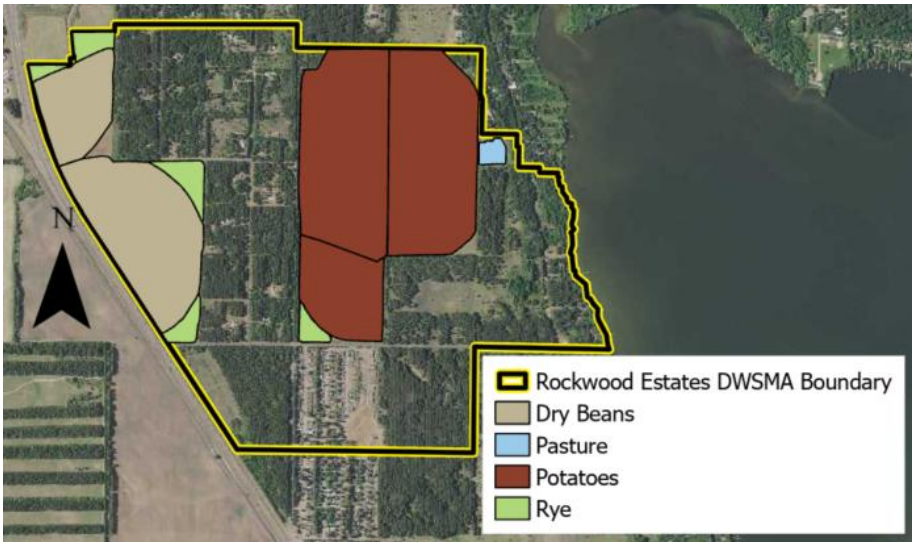
nitrate-nitrogen. With nitrate levels projected to exceed 10 mg/L within ten years and without a point source contribution, this DWSMA was designated at Mitigation Level 2 under Part 2 of the Groundwater Protection Rule in January 2023 (Minnesota Statute 1573.0040, Subp. 7, C, 2).

Part 2 of the Groundwater Protection Rule responds to DWSMAs which have 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 Rockwood Estates designated at Level 2, the MDA works with a local advisory team (LAT) including local farmers, agronomists, and others to get input on agricultural practices that can reduce nitrate levels in groundwater.

The Groundwater Protection Rule 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 (hosted on Crop Scape)[1] in the Rockwood Estates DWSMA shows that 39% of the landcover is cropland (Figure 4).

Figure 4. 2022 cropland cover in the Rockwood Estates DWSMA based on the USDA Cropland Data Layer. See Table 3 for specific 2022 cropland cover information.



In addition to review of cropping history, the MDA also surveyed farmers to understand the nitrogen fertilizer management practices used in the Rockwood Estates area. The MDA was able to obtain farming information for all the cropland acres across the DWSMA where nitrogen fertilizer is applied. 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. With computer modeling tools, the MDA compares nitrogen leaching loss below current nitrogen fertilizer management and under management changes proposed to protect groundwater. 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.

Table 2. Rockwood Estates DWSMA Cropland Rotations

Crop Rotation (2013-2022)	Acres	% of Cropland (416 acres total)
Corn-Dry Beans-Potatoes	307	93%
Rye	21	6%
Pasture	3	1%

Due to the small number of operators farming 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

[1] National Ag Statistics Service (NASS) Cropland Data Layer (Feb 2023 release). Retrieved from https://www.nass.usda.gov/Research_and_Science/Cropland/Release/index.php

assessment of farm practices. If farm practice information could identify an individual, it is considered private information and cannot be shared by the MDA.

Based on the detailed nitrogen fertilizer use information the MDA was able to collect within this DWSMA, nitrogen rates are within University of Minnesota guidelines, nitrogen applications are split, all nitrogen sources are accounted for, and nitrogen credits from previous legume crops are taken. Most of the BMPs recommended by the University of MN for the cropping rotations and soil types present within this DWSMA are currently being used.

Within the Rockwood Estates DWSMA the crops grown in 2022 included dry beans, potatoes, rye, and pasture (Table 3). Corn is not shown in the 2022 crop year, but this is another important crop grown in this DWSMA.

