as noted above, are not enough to ensure that groundwater be maintained in its natural condition or to ensure that nitrate-nitrogen concentrations will not exceed the MDH HRL.

Less Intrusive

Water quality varies significantly throughout the state. Current adoption of the nitrogen fertilizer BMPs is mixed based on region; they are adopted at higher rates in some parts of the state than others. In some places, implementing the nitrogen fertilizer BMPs will be more effective than in other places.

The proposed Rule is targeted in vulnerable groundwater areas and DWSMAs where nitrate-nitrogen concentrations meet certain criteria. Areas that do not meet the vulnerability criteria or that do not meet the nitrate-nitrogen criteria do not fall under regulation. The proposed Rule is designed to be tailored to local conditions and practices. The MDA could have developed a statewide rule requiring the implementation of the nitrogen fertilizer BMPs. Although this approach may have been less work for the MDA, the MDA believes that not actively engaging local farmers and their agronomists in problem-solving to address the local water quality concerns would be far less effective while also being more intrusive for farmers and the agricultural industry throughout the state.

4. Alternative methods of achieving the proposed Rule that were considered and rejected

Description of any alternative methods for achieving the purpose of the proposed Rule that were seriously considered by the MDA and the reasons why they were rejected in favor of the proposed Rule.

Alternatives considered regarding Statewide Water Resource Protection Requirements

Alternative of exclusively relying on water resource protection requirements in proposed Rule – The MDA considered a rule solely based on nitrate-nitrogen concentrations in groundwater and not restricting the application of nitrogen fertilizer in fall and on frozen soils. The second part of the proposed Rule defines a process in which time is allowed for input from local advisory teams and the adoption of nitrogen fertilizer BMPs. It also requires adoption of the nitrogen fertilizer BMPs if 80% of the cropland is not implementing the nitrogen fertilizer BMPs or if certain nitrate-nitrogen water quality criteria are met. The MDA rejected this alternative because restricting the application of nitrogen fertilizer in the fall and to frozen soils in vulnerable groundwater areas serves as a preventive measure in some areas and a mitigation measure in others, allowing MDA to meet its obligation to achieve the goals of 103H.001.

Alternatives considered to Drinking Water Supply Management Area: Mitigation Level Designation

Alternative of regulating townships –The MDA considered a rule that included regulatory levels and water resource protection requirements for private wells in vulnerable townships with high nitrate-nitrogen concentrations that were similar to those in the proposed Rule for DWSMAs. The MDA rejected this alternative because the DWMSAs are the highest priority in the NFMP and the need to make DWSMAs a high priority was a recurring theme in many comments on a draft rule. DWMAs represent the greatest concentration of population at risk from high nitrate. Public water suppliers face substantial costs for addressing nitrate in groundwater as discussed in this SONAR (Section 2). Additionally, the large land area represented by the townships would have required an entirely new program requiring significant resources that the MDA currently does not have. The MDA's current proposed framework allows it to focus its resources on the highest priority areas affecting the greatest number of people, thus having the greatest impact on public health. The MDA will continue to implement the work set out in the NFMP for townships, including private well testing, development and promotion of nitrogen fertilizer BMPs, establishing monitoring networks where feasible, and helping to form local advisory teams to involve local farmers and their advisors in water quality issues in their area.

5. Probable costs of compliance

Probable costs of complying with the proposed Rule, including the portion of the total costs that will be borne by identifiable categories of affected parties, such as separate classes of governmental units, businesses, or applicants.

Statewide Water Resource Protection Requirements

Fall application prohibition – For most farmers, complying with Part 1 of the proposed Rule should not result in additional costs. The MDA believes that most farmers in southeast and central Minnesota, where most vulnerable groundwater areas are located, already follow the nitrogen fertilizer BMP restricting fall application on vulnerable soils or in karst that applies to these areas. It is possible that some farmers may have some additional costs if certain events occur – such as fertilizer prices going up in the spring due to higher demand at that time. Some farmers might incur additional costs if they need to pay for additional help to get their fertilizer applied in the spring. However, these costs are speculative and difficult to quantify.

Suppliers of nitrogen fertilizer, as well as agricultural chemical facilities, could face additional shipping and storage costs since applications will occur in spring and summer. We heard this comment primarily from those entities in the northwest part of the state, but that area is excluded from Part 1 under the current proposed Rule.

Drinking Water Supply Management Area: Mitigation Level Designation

Farmers could face additional costs if nitrogen fertilizer BMPs are required in mitigation level 3 and mitigation level 4 of the proposed Rule. Examples include additional education, soil and

manure testing, using soil amendments, and splitting nitrogen fertilizer applications to apply smaller amounts at one time. However, most nitrogen fertilizer BMPs are developed to be economically viable and farmers may increase their profitability by following them.

Requiring the adoption of AMTs in DWSMAs for mitigation level 3 will increase overall costs, but the practices may only be required if funding is available, so it would not result in increased costs to Responsible Parties.

Water resource protection requirements in mitigation level 4 are based Minn. Stat. § 103H.275 and could increase costs. The criteria for evaluating water resource protection requirements cited in the statute include the use and effectiveness of best management practices, the product use and practices contributing to the pollution detected, economic factors, availability, technical feasibility, implementability, and effectiveness. Thus, economic factors and implementability are major considerations that are likely to prevent excessive increased costs to farmers. Further, the proposed Rule requires that these practices be selected in consultation with the Local Advisory Team (LAT), which should provide important input on which practices are practicable and implementable.

There will be no or limited additional costs to other units of government. The primary costs of implementing the proposed Rule will be borne by the MDA. The MDA will be using nitrate-nitrogen concentration data from public wells that the MDH is already required to collect through the Safe Drinking Water Act.

6. Probable costs of not adopting the proposed Rule

Probable costs or consequences of not adopting the proposed Rule, including those costs or consequences borne by identifiable categories of affected parties, such as separate classes of governmental units, businesses, or individuals.

If the proposed Rule is not adopted, public water suppliers dealing with high concentrations of nitrate-nitrogen will be required to continue to perform drinking water treatment while incurring increased costs, which can be very substantial. Public water suppliers who face high concentrations of nitrate-nitrogen in the future will need to take action. This could involve drilling a new well, blending from additional wells, or building a facility to treat water prior to consumption. Often current water pricing cannot cover the additional costs of new wells or treatment (MEQB, 2015), so public water suppliers have to raise water rates.

Public water suppliers are required to monitor quarterly if nitrate-nitrogen concentrations exceed 5.4 mg/L. If concentrations exceed 10 mg/L, public water suppliers must issue a drinking water advisory to the community and are required to take immediate steps to return to compliance, while monitoring, as directed by the MDH. Monitoring occurs until concentrations fall below the 10 mg/L nitrate-nitrogen limit. Residents, businesses and industries bear the economic cost of

water use restrictions during the drinking water advisory (paying for bottled water, and possibly business-related costs).

The section provides cost estimates for alternatives that public water supplies may consider providing safe drinking water to the public. The estimates come from the MDH, from a report developed by the MDA based on interviews with seven water suppliers, and from a report titled Addressing Nitrate in California's Drinking Water.

Installing a new well - In some cases, a new public water supply well may need to be installed in a deeper or uncontaminated aquifer. Communities face considerable costs for locating and drilling wells and associated needs such as land purchase and constructing pump houses and transmission mains. Interviews from public water suppliers in 2007 estimated drilling, pump installation and well housing costs of $162,000 in Park Rapids and $246,300 in Clear Lake (UM, 2016). A California report estimates small community costs range from $40,000 to $290,000 to drill new wells and $80,000 to $100,000 to drill deeper wells (UC Davis, 2012). Although deep aquifers tend to be lower in nitrate, the water pumped from them may require treatment to remove iron, manganese, sulfate, arsenic, or radium. Installing a new well is not an option if a deeper aquifer is not available or if other aquifers contain nitrate.

Source water blending – Some public water suppliers blend water from a high nitrate source with water from a low- or no-nitrate source. Costs for blending include labor, pumping, monitoring, and reduced capacity. This alternative blend depends on having a connection to a source of water that is low in nitrate with adequate capacity. Annual costs ranged from $900 to $3,000, and capital costs may include the need to replace pumps and add transmission mains ($500,000 or more) (MDH, Personal Communication. 2018).

Purchase water from another entity – This can be an option if a nearby water supplier is able to provide low nitrate water. Costs can be substantial including costs for building the infrastructure to distribute the water and to ensure the chemistry or treatment is adequate for the distribution system.

Treatment – Nitrate removal (treatment) may be the only feasible option in situations where an adequate quantity or quality of water is not available. Nitrate removal systems used by public water suppliers include:

- *Reverse Osmosis Process* – Pressure forces water through a semi-permeable membrane leaving most contaminants behind along with a portion of the rejected solution. For one municipal reverse osmosis system, the initial construction cost was more than $7 million. Estimated annual operating and maintenance costs for these types of treatment plants can range from tens of thousands of dollars to more than $100,000. Disadvantages with this type of treatment is that the system

uses up to 4 gallons of water for every gallon produced, has a large energy footprint, creates a salty waste product that is discharged to the environment, and it enhances corrosion potential for lead and copper exceedances in finished drinking water.

- *Anion Exchange Process* – Contaminated water is passed through a resin filled bead tank. The resin is saturated with chloride, which chemically trades places with the similarly charged nitrate ion. Eventually the resin needs to be recharged by back washing it with a sodium chloride solution. Construction costs range from $300,000 for a nonmunicipal system to more than $4 million for a municipal system, with annual maintenance costs at $7,000 to $22,000, or more. Disadvantages with this type of treatment is that it creates a salty waste product that is discharged to the environment, and it enhances corrosivity potential for lead and copper in finished drinking water.

According to the report based on interviews with public water suppliers, the installation and maintenance of municipal nitrate removal systems increased the cost of water delivered by fourfold or more. Additional costs range from $0.82 to $7.23 to produce 1,000 gallons. Communities with treatment also need to hire staff with higher class licenses and provide an adequate payscale to operate the treatment plant. These additional costs are passed on to rate payers.

The MDH estimates that the number of community water systems that treat for nitrate has increased from six systems serving 15,000 people in 2008 to eight systems serving 50,000 people in 2014. For communities with nitrate-nitrogen above 10 mg/L, annual costs over the five-year period of 2011 to 2016 ranged from $46 to $7,900 per household. Six noncommunity systems exceeded the 10 mg/L nitrate-nitrogen MDH HRL in 2016, requiring system owners to take corrective action (MDH, 2017). If community water systems that either sealed a well or removed a well from use are included, the number of affected communities increased to 56 between 1994 and 2016 (MDH, Personal Communication., 2018).

7. Assessment of differences between proposed Rule and federal regulations

The proposed Rule covers areas that are not addressed by federal law; therefore, this consideration is not applicable for those portions of the proposed Rule.

8. Assessment of cumulative effect of Rule with federal and state regulations

Minn. Stat. § 14.131 defines *"cumulative effect" as "the impact that results from incremental impact of the proposed rule in addition to other rules, regardless of what state or federal agency*

has adopted the other rules. Cumulative effects can result from individually minor but collectively significant rules adopted over time."

There are no existing rules that regulate the use of nitrogen fertilizer. The proposed Rule is complementary to and works efficiently with existing regulations. Minn. R. chap. 7020 regulates animal feedlots and land application of manure. The proposed Rule does not regulate the application of manure, but manure application will need to be considered in order to determine the total amount of nitrogen fertilizer applied. The MDA has included a provision in the proposed Rule to allow the use of manure management plans and related approvals and inspections to document that appropriate nitrogen fertilizer BMPs are being followed as an efficiency option.

The MDH has the authority to administer the Safe Drinking Water Act in Minnesota. Public water suppliers monitor drinking water. Residents are informed, and corrective action is action if nitrate-nitrogen exceeds the 10 mg/L MDH HRL. The actions public water suppliers pursue involve providing alternative sources of safe water (MDH, 2015). The proposed Rule will complement these existing requirements by addressing nitrogen fertilizer, which is one of the main sources of nitrate in groundwater, prior to public water supplies reaching the 10 mg/L HRL.

E. Cost of Complying for Small Business or City

Minn. Stat. § 14.127, subd. 1. states, *"An agency must determine if the cost of complying with a proposed rule in the first year after the rule takes effect will exceed $25,000 for: (1) any one business that has less than 50 full-time employees; or (2) any one statutory or home rule charter city that has less than ten full-time employees. For purposes of this section, "business" means a business entity organized for profit or as a nonprofit, and includes an individual, partnership, corporation, joint venture, association, or cooperative."*

The rule does not apply to cities; therefore, there will be no cost to them.

The MDA does not believe that compliance with Part 1 of the rule will exceed $25,000 for any Responsible Party subject to the fall restriction. As noted above, most farmers in vulnerable groundwater areas already are not fall applying, or they should not be fall applying according to University of Minnesota BMPs. Potential scenarios where a Responsible Party would incur a cost of more than $25,000 would either be based on voluntary choices made by the Responsible Party, or are very speculative.

The MDA does not believe that compliance with Part 2 of the rule will exceed $25,000 for any responsible party subject to the rule within the first year after the rule takes effect. As noted in 1573.0060, Drinking Water Supply Management Areas will be initially designated level 1 or level 2 – both of which involve solely voluntary measures. Under part 2 of the rule, a Responsible Party

cannot move to a level with mandatory regulations until after at least three growing seasons. DWSMAs can only move up one level at a time, so the first year of regulation that any Responsible Party would face would be level 3, which would entail a commissioner's order requiring implementation of nitrogen fertilizer BMPs. The nitrogen fertilizer BMPs are designed to be economically viable and their adoption in most cases will not result in any increased costs and should result in profitable to farmers. In level 3, the commissioner could order the implementation of AMTs but only if they are funded, so that will not result in increased costs.

F. Determination About Rules Requiring Local Implementation

The proposed Rule will not apply to local government (LGUs) because there is no requirement that a LGU must adopt any or all of this proposed Rule. The MDA has sole authority for the proposed Rule and the regulations therein. The MDA notes that there is no state pre-emption of local regulation of the use of nitrogen fertilizer (Minn. Stat. chap. 18C). A LGU may choose to regulate the use of nitrogen fertilizer with or without the MDA's proposed Rule.

G. Performance-Based Regulatory Systems

The SONAR must describe how the MDA, in developing the proposed Rule, considered and implemented the legislative policy supporting performance-based regulatory systems set forth in section 14.002 which states, *"whenever feasible, state agencies must develop rules and regulatory programs that emphasize superior achievement in meeting the agency's regulatory objectives and maximum flexibility for the regulated party and the agency in meeting those goals."*

Part 1 of the proposed Rule restricts the application of nitrogen in the fall and on frozen soils in vulnerable groundwater areas. This rule contains performance-based standards in that the proposed Rule focuses on areas that are most vulnerable to nitrates leaching into groundwater. The area covered in this proposed Rule includes quarter-sections that are equal to or greater than 50% vulnerable and does not include quarter-sections less than 50% vulnerable. Rather than regulate on invisible lines, the use of known boundaries is clearer for regulated parties. The proposed Rule is also performance-based in that, in Part 2, all of the regulations will be based on objective measures, such as documented increase in nitrates or the failure to implement BMPs, which are aimed at achieving the goal of the Groundwater Protection Act.

The proposed Rule also incorporates maximum flexibility for regulated parties and the MDA in achieving the MDA's regulatory goals. Some areas of the state are excluded based on climate or

where counties are less than 3% agriculture. Exceptions are made in cases where fall fertilization is necessary and for fertilizers where phosphorus or micronutrients are included, among others.

In Part 2 of the proposed Rule, the primary purpose is to work with farmers to come up with local solutions to address nitrate levels in groundwater. The approach is designed to allow flexibility and for local input to influence the practices that are adopted or required in a DWSMA. Under the site specific water resource requirements, DWSMAs meeting the criteria will start in voluntary mitigation levels 1 or 2. This provides time for discussion and the formation of a local advisory team. The Local advisory teams will advise the MDA commissioner on the nitrogen fertilizer BMPs that should be adopted in that area, based on soils, crops grown, equipment available and other factors. Farmers will have at least 3 growing seasons to adopt the practices and to address nitrate levels. Farmers also have the option of implementing Alternative Management Tools, which are designed to go beyond the nitrogen fertilizer BMPs and to be local solutions. All of these factors make for a proposed Rule that meets the MDA's regulatory objectives and provides maximum flexibility for the regulated party.