Table 3. 2022 Rockwood Estates DWSMA Cropland Cover

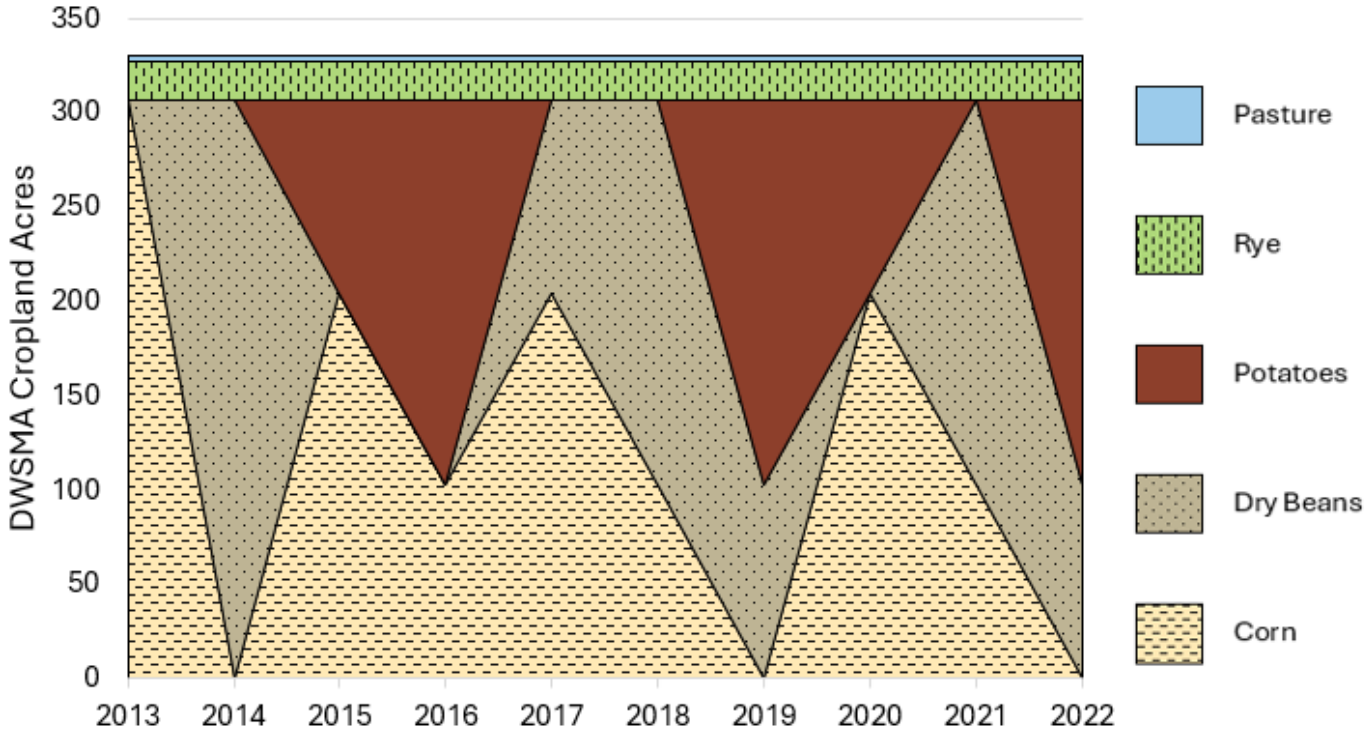
Crop Type	**Acres**	**% of Cropland** (416 acres total)
Dry Beans	101	31%
Potatoes	204	62%
Rye	21	6%
Pasture	3	1%

The MDA has also reviewed the USDA Cropland Data Layer[1] over the past ten years in the Rockwood Estate DWSMA. During this time, corn, dry beans and potatoes have been the primary crops grown (Table 4 and Figure 5). The crop rotation on irrigated acres during this ten-year history is corn-dry beans-potatoes with at least two of these crops growing in the DWSMA every year since 2015 (Table 4 and Figure 5).

Table 4. Rockwood Estates DWSMA cropland crop history 2013-2022.