H. Consultation with MMB

The MDA will consult with Minnesota Management and Budget (MMB) as required by Minn. Stat. § 14.131. The MDA will do this by sending MMB copies of the proposed Rule, SONAR and proposed Rule and SONAR form that will be sent to the Governor's office for review and approval prior to publication. The MDA will send these to MMB on, or near, the same day they are submitted to the Governor's office, well in advance of publishing the proposed Rule in the State Register. A copy of the correspondence and any response received from MMB will be included in the record the MDA submits to the Office of Administrative Hearings (OAH) for the required Administrative Law Judge's review.

I. List of Witnesses

If the proposed Rule goes to a public hearing, it is anticipated that the MDA will be represented by the following personnel involved at the administrative hearing on the need for and reasonableness of the proposed Rule.

1. Susan Stokes – Assistant Commissioner, Minnesota Department of Agriculture
2. Doug Spanier – Department Counsel, Minnesota Department of Agriculture
3. Dan Stoddard – Assistant Director, Pesticide and Fertilizer Management Division
4. Bruce Montgomery – Manager, Fertilizer Non-Point Section

J. Public Participation and Stakeholder Involvement

The proposed Rule has been in development for several years and the MDA has made extensive efforts to inform and engage specific stakeholders and the general public. The MDA used a number of mechanisms to encourage public participation and provide access to information.

Minn. Stat. §103H.275, subd. 2(b) requires the Commissioner of Agriculture to notify affected persons and businesses for comments and input in developing the water resource protection requirements. The MDA believes that it has met this requirement by conducting the activities outlined below. These activities are also part of the MDA's efforts to provide additional notification under Minn. Stat. § 14.14, subd. 1(a), to persons or classes of persons who may be affected by the proposed Rule.

1. Pre-proposal outreach and notice

The MDA began outreach activities with the updating of the NFMP in 2010 and these activities will continue beyond the adoption of the proposed Rule. The draft rules were part of the activities to address nitrate in groundwater included in the NFMP. This section describes the MDA's public outreach efforts.

Nitrogen Fertilizer Management Plan Advisory Committee

In revising the 1990 NFMP, the MDA used an advisory committee that consisted of representatives from the agricultural community, the environmental community, state and local government, and representatives from the U of M. The input from this advisory committee as well as the NFMP (which was revised and adopted in 2015) was used as guidance for the proposed Rule. (MDA, 2015).

Website – The Nitrogen Fertilizer Rule website (www.mda.state.mn.us/nfr) was created to provide information on the draft rule and the rulemaking process to interested parties. The availability of this website was included in correspondence with interested parties and linked to by other related websites. The website included information on the rulemaking process, details regarding components of the draft rule, and information about listening sessions held throughout the state and frequently asked questions (FAQs) about the rule. Also included was a comment page where persons were able to submit comments directly to the MDA. Drafts of the rule were also posted to the website. The website also provides MDA staff contact information if someone wished to contact the department directly.

A website was also created for the revision of the NFMP. This website contained factsheets, drafts of the revised NFMP, and links to other sites with information about projects related to the NFMP revision.

GovDelivery – GovDelivery is a self-subscription service that MDA uses to electronically notify interested or affected persons of various updates and public notices issued on a wide range of topics. Individuals can register their email address and choose the notifications they want to receive from the MDA at the following webpage:
https://public.govdelivery.com/accounts/MNMDA/subscriber/new

The Nitrogen Fertilizer Rule was added to the list of topics for subscribers when the service became available to the MDA in 2015. Prior to GovDelivery being available, the MDA used a different service for notifying large groups via email. The listserv from the previous service was copied to GovDelivery when MDA transferred services. A notice was sent via GovDelivery when the Request for Comments became available for comment. Notice was also sent to this list when the draft Nitrogen Fertilizer Rule was made available for comment. Reminders were also sent regarding the listening sessions. The MDA will continue to use GovDelivery to inform stakeholders about the proposed Rule and the implementation of the NFMP.

Request for Comments – A Request for Comments on the Nitrogen Fertilizer Rule was published in the State Register on Monday, October 26, 2015. The MDA received 23 original written comments and over 100 copies of a form letter. These letters were made available on the MDA's website at http://www.mda.state.mn.us/chemicals/fertilizers/nutrient-mgmt/nitrogenplan/mitigation/wrpr/wrprcomments.aspx. These comments were considered by the MDA when drafting the language for the proposed Rule. The MDA asked for comments on specific areas proposed in the Rule, but also requested any additional information stakeholders thought might be relevant any comments interested parties wished to provide.

Public Presentations – Several public presentations were made to various groups throughout the state of Minnesota to gather input from various groups prior to, and during the writing the rules.

- Groundwater Conference, October 2016
- Nitrogen Conference, February 2017
- Nutrient Conference, February 2017

Draft Nitrogen Fertilizer Rule Comment Period – The MDA made a draft of the rule available for public comment. This draft was published on the MDA's website, distributed via the GovDelivery email list, and the MDA had a comment period open from June 7, 2017 until August 25, 2017. The comment period was originally scheduled to end on August 11, but after requests for an extension by many interested parties, especially agriculture associations and industry, the MDA extended it until August 25th. During this time the MDA received over 820 comments, held 11 listening sessions throughout the state and gave presentations at 6 invited meetings.

Listening Sessions on the Draft Rule – After the draft of the rule was published on June 7, 2017 the MDA held eleven public listening sessions at locations throughout the state in order

inform stakeholders and interested parties about the Nitrogen Fertilizer Rule. Each of these listening sessions included a formal presentation by MDA regarding details of the draft rule, followed by participant questions and answers. Listening Sessions were held at the following locations:

Table V-1. Draft Nitrogen Fertilizer Rule listening session locations, dates and times: June 2017.

Location		Date	Time
Marshall:	**Marshall Public Library 201 C Street Marshall, MN 56258**	Thurs. June 22	5:00 pm
Chatfield:	**Chatfield Center for the Arts 405 Main Street Chatfield, MN 55932**	Wed. June 28	6:00 pm
Farmington:	**University of MN Extension Office 4100 220th St W. Farmington, MN 55024**	Thurs. June 29	2:00 pm
St. Cloud:	**Great River Regional Library 1300 W. St. Germain Street St. Cloud, MN 56301**	Thurs. July 6	3:00 pm
Wadena:	**Robertson Theatre Wadena-Deer Creek High School 600 Colfax Ave. SW, Wadena, MN 56482**	Tues. July 11	6:00 pm
McIntosh:	**McIntosh Community Center 115 Broadway NW, McIntosh, MN 56556**	Wed. July 12	4:00pm
St. Paul:	**Orville Freeman Building 625 Robert Street North, St. Paul, MN 55155**	Mon. July 17	2:00pm
Fairmont:	**Holiday Inn 1201 Torgerson Dr. Fairmont, MN 56031**	Tues. July 25	2:00pm
Roseau:	**Roseau Civic Center 121 Center Street East Roseau, MN 56751**	Wed. July 26	6:30 pm
Warren:	**Warren Community Center 110 West Johnson Avenue Warren, MN 56762**	Thurs. July 27	8:30 am
Hawley:	**Hawley High School 714 Joseph Street Hawley, MN 56549**	Thurs. July 27	7:00 pm

After the publication of the draft rule the MDA also gave presentations and received feedback from groups requesting that the MDA provide more information on the proposed Rule. These additional meetings included:

Table V-2. Draft Nitrogen Fertilizer Rule presentation locations and dates: July 2017-December 2017.

Additional Meetings	Location	Date
Greater Blue Earth River Basin Alliance	Mankato, MN	Friday, July 14, 2017
Soybean Growers Meeting	Mankato, MN	Thursday, July 20, 2017
Corn Growers Meeting	Shakopee, MN	Thursday, July 27, 2017
MCPR Member Meeting	Morgan, MN	Monday, July 31, 2017
MPCA/MDA meeting on Nitrogen Fertilizer Rule	MPCA office, St. Paul, MN	Friday, August 11, 2017
MCPR Member Meeting	Cold Spring	Wednesday, August 16, 2017
Cooperative Network Farm Supply, Grain and Fuel Committee	Brainerd, MN	Wednesday, September 6, 2017
BWSR Board Presentation	St. Paul, MN	Wednesday, October 25, 2017
Minnesota Association of Townships Annual Meeting	Rochester, MN	Friday, November 17, 2017
Minnesota Association of Soil and Water Conservation Districts Annual Meeting	St. Paul, MN	Tuesday, December 5, 2017

In addition, the MDA held six stakeholder listening sessions in conjunction with Governor Dayton's 25 by 25 listening sessions. The rule was a primary topic addressed in those listening sessions. Those meetings were held at the following locations and dates:

Table V-3. MDA listening sessions held in conjunction with the 25 by 25 listening sessions.

Location	Date
Rochester	Monday, July 31, 2017
Mankato	Wednesday, August 16, 2017
Marshall	Thursday, August 17, 2017
Crookston	Tuesday, September 5, 2017
St. Cloud	Wednesday, September 6, 2017
Bemidji	Wednesday, September 13, 2017

2. Additional notice plan

Minn. Stat. §§ 14.131 and 14.22 require that the SONAR contain a description of MDA's efforts to provide additional notice to persons who may be affected by the proposed Rule.

Because of the degree of public interest in the proposed Rule, the MDA intends to conduct more outreach and public notice than the minimum required by the state Administrative Procedures Act. When the MDA publishes the Notice of Hearing, the MDA intends to conduct the following additional activities to ensure that all interested people and affected communities will be notified and have a chance to meaningfully engage in the comment process.

This additional notice plan was sent to the Office of Administrative Hearings for review and approval by Administrative Law Judge_____ on _____.

The additional notice plan consists of the following steps:

1. Mail the Notice of Hearing, proposed Rule and SONAR to all registered parties on the MDA's rulemaking list, per Minn. Stat. §14.14, subd. 1(a).
2. Email the Notice of Intent, proposed Rule and SONAR to the Minnesota Legislature per Minn. Stat. § 14.116.
3. Email the Notice of Intent, proposed Rule and SONAR to the House and Senate committees with jurisdiction over the environment, natural resources and agriculture as required in Minn. Stat. § 103H.275, subds. 2(a) and 1(c)(3).
4. Publish the Notice of Intent to Adopt Rules, a copy of the proposed Rule, and the SONAR on the MDA's Nitrogen Fertilizer Rule website for public viewing and comment.
5. Issue a press release announcing the publication of the Notice of Intent to Adopt Rules and directions on how to comment.
6. Email the Notice of Intent, proposed Rule and SONAR to all parties that were sent the Request for Comments in October 2015.
7. Email all parties who have expressed interest in the proposed Nitrogen Fertilizer Rule by signing up for a GovDelivery email mailing list.
8. Email the Notice of Hearing, proposed Rule language and SONAR to other governmental agencies – MDNR, MPCA, MDH, BWSR, and SWCDs.

The Additional Notice Plan does not include notifying the state Council on Affairs of Chicano/Latino People because the proposed Rule does not have a primary effect on Chicano/Latino persons.

K. Effect on Local Government Ordinances

The proposed Rule will not apply to local government because there is no requirement that a local government must adopt any or all of this proposed Rule. The MDA has sole authority for the proposed Rule and the regulations therein. The MDA notes that there is no state pre-emption of local regulation of the use of nitrogen fertilizer. A local government may choose to regulate the use of nitrogen fertilizer with or without the MDA's proposed Rule.

VI. Rule by Rule Analysis of Need and Reasonableness

A. 1573.0010 Definitions

The proposed Rule 1573.0010 defines the terms used throughout the proposed Rule parts 1573.0010 – 1573.0090. The definitions are necessary to ensure that the proposed Rule is clearly understood. The inclusion of definitions is reasonable so that the MDA may consistently apply the proposed Rule, and so that regulated and other affected parties do not become confused as to how to interpret the language contained in the proposed Rule.

Twenty-two terms used in the proposed Rule were identified as needing definitions. Seven of these terms and their associated definitions were derived from existing terms and definitions in other state statutes or rules including: *commissioner, drinking water supply management area, groundwater, municipal public water supply well, public well, responsible party, section*.

Fifteen terms are unique to this proposed Rule and are further described below.

Subp. 2. Definitions. – Alternative management tools (AMTs)

This definition is needed and reasonable in order to clarify that these are practices and solutions that are different from the nitrogen fertilizer BMPs as defined in this SONAR. AMTs are designed to go beyond the nitrogen fertilizer BMPs and be local solutions for addressing groundwater nitrate problems that are implemented on a site-specific basis. Local advisory teams will be able to identify and promote these beneficial practices (AMTs) that go beyond the nitrogen fertilizer BMPs. Examples include alternative cropping systems, low nitrogen input crops, continuous cover such as CRP, or putting perennials in key charge areas, and land swapping to shift high nitrogen using crops to non-vulnerable land. Precision agriculture is included in the definition to provide clarity to stakeholders that various precision agricultural techniques such as variable rate planting and fertilization, soil and plant tissue sampling, nitrogen enhancement products, and others are recognized and encouraged. This term comes from the NFMP, which serves as the basis for the proposed Rule. Further discussion about how these tools will be defined and where they will be available is discussed in this SONAR, under 1573.0090 Alternative Management Tools; Alternative Protection Requirements (MDA, 2015).

Subp. 3. Definitions. – Coarse textured soils

This definition is needed because coarse texture is an important criterion within the vulnerable area definition and needs to be defined in order to provide clarity to the regulated party. While ‘coarse textured soils’ is a commonly used term, its definition varies depending on the context within which it is used. A definition of coarse textured soils is needed because coarse texture is a physical characteristic of soil that makes underlying groundwater at a higher risk for contamination by agricultural chemicals (IPNI, 2018). The U of M nitrogen fertilizer BMPs

specify nitrogen fertilizer management practices for coarse textured soils, including not recommending fall nitrogen fertilizer application, regardless of form. However, a clear definition of 'coarse texture' is not provided in the nitrogen fertilizer BMPs (the term 'sandy soil' is used interchangeably with 'coarse textured soil'), therefore it is reasonable that the proposed Rule provide a definition in order to clearly define the soils where this criterion applies. The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) is the national source for soils information (Soil Survey Staff, n.d.). The USDA-NRCS definition is used in federal practice standards and technical assistance programs, and this soils data has been used by farmers, agriculture and natural resource professions for many years, therefore it is reasonable that the definition comes from the USDA-NRCS.

This definition of coarse textured soils also aligns with the definition used by the Minnesota Pollution Control Agency (MPCA) for applying manure in areas sensitive to leaching of nutrients through the bottom of the root zone (MPCA, 2005) and the USDA-NRCS Minnesota conservation practice standard for nutrient management (USDA NRCS, 2007).

Subp. 5. Definitions. – Cropland

This definition is needed to clarify for the regulated party what is included as 'cropland.' This term is based on the USDA National Agricultural Statistics Service (NASS) definition of cropland and includes the major and minor row crops, hay and silage crops, a variety of pasturing scenarios, idle cropland such as Conservation Reserve Program and other set aside programs, and numerous miscellaneous crops. NASS conducts hundreds of national agriculture-related surveys on cropland and other features each year, therefore it is reasonable to use the NASS definition of cropland. It is broadly understood and anticipated that these lands would receive commercial nitrogen fertilizer applications somewhere in the rotation, and the vast majority of these acres would receive annual or biannual applications of nitrogen fertilizer.

Commercial sod production acres fall under this definition as sod is harvested from the land surface as an annual crop. Turfgrass is not included in this definition as it is not removed for use as a food, forage, fiber or energy crop and is not used as pasture. Forestland is not included in the definition of cropland as the land remains covered by trees for multiple growing seasons, is minimally fertilized not typically in an agricultural rotation and the risk of nitrate movement to the groundwater under forestland is normally small.

Subp. 7. Definitions. – Fall application

The definition is needed so the MDA and regulated parties have clarity and a mutual understanding of when fall fertilizer restrictions apply. This term defines the time of year where application of nitrogen fertilizer has the greatest potential for runoff or leaching through the soil. Fall applications on coarse texture soils and in karst regions are not recommended by the nitrogen fertilizer BMPs, therefore a definition of fall application is needed to define when

nitrogen fertilizer application should not occur. This is a reasonable approach because a specific date provides the greatest clarity when this restriction goes into effect.