Year	**Corn** Acres	**Corn** % of Cropland	**Dry Beans** Acres	**Dry Beans** % of Cropland	**Potatoes** Acres	**Potatoes** % of Cropland	**Rye** Acres	**Rye** % of Cropland	**Pasture** Acres	**Pasture** % of Cropland
2013	307	93%					21	6%	3	1%
2014			307	93%			21	6%	3	1%
2015	204	62%			103	31%	21	6%	3	1%
2016	103	31%			204	62%	21	6%	3	1%
2017	204	62%	103	31%			21	6%	3	1%
2018	103	31%	204	62%			21	6%	3	1%
2019			103	31%	204	62%	21	6%	3	1%
2020	204	62%			103	31%	21	6%	3	1%
2021	103	31%	204	62%			21	6%	3	1%
2022			103	31%	204	62%	21	6%	3	1%

Figure 5. Rockwood Estates DWSMA cropland crop history graph 2013-2022. See Table 4 for more information.



DWSMA Nitrate-Nitrogen Loss Below Cropland

Using a crop and soil computer simulation model called the Decision Support System Agrotechnology Transfer (DSSAT) (www.dssat.net), the University of Minnesota worked with the MDA to estimate the nitrogen loss in the Rockwood Estates DWSMA comparing the nitrogen management practices used in the recent past with the nitrogen loss below alternative practices. The table below shows the crop rotations modeled within the Rockwood Estates DWSMA (Table 5). Including a cover crop following potatoes and accounting for all nitrogen credits in the total nitrogen rate applied results in an estimated 6.9% reduction in annual nitrogen loss (Table 6). Additional practices adopted in the DWSMA to support groundwater protection include growing a pea/forage crop and alfalfa on a portion of the cropland acres. Modeling estimates a 30% reduction in nitrogen loss is accomplished with these changes (Table 7).

With most of the nitrogen fertilizer BMPs applicable to the crop and soils present already in use within the DWSMA, MDA modeling considered additional practices (Table 8) and AMTs (Table 9). These practices go above and beyond already adopted BMPs and can further reduce nitrogen loss below the root zone. If AMTs were adopted the model estimates that nitrogen leaching below the rootzone within this DWSMA could be reduced by the percentages shown in Tables 8 and 9. These are voluntary practices. Working with local farmers this list will be promoted and when possible, funding will be identified to support adoption of these practices.

Table 5. Rockwood Estates DWSMA cropland rotations that MDA modeling estimated nitrate-nitrogen loss below following current nitrogen management practices.

Crop Rotation	Acres
Corn-Dry Beans-Potatoes	307
Rye-Rye	21
Pasture	3

Table 6. Rockwood Estates DWSMA modeled nitrate-nitrogen loss reductions below listed nitrogen fertilizer BMPs.

Nitrogen Fertilizer Best Management Practice	Acres within the DWSMA	Nitrogen Loss Reduction
Nitrogen crediting	307	1.5%
Cover crop following potatoes	307	5.4%

Table 7. Modeled nitrogen loss reductions below additional practices and AMTs voluntarily adopted in the Rockwood Estates DWSMA to support protection of this drinking water source.

Management Change	Acres within the DWSMA	Nitrogen Loss Reduction	Notes
Convert Corn-Dry Bean-Potato rotation to Corn-Dry Bean-Potato-Peas/Forage-Dry Bean-Potato	103	6.0%	Extending a 3-year rotation into 6 years by replacing corn with a pea crop followed by a forage crop in the fourth year of the 6-year rotation.
Convert Corn-Dry Bean-Potato rotation to Corn-Dry Bean-Potato-Alfalfa (x3)	204	24.0%	Extending a 3-year rotation into 6 years by adding 3 years of perennial alfalfa hay into the rotation.

Table 8. Rockwood Estates DWSMA modeled nitrogen loss below additional practices considered by the Rockwood Estates LAT.

Management Change	Acres within the DWSMA	Nitrogen Loss Reduction	Notes
Convert Corn-Dry Bean-Potato rotation to Corn-Dry Bean-Potato-Peas/Forage-Dry Bean-Potato	307	17%	Extending a 3-year rotation into 6 years by replacing corn with a pea crop followed by a forage crop in the fourth year of the 6-year rotation.