Subd. 8. Definitions. – Frozen soil

The term frozen soil is needed to define under what conditions nitrogen fertilizer should not be applied. When nitrogen fertilizer is applied to frozen soils, it is not able to be properly incorporated into the soil, resulting in a greater chance of fertilizer to runoff the soil surface or convert to a gaseous form. The MDA considered a definition of frozen soil using a temperature of 32 °F. However, this was ruled out, since there could be variability in soil temperature at different soil depths as well as variability by locations. In addition, it would take greater effort by the regulated parties to take temperature measurements and for the MDA to verify these. The MDA chose to use a more practical definition of frozen based on the physical ability to apply and incorporate fertilizer. Frozen soil is a commonly used term in the proposed Rule and defining it is reasonable to clarify the intent of the proposed Rule.

Subd. 10. Definitions. – Groundwater monitoring network

This definition is needed to define how the MDA may monitor shallow groundwater in a DWSMA. A groundwater monitoring network consists of multiple wells. The network will allow the MDA to determine the current nitrate levels in groundwater instead of waiting up to ten years to detect how nitrate levels in a public well respond to changes in agricultural practices in the DWSMA. It provides an approach to monitor nitrate in groundwater as required in Minn. Stat. § 103H.251, subd. 2.

Subd. 11. Definitions. – Growing season

This term is needed as it defines the timeframe and time of year in Minnesota where normal conditions for crop growth occur. The length of the growing season varies by crop and impacts the applicable nitrogen fertilizer BMPs. Growing season is a commonly used term in the proposed Rule and defining it is reasonable to clarify the intent of the proposed Rule.

Subd. 12. Definitions. – Lag time

The definition of this term is necessary to ensure the proposed Rule addresses, in a scientifically correct manner, how long it will take before changes in practices on the land surface will result in changes in water quality that can be observed in groundwater wells. Since regulatory requirements may be based on changes in water quality it is reasonable and necessary that the proposed Rule describe what lag time means. Since lag time is a method used by hydrogeologists in determining the potential impacts of surface land use on groundwater, it is reasonable that the MDA uses lag time criteria in the proposed Rule (Sousa et al., 2013).

Subd. 13. Definitions. – Leaching index

This term is needed to explain the risk of nitrate from nitrogen fertilizer moving through the root zone towards the groundwater in different parts of the state. The leaching index is calculated as the daily precipitation minus evapotranspiration (evaporation of water from the soil and from the vegetation) summed to annual values. The leaching index can be a positive or a negative number. A more negative leaching index indicates less water available for moving through the soil resulting in lower risk of nitrate leaching losses. The input data from the gridMET dataset is developed based on gridded climate data from the national PRISM dataset and reanalysis data from NASA's NLDAS-2 dataset (Abatzoglou, 2013). Evapotranspiration is estimated using the standardized, grass-based Penman-Monteith equation. (ASCE-EWRI, 2005)

Subd. 14. Definitions. – Local advisory team

The term local advisory team (LAT) comes from the NFMP. One of the goals of the proposed Rule is to involve the agricultural community in problem solving at the local level. This definition is needed in order to help meet that goal, and advise the MDA regarding appropriate response activities for the area and to support implementation of these activities. The team will help develop, communicate, and implement locally viable solutions to address elevated nitrate in the local project area. The intent is to develop a team which will consist of 15-20 people who are from the area, including farmers, crop advisors/consultants, representatives of local groups/organizations, representatives of public water supply systems (in Drinking Water Supply Management Areas, or DWSMAs), and government staff and/or professionals who can provide technical or financial support. The majority of the members will be local farmers and their crop advisors/consultants. It is reasonable that LATs be formed because they are best able to identify local conditions and nitrogen management practices to address nitrate in groundwater. In addition to LATs providing recommendations to the MDA on nitrogen fertilizer BMPs and other practices, successful LATs will provide credibility and support for the nitrogen management activities to be implemented.

Subp. 16. Definitions. – Nitrogen fertilizer best management practices

This term is needed to define the nitrogen fertilizer BMPs adopted under Minn. Stat. § 103H.151, subd. 2, the MDA developed best management practices (BMPs) for agricultural chemicals and practices specific to nitrogen fertilizer with the help of the U of M. The MDA gave public notice and solicited comments from affected persons and business interested in developing the nitrogen fertilizer BMPs and has updated these BMPs using the process outlined in Minn. Stat. § 103H.151, subd. 2, so as to reflect U of M updates to fertilizer recommendations. It is needed to provide farmers a set of practices to use to address nitrate in groundwater and is reasonable because the practices are based on U of M research.

Subp. 17. Definitions. – Nitrogen fertilizer

There are many different products that contain nitrogen and are used for agricultural purposes. This definition is needed to clarify what agricultural products are covered under the rule. This definition is reasonable because it is based on the definition of fertilizer in Minn. Stat. 18C.215 and modified based on public comment. Public comments were received stating that biosolids, industrial by-products, industrial wastewater, and irrigation water should not be included in this definition and they were removed.

Subp.19. Definitions. – Residual soil nitrate tests

For purposes of the proposed Rule, this term is needed to define the process of analyzing the results from soil samples between the root zone and the water table on an established time frame to evaluate changes in nitrate levels in soil. This definition is reasonable as this technique may be needed in areas where lag times are very long (typically in terms of decades) and where it may be cost prohibitive to install monitoring wells due to excess drilling depths.

Subp. 22. Definitions. – Spring frost-free date

The term was needed to specify the date where the probability of the last day of frost occurring in the spring is 10% or less. The spring frost-free date depends on the climate and varies across Minnesota. A later spring frost-free date indicates a shorter period in the spring to complete farm field operations and a greater risk of crops being damaged by frost. This is important for nitrogen fertilizer management because it is indication of when crops will be actively growing and using nutrients. The input data is from National Oceanic & Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) and is available through the Minnesota Department of Natural Resources (MDNR) State Climatology Office (MDNR, 2018).

Subp. 23. Definitions. – Vulnerable groundwater area

The term vulnerable groundwater area is needed to define the areas of the state where nitrate can move easily through the soil and/or bedrock to the groundwater. The criteria for this definition was developed using soil information from the USDA-NRCS (Soil Survey Staff, n.d.) and geology information from the MDNR to identify areas with the greatest risk of nitrate traveling into groundwater. In addition, the MDNR 'ultra-low' sensitivity layer (Adams, 2016) was used as a criterion to identify areas that are not vulnerable. A further discussion about the general need and reasonableness for this term can be found in this SONAR, 1573.0030 Statewide Water Resource Protection Requirements.

B. 1573.0020 Incorporation by Reference

Rather than repeating the content of these guidance documents in the proposed Rule, they are incorporated by reference. While not subject to frequent change, these guidance documents are updated more frequently than rules. These documents are all readily available on the MDA's website www.mda.state.mn.us/nfr/references.

C. 1573.0030 Statewide Water Resource Protection Requirements

Background on vulnerable groundwater areas

The proposed Rule restricts the application of nitrogen fertilizer in the fall and to frozen soils in vulnerable groundwater areas. Vulnerable groundwater areas are defined as:

- Coarse textured soils, as identified in the USDA-NRCS, Soil Survey Geographic Database (SSURGO) soil database (Soil Survey Staff, n.d.);
- Soils with shallow depth to bedrock as identified in the USDA-NRCS, SSURGO soil database, Web Soil Survey (Soil Survey Staff, n.d.); and
- Karst geology as identified in the Department of Natural Resources Pollution Sensitivity of Near-Surface Materials (Adams, 2016).

The MDA used the criteria above to define vulnerable groundwater areas, and it is needed, because of the increased risk of nitrogen fertilizer leaching into groundwater.

It is well established in research literature that nitrogen fertilizer is a source of nitrate, and nitrate, due to its high solubility in water can leach easily through soil to reach groundwater (IPNI, 2018). For this reason, U of M nitrogen fertilizer BMPs do not recommend fall nitrogen fertilization in vulnerable groundwater areas due to environmental and financial risk (Lamb, 2008). The financial risk is that a farmer applies nitrogen fertilizer in the fall and loses the investment if the nutrient has moved away from the root zone and is no longer available for next year's crop.

Factors influencing nitrate leaching

Nitrate is highly water soluble in water and due to its negative charge, it easily moves through the soil profile. The degree of leaching is affected by many factors, including soil characteristics (such as soil texture and moisture holding capacity), climate (such as timing and amounts of precipitation), and plant water use. These factors must be considered when designing appropriate nitrogen fertilizer BMPs and are discussed later in this document.

Minnesota has over 21 million acres of cropland. The MDA has recently estimated that 2.6 million acres are "vulnerable," meaning that nitrogen inputs must be very carefully managed to protect groundwater quality. This is a mixture of coarse-textured soils, karst landscapes, and situations where there is shallow depth to bedrock. The following section presents criteria used

for identifying the vulnerable groundwater areas and other options considered in the process. Soils that are shallow to bedrock are those soils where the bedrock is within 5 feet of the surface.

Coarse textured soils and soils that are shallow to bedrock criteria
The MDA identified coarse textured soils and soils that are shallow to bedrock using the USDA-NRCS Soil Survey Geographic (SSURGO) soil database Web Soil Survey, an online tool USDA-NRCS developed to display the SSURGO data. The SSURGO database and Web Soil Survey are produced and distributed by USDA-NRCS.

Web Soil Survey, Nutrient Management for Sensitive Soils (MN) query. This data will be used as soil criteria to identify vulnerable groundwater areas. This definition of 'coarse textured soils' is also used in the USDA-NRCS Minnesota conservation practice standard for nutrient management (590) (USDA NRCS, 2007).

It is reasonable to use the SSURGO database for the following reasons:

- Soil maps have been used by farmers and their agriculture advisors for decades. This includes such things as soil testing for nutrients, variable rate fertilizer application, crop productivity index, as well as many other soil interpretations.

- Use of USDA-NRCS soils information is well established. Farmers, local government, and others have been using soils information for many years. Farmers participating in federal farm programs have been subject to soil evaluations on their fields and therefore will be familiar with an evaluation based on soil characteristics.

- It is readily available and contains the best available statewide data. Soils data provides continuous coverage across the state, including agricultural areas. (Note that portions of Pine, and 'Arrowhead' counties have not yet been soil mapped; it is anticipated these will be completed in 2022). There is a very low occurrence of agriculture in these areas of the state.

- Soil survey information is used, since it is the statewide (and nationally) recognized 'standard' for soils information. Rigorous investigation, mapping, evaluation, and scientific interpretation of soil information has been and continues to be done by USDA-NRCS Soil Scientists and others. Each soil mapping unit has been examined and soil interpretations are standardized throughout the state.

- This soils data used are based on published soil surveys which are of consistent scale and quality statewide. Soils data are reviewed and updated annually (if applicable) in Web Soil Survey. The scale of soils map range from 1:12,000 to 1:63,360, with most being 1:20,000

or less. The soils were mapped in each county, and data correction was done to ensure soil information matches across county lines.

- Criteria for "Sensitive Soils for Nutrient Management" data set is used in the USDA-NRCS Minnesota Nutrient Management specification. This is already being used (and has been for many years) by resource professionals for on farm nutrient management plans. This 'sensitive soils' data set includes nitrogen management and leaching into groundwater criteria, and specifically notes coarse textured and shallow to bedrock soils as soil features that must be considered.

- The SSURGO soil database is available in a user-friendly format online and can be searched by the public through Web Soil Survey portal (Soil Survey Staff, n.d.).

Using this 'coarse textured' soils definition is consistent with the U of M Extension nitrogen fertilizer BMPs (Table III-1). Consistency with the terminology between the proposed Rule and the nitrogen fertilizer BMPs will add clarity for the regulated party. U of M Extension has developed fertilizer application rate guidance and other nitrogen fertilizer BMPs specifically for coarse textured soils. It is beneficial to use the same soil criteria and consistent soils maps and criteria for fall restrictions in the first part of the Rule (see 1573.0030 Statewide Water Resource Protection Requirements,) and follow nitrogen fertilizer BMPs for coarse textured soils in the second part of the proposed Rule (see 1573.0040 Drinking Water Supply Management Areas; Mitigation Level Designations).

The USDA-NRCS definition of coarse textured and shallow to bedrock soils also aligns with the definition used by MPCA for applying manure in areas sensitive to leaching of nutrients through the bottom of the root zone (MPCA, 2015).

Other soil options considered

MDA staff evaluated alternative soil criteria that could be used to characterize the vulnerability of groundwater contamination from nitrogen fertilizer application. This included soils information from federal and state agencies as well as academic institutions, including the U of M. The MDA specifically worked with the USDA-NRCS Minnesota State Soil Scientist staff to discuss alternatives and they provided the statewide soil query results based on criteria identified by the MDA. The following are various options that the MDA considered. Note that some of these soils criteria were considered in combination but are generally discussed individually as follows:

- The texture of the uppermost soil layer, or soil horizon, was considered, because soil units within the USDA-NRCS Soil Survey system are named based on the surface texture. Users of soils information are normally familiar with the names. The MDA considered using soils with surface textures defined by the USDA-NRCS as sand, loamy sand, and sandy loam as a criterion. However, the surface horizon does not necessarily represent the

texture of the soil layers below the surface and is not a good indicator of water movement through the soil profile. Based on this, the MDA decided against basing vulnerable groundwater areas on surface texture alone.

- A 0-5 foot soil profile depth was considered, since this is the standard depth of a typical soil profile. Soil profile data is available statewide (except in some or all of Pine, Cook, St. Louis and Lake Counties) at these depths. The USDA-NRCS is transitioning to a 0-2 meter profile depth and this depth was also considered in the evaluation process. This would provide additional depth information; however, the 2-meter depth was ruled out since it is not available yet statewide.

- Soil physical characteristics based on the USDA textural triangle were considered (Figure VI-1). The MDA, in the Request for Comments, specified that sand, loamy sand, and sandy loam would be considered. These textures represent the coarsest of the soil textures, and can be itemized by percentage of sand, silt, and clay thresholds. However, regulated parties may not be aware of these distinctions. Also, closer examination showed that sandy loams are diverse in characteristics that make them difficult to characterize as vulnerable based on texture alone. Some responses to the Request for Comments and subsequent comments during the summer 2017 comment period suggested that sandy loam should not be included as coarse texture criteria.

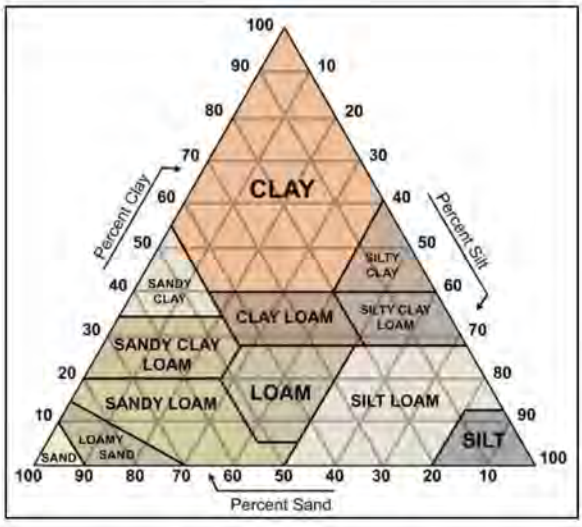

Figure VI-1. USDA soil textural triangle.

- Saturated Hydraulic Conductivity (Ksat), was considered as vulnerable soil criteria. Ksat is an objective measure of the ability of water to move through a saturated soil. Ksat values are available for each soil horizon of the soil mapping units; therefore a weighted average of the combined horizons was considered. The NRCS delineates values for high versus low Ksats that provide differentiation criteria for water movement through a

saturated soil. Based on this, a Ksat >10 micrometers per second (µm/s; equivalent to approximately 1.4 inches per hour) criteria was considered 'high' for water movement through the soil profile; and therefore was considered by the MDA as the threshold for vulnerable soil. Combined criteria with other soil features was also considered to further refine vulnerable soil criteria. This included using Ksat in combination with coarse texture soils, using a Ksat<1 um/s value for any soil layer (horizon) within the soil profile as a disqualifying criterion to represent a confining layer for water movement within the soil profile, and slope >12% to represent slopes where water is more likely to runoff than infiltrate into the soil profile.