Table 9. Rockwood Estates DWSMA modeled nitrogen loss below AMTs considered by the Rockwood Estates LAT.

Management Change	Acres within the DWSMA	Nitrogen Loss Reduction	Notes
Convert Corn-Dry Bean-Potato rotation to Corn-Dry Bean-Potato-Alfalfa (x3)	307	36%	Extending a 3-year rotation into 6 years by adding 3 years of perennial alfalfa hay into the rotation.
Convert Corn-Dry Bean-Potato rotation to Corn-Alfalfa (x3)	307	51%	Converting a corn-dry bean-potato rotation to corn followed by 3 years of perennial alfalfa hay.

MDA Recommended Nitrogen Fertilizer Best Management Practices for the Rockwood Estates DWSMA

In consultation with the local advisory team that includes farmers and agronomists managing cropland within the DWSMA, the MDA has developed the following list of BMPs to protect groundwater. A more detailed list of these BMPs is available at www.mda.state.mn.us/rockwoodestatesmhp-dwsma.

- Apply nitrogen to irrigated corn in a corn-soybean rotation at or below the 0.10 MRTN in the University of Minnesota's nitrogen fertilizer application guidelines.
- Apply nitrogen to irrigated corn in a corn-corn rotation at or below the 0.10 MRTN in the University of Minnesota's nitrogen fertilizer application guidelines.
- Apply nitrogen to dryland corn in a corn-soybean rotation at or below the 0.125 MRTN in the University of Minnesota's nitrogen fertilizer application guidelines.
- Apply nitrogen to dryland corn in a corn-corn rotation at or below the 0.125 MRTN 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.

- Split applications of nitrogen fertilizer for corn and edible beans.
- On coarse textured soils use nitrogen stabilizer on labeled crops when applying at early sidedress.
- Use a nitrogen rate for potatoes based on variety, harvest date, and realistic yield goals.
- Limit the rate of starter nitrogen applied to potatoes.
- Plant a fall cover following potatoes whenever possible.

The MDA will conduct an evaluation in this Level 2 DWSMA to determine whether these nitrogen fertilizer BMPs have been 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 Rockwood Estates DWSMA the MDA has reviewed the cropping history, surveyed nitrogen management practices, modeled nitrogen loading estimates below existing nitrogen fertilizer management practice and alternative practices.

Based on our farmer and fertilizer dealer survey, most of the current University of Minnesota nitrogen fertilizer BMPs are being followed on all cropland acres within the DWSMA. University of Minnesota nitrogen rate guidance is being followed for all crops, corn nitrogen rates are below the 0.10 MRTN, all nitrogen sources are considered, nitrogen applications to corn are split, and nitrogen credits from legumes are counted.

Modeling of nitrogen loss below additional nitrogen crediting included in the BMP list and the practice of planting a fall cover crop after potatoes estimates a nitrogen loss reduction of 6.9%. In addition to these reductions, the addition of a pea/forage crop and alfalfa in the rotation on a portion of the cropland acres in this DWSMA reduces nitrogen loss by 30%. Modeling of additional practices and alternative management tools within this DWSMA illustrate options that can further reduce nitrogen loss below the crop root zone. These options were developed in consultation with the LAT. The MDA will continue to work with producers in this DWSMA to seek opportunities for adoption of these practices and explore possible funding sources to support this.

In addition to the nitrogen loss reductions accomplished with these changes, the MDA recognizes that 100% of the cropland in the DWSMA where nitrogen fertilizer is applied is certified under the Minnesota Agricultural Water Quality Certification Program. This is a voluntary certification assuring that the producers farming this cropland are using conservation practices to protect Minnesota's water resources.

Based on the understanding and information provided above, the MDA believes that the recommended nitrogen management practices within the Rockwood Estates DWSMA are appropriate and that over the long-term the continued use of these practices along with the adoption of Alternative Management Tools and additional practices identified will reduce nitrate-nitrogen loss below cropland. Promotion and funding to support the establishment of alternative practices within the Rockwood Estates DWSMA will be a priority.

Supplemental Data

The following tables are supplemental information for the "Rockwood Estates DWSMA Groundwater Protection Rule Summary". The data included below is presented as a graph in Figure 2 and Figure 3 in the summary document.

Table 10. Rockwood Estates public well nitrate data through February 2024

Well Number	Collection Date	Nitrogen Test Levels in mg/L
3	11/24/2003	1
3	7/22/2004	0.94
3	4/25/2005	0.59
3	7/26/2006	1.7
3	8/23/2007	1.2
3	4/8/2008	1.1
3	8/4/2009	1.2
3	5/26/2010	1.7
3	8/29/2011	2
3	4/4/2012	2.9
3	7/31/2013	2.7
3	5/7/2014	3.6
3	9/8/2014	3.4
3	8/10/2015	4
3	3/16/2016	5.3
3	6/15/2016	5.3
3	6/15/2016	5.3
3	9/19/2016	4.9
3	12/14/2016	4.8
3	3/7/2017	6
3	6/7/2017	5.7
3	6/7/2017	5.8
3	8/28/2017	5.3
3	9/12/2017	5.2
3	12/19/2017	6
3	3/13/2018	6.4
3	6/12/2018	6
3	8/29/2018	5.6
3	9/12/2018	0.05
3	12/3/2018	6.3
3	12/20/2018	6.3
3	2/28/2019	6.4
3	3/12/2019	6.4
3	3/18/2019	6.3
3	4/29/2019	6.2
3	8/14/2019	5.1
3	12/5/2019	6.2
3	12/19/2019	6.4
3	12/30/2019	6.3
3	2/26/2020	6.7
3	5/12/2020	7
3	7/21/2020	6.5
3	9/8/2020	6

Well Number	Collection Date	Nitrogen Test Levels in mg/L
3	11/17/2020	6.8
3	12/15/2020	6.9
3	2/17/2021	7.2
3	3/18/2021	7.3
3	4/28/2021	7.5
3	6/20/2021	7
3	7/28/2021	6.2
3	9/21/2021	6.1
3	11/29/2021	6.6
3	12/14/2021	6.4
3	1/12/2022	6.3
3	3/2/2022	6.7
3	5/24/2022	6.6
3	7/1/2022	6
3	7/26/2022	5.9
3	10/17/2022	5.9
3	12/9/2022	6.4
3	2/13/2023	6.3
3	3/1/2023	6.6
3	5/25/2023	6.6
3	6/21/2023	6.2
3	7/12/2023	5.9
3	9/25/2023	5.8
3	10/24/2023	5.9
3	12/19/2023	6.1
3	1/22/2024	6.1

Table 11. Nitrate trend analysis of Rockwood Estates public well nitrate data collected January 2012 through April 2022

Well Number	Collection Date	Nitrogen Test Levels in mg/L
3	4/4/2012	2.9
3	7/31/2013	2.7
3	5/7/2014	3.6
3	9/8/2014	3.4
3	8/10/2015	4
3	3/16/2016	5.3
3	6/15/2016	5.3
3	6/15/2016	5.3
3	9/19/2016	4.9
3	12/14/2016	4.8
3	3/7/2017	6
3	6/7/2017	5.7
3	6/7/2017	5.8
3	8/28/2017	5.3
3	9/12/2017	5.2
3	12/19/2017	6

Well Number	Collection Date	Nitrogen Test Levels in mg/L
3	3/13/2018	6.4
3	6/12/2018	6
3	8/29/2018	5.6
3	9/12/2018	0.05
3	12/3/2018	6.3
3	12/20/2018	6.3
3	2/28/2019	6.4
3	3/12/2019	6.4
3	3/18/2019	6.3
3	4/29/2019	6.2
3	8/14/2019	5.1
3	12/5/2019	6.2
3	12/19/2019	6.4
3	12/30/2019	6.3
3	2/26/2020	6.7
3	5/12/2020	7
3	7/21/2020	6.5
3	9/8/2020	6
3	11/17/2020	6.8
3	12/15/2020	6.9
3	2/17/2021	7.2
3	3/18/2021	7.3
3	4/28/2021	7.5
3	6/20/2021	7
3	7/28/2021	6.2
3	9/21/2021	6.1
3	11/29/2021	6.6
3	12/14/2021	6.4
3	1/12/2022	6.3
3	3/2/2022	6.7