During the draft rule summer 2017 listening sessions, the MDA presented to stakeholders information on Ksat and vulnerable soil criteria. The MDA determined Ksat was not known or well understood by many stakeholders or policymakers, therefore it may be difficult for regulated parties to follow. In addition, stakeholders tended to know soils based on texture, including in many cases, the nitrogen fertilizer BMPs for coarse textured soils. Significantly, Ksat does not necessarily align with the nitrogen fertilizer BMPs for coarse textured soils. For these reasons, the MDA determined that Ksat should not be used.

- Bulk density, a measure of the weight of soil per volume, was considered because it could be a relative comparison of water movement through the soil profile by measuring 'compactness' a volume of soil occupied by soil and air (hence density). While this would provide a good indication of water movement through soil, there are other soil characteristics that better represent soil vulnerability. In addition, bulk density also does not necessarily align with soil texture. For these reasons, the MDA determined bulk density should not be used.

- The depth from the soil surface to the water table from NRCS was considered as vulnerable soil criteria. However, the NRCS definition provided in the soil survey data may not represent permanent water table conditions of an aquifer that is useable or extractable. A permanent water table is the level where saturated soil occurs. The water table definition for the NRCS data set may not represent the permanent groundwater level and may be present due to a soil confining layer, which keeps the water closer to the land surface and not connected to the aquifer. The water table level can change by season and the amount of precipitation in a given year, or could be altered due to drainage activities (ditching or tiling). For these reasons, the MDA determined depth from the soil surface to the water table should not be used.
- Hydrologic Group: The USDA-NRCS places soils into hydrologic group classes based on runoff potential. The classification in the four groups or three dual groups are based either on historic measurements or interpolation to similar soils based on factors including depth to restrictive layer or water table, texture, structure, and Ksat. Because: 1) the hydrologic

groups are designed for use with surface runoff, not water movement through the soil, 2) the groups are qualitative and there is substantial uncertainty associated with assigning quantitative flow rates to each category, and 3) many soils with a seasonally high water table are assigned a dual classification that may change based on drainage status (such as presence of artificial drainage), the MDA decided not to use hydrologic group as a criterion.

- Permeability: The term permeability has often been used synonymously with hydraulic conductivity. Confusion has arisen since the term permeability has been used to describe a soil's readiness to transmit water or other fluids, or as a parameter estimated based on hydraulic conductivity, fluid density and viscosity, and the gravitational pull. Because the meaning of permeability is not specifically discernable, the USDA-NRCS emphasizes Ksat rather than the term "permeability" and Ksat classes rather than Permeability Classes to prevent confusion and avoid scientific inaccuracies (Schoeneberger et al., 2012). (See previous discussion of Ksat.) For these reasons, the MDA determined permeability should not be used.

- Organic Matter: Percent organic matter was considered. Generally, soils with higher organic matter have greater water holding capacity, which would allow more water storage in the soil profile versus migration to groundwater. However, for the most part (i.e. for organic peat soils called histosols), organic matter is dominant in the surface profile and diminishes at soil depth. Due to this limitation, the MDA ruled out organic matter as criteria to determine vulnerable soils.

- Restricting fertilizer application based on soil temperature: The MDA considered using the U of M nitrogen fertilizer BMP language, "no fall N fertilization until soil temperatures have stabilized to less than 50 degrees [50°F]." Soil temperature affects the activity of bacteria that converts nitrogen fertilizer to nitrate (Fernandez, 2017).

  It is difficult to ensure consistent depth at which soil temperature is measured (for example, it varies from 4 to 6 inches (MDA (n.d. (l)). Erosion, tillage, or animal disturbance may further change the depth of the soil temperature sensors over time. In addition, it may be difficult to determine when soil temperatures have 'stabilized' due to annual differences, temperature unpredictability and day versus nighttime temperatures. In addition, requiring soil temperature readings could be burdensome for the regulated party and regulator, since this could involve many and multiple readings per farmer and per field. It would be inefficient for MDA as well due to the volume of soil temperature readings that may need to be reviewed. There may be inconsistency in time and location between soil temperature supplied by the famer and those done by MDA is a compliance check. Therefore, soil temperature was not chosen to define fall application.

- The MDA considered using its soil temperature network to define fall nitrogen fertilizer application restrictions (MDA, n.d. (l)). This would rely on actual soil temperature readings at established sites. An advantage is that it uses known locations with accessible data to all. However, the issue of 'stabilized below 50 ºF' would still be a concern, as described above. Additionally, it may be unclear to regulated parties which soil temperature station(s) to use for regulatory purposes, and the network only has a limited number of monitoring sites. Due to these difficulties, the MDA did not choose this option.

- There is climate variability throughout the state, so the MDA considered choosing various fall dates based on climate and location within the state. This would be difficult, however, since temperature patterns do not fall naturally on county or other cultural feature boundary. This would also create a substantial regulatory burden to the MDA, and to fertilizer suppliers and farmers that cover multiple counties. In addition, historic soil temperature data may be inadequate, and yearly variability would not be accounted for.

- August 31st was chosen because it represents the end of the quarter for meterological season as described by the State Climatology Office: The MDA consulted the MDNR State Climatologist when making and drafting this definition.

  The MDA provided this draft date during the request for comments and draft rule summer 2017 listening sessions. Though stakeholders provided some comments on this, most did not find an August 31st date unreasonable.

The MDA also considered some combinations of these criteria. These combinations were ruled out, primarily because the resulting criteria would be too complicated for regulated parties and difficult to administer by the MDA.

Geology criteria

The MDA used karst geology as identified by the DNR's Pollution Sensitivity of Near-Surface Materials Minnesota Hydrogeology Atlas (Adams, 2016) and Minnesota Regions Prone to Surface Karst Feature Development report (Adams et al, 2016) as one of the criteria for the proposed Rule's Part 1 restrictions.

Karst features are the most significant geologic feature that needs to be considered for determining groundwater vulnerability (Runkel et al, 2014, Steenberg et al, 2014, Gordon, 2016, Groten and Alexander, 2013, Katz, 2012). Karst geology is fractured bedrock, generally limestone, overlaid by shallow soils. This combination allows for nitrate dissolved in soil water to readily move downward into groundwater once below the plant rooting depth. Therefore, it is necessary and reasonable for the rule to include areas with karst geology when considering areas vulnerable to groundwater contamination.

The rule uses groundwater vulnerability data from the sources that provide the most accurate data with the highest level of resolution for the characteristic that is being evaluated and mapped. It is necessary to provide clear maps of areas subject to regulatory requirements in order for individuals to understand what is expected of them under the rule. It is reasonable to use the most accurate information available so that the purpose of the rule, to reduce nitrate contamination in groundwater, will be implemented in a practicable and effective manner as directed in the Groundwater Protection Act.

The rule uses DNR pollution sensitivity reports and maps (The Pollution Sensitivity of Near-Surface Materials Atlas) for defining areas with karst geology because it is the most accurate information available on areas with karst geology.

The rule also considers areas with ultra-low vulnerability to groundwater contamination. These are areas primarily in northwestern Minnesota where thick clay deposits provide an exceptionally high level of protection for groundwater. In these areas there may be shallow sandy soils near the ground surface but because of the thick clay layer the groundwater is not vulnerable to contamination. Considering this land characteristic is necessary to ensure that the vulnerability of groundwater is assessed accurately in all areas of the state. The rule uses DNR pollution sensitivity reports and maps (The Pollution Sensitivity of Near-Surface Materials Atlas) for mapping these areas. This is reasonable because they are the most detailed and accurate maps available on this characteristic and to use less accurate maps would be unreasonable.

Other geology options considered

The MDNR has completed geologic evaluations in some areas of the state through the County Geologic Atlas Program (MDNR, n.d.). However, these atlases are not available statewide; they are available only for some regions and counties. In addition, the criteria used for developing the atlases have changed over time, resulting in maps being inconsistent across the state. Hence, applying the Geologic Atlases would result in applying inconsistent vulnerable geology criteria depending on map availability and when the geologic investigation was done. For these reasons, the MDA determined the Geologic Atlases are inadequate to use for the purpose of developing geologic criteria.

The MDA considered using the ‘Bedrock at or Near the Surface’ criteria within the Pollution Sensitivity of Near-Surface Materials Report (Adams, 2016). This data source provides a statewide illustration where rock underlays the soil and unconsolidated surficial materials. This was ruled out because, as noted above under geologic criteria section, other sources of data provide a much higher level of resolution of this characteristic which is important for accurately defining those areas subject to regulatory requirements.

During the summer 2017 comment period, several comments recommended not including the shallow to bedrock geology criteria. This was because they were unclear on the criteria, and/or

they felt it did not accurately represent actual ground features, and represent a sensitivity to groundwater contamination.

The MDA considered using other geology criteria as well, such as those shown on pages 13-20 of the NFMP (MDA, 2015). These were ruled out because they have the same scale limitations as other geology maps as previously described (all are approximately 1:500,000). Also, the Pollution Sensitivity of Near-Surface Materials Report was published more recently and contains the same or similar geology as those shown in the geology maps in the NFMP.

Based on the previous discussion, the agency determined that 'vulnerable area' must include both soils data for coarse texture and shallow to bedrock conditions, and geology data for karst, and an 'ultra-low' geologic sensitivity rating of the near surface as defined by vertical travel time to represents glacial lake geology (Breckenridge, 2015).

Subp. 1. Prohibitions. A. (1) – Fall application of nitrogen fertilizer in DWSMAs

The agency considers DWSMAs as high priority under the proposed Rule. Public wells supply drinking water to many people including homes, businesses, and public facilities. Communities rely on public wells to provide safe drinking water, therefore proper land and water management within the DWSMA must take place.

MDH delineates WHPAs based on a ten-year time of travel. DWSMAs are defined by MDH based on readily identifiable physical or political features as specified in Minn. R. 4720.5100, subp. 13.

On average there are 136 people served by a public well for every person served by a private well (MDH, 2017).

The proposed Rule restricts the application of nitrogen fertilizer in the fall and to frozen soils in DWSMAs with any municipal public water supply wells with concentrations greater than or equal to 5.4 mg/L nitrate-nitrogen. This is needed and reasonable because, public water supplies exceeding 5.4 mg/L nitrate-nitrogen value are required to monitor water as specified in Code of Federal Regulations (CFR) 141.23: National Primary Drinking Water Regulations (USEPA, 1998). *"(2) For community and non-transient, non-community water systems, the repeat monitoring frequency for groundwater systems shall be quarterly for at least one year following any one sample in which the concentration is ≥50 percent of the MCL. The State may allow a groundwater system to reduce the sampling frequency to annually after four consecutive quarterly samples are reliably and consistently less than the MCL."*

Accordingly, the MDH Drinking Water Protection Section Community Public Water Supply Unit uses a value of 5.4 mg/L as nitrogen-nitrogen when comparing analytical results with

regulatory monitoring triggers (D. Rindal, MDH. Personal communication. March 5, 2018). Public wells that exceed this threshold need to monitor nitrate-nitrogen concentrations quarterly.

The public water supplier must be a municipal public water supplier. This is reasonable because the agency will use its resources to regulate larger DWSMAs and not those that are extremely small under this part of the proposed Rule.

There also must be a DWSMA established by the MDH so it is clear where the proposed Rule applies.

Currently, there are 30 DWSMAs that have nitrate-nitrogen in groundwater greater than or equal to 5.4 mg/l.

Subp. 1. Prohibitions. A. (2) – Fall application of nitrogen fertilizer where vulnerable groundwater makes up 50% of quarter-section

When more than 50 percent of a quarter-section has vulnerable groundwater areas (see SONAR, 1573.0010, Definitions), there is a progressively greater risk that nitrate from nitrogen fertilizer could make it into the groundwater. Therefore, the agency sees a need to restrict the application of nitrogen fertilizer to non-vulnerable groundwater areas in these quarter-sections, including on areas within the quarter section that are otherwise not considered vulnerable.

The agency considered many different options when deciding the scale on which vulnerable groundwater areas should apply. Vulnerable groundwater areas are based on soils and geology, and since these are natural features, their boundaries do not align with features such as county boundaries, roads, townships or sections. Defining an area is needed and reasonable in order to be clear to both the regulated party and regulator where fall nitrogen fertilization will be prohibited.

The approach of using a portion (percentage) of an area to designate an entire area is already used by USDA-NRCS under the federal farm bill. Use of percentage of an area criterion is used by the USDA-NRCS to determine highly erodible cropland (HEL). This criterion uses 33% or more of a field that contains highly erodible soils, then the entire field is considered highly erodible. The agency considered using 33% like the HEL criteria. However, this is used as criteria for soil erosion potential which is dissimilar to groundwater vulnerability which includes different soils characteristics as well as geology.

The agency considered using the section (1 square mile) scale. This scale was considered because a section of land is at an identifiable scale, nitrogen management is practicable at this scale, and in most cases in agricultural areas, and this involves few landowners. The agency presented this option to the public during the summer 2017 listening sessions. Many commenters

believed that a section scale is too large of an area, and thus was an unnecessary and overly broad application.

Use of natural soil and geologic boundaries were considered, since this is their defined boundary and no vulnerable area extrapolation is needed because no additional conditions are included. However, even though this would identify vulnerable groundwater areas based on their mapped boundaries, soils and geology boundaries can be difficult to identify. This is not only because they are often irregular in shape and size, but they may not be visible at the surface. Therefore, it would be difficult for a regulated party to identify the exact boundaries on the ground. Though some comments noted soil boundaries should be used to define vulnerable groundwater area boundaries, and farmers are capable of doing this, it would be difficult to manage and regulate in a field where only some of the field is vulnerable. Individual vulnerable area mapping features are often variable and irregular in size and shape. This makes it more difficult to manage and understand for the agency and regulated parties. For example, in a field with various separate vulnerable soils and where fertilizer is custom applied, the farmer would need to provide vulnerable area information to the dealer. The dealer would need to ensure that applicator staff is aware of and able to avoid nitrogen fertilizer application in vulnerable groundwater areas of the field when fertilizing others. This is logistically more difficult both from a communication standpoint as well as actual application. For these reasons, the agency ruled out using the boundaries of soil and geology features in determining vulnerable groundwater areas.

As a subset of defining vulnerable groundwater areas based on soil and geology boundaries, the agency considered *de minimis* criteria. This would address ‘small’ vulnerable groundwater areas that were deemed to be too small to be a concern to impact groundwater contamination. *De minimis* criteria considered included area (acreage) and percentage. The agency considered an area too small based on whether it would likely cause practical difficulties for farming (i.e. too small to manage differently) or an administrative burden to the agency. The agency considered various *de minimis* acre ranges; from approximately 1-10 acres. The agency also considered *de minimis* based on a small percentage of an area. In the end, the agency concluded that any number or percentage used would create practical and administrative difficulties. There was no clear consensus on *de minimis* number or percentage that was reasonable, therefore *de minimis* criteria was ruled out.

The agency considered vulnerable area designation at a township scale. This would make sense because townships are a defined area, and the agency is actively monitoring townships for nitrate and is establishing Local Advisory Teams, as outlined in the NFMP. However, this is a large area (36 square miles) so a township with variable vulnerable area could have significant area (literally several square miles) that would be included or excluded from fall application, vulnerable or not. Therefore, due to this scale issue, this was ruled out.

The agency considered vulnerable designation based on BMP region. This was considered because U of M nitrogen management recommendations (as part of the nitrogen fertilizer BMPs) are variable by BMP region. However, this would include many counties, so is much too large of a scale to implement vulnerable area criteria. Therefore, this option was ruled out.

Using cropland boundaries to identify vulnerable area was considered. This could be ideal because farmers manage based on field boundaries; this is where the nitrogen fertilizer management activities take place. However, farmers and contractors who apply fertilizer on fields may not be able to apply nitrogen fertilizer based on variable vulnerable area in a field. In these cases, it is reasonable to determine whether the entire field is vulnerable. The 'scale' would be variable since fields vary significantly in size throughout the state (ranging for less than 1 acre through approximately 640 acres in size). Additionally, the boundaries of cropland are not public information, therefore is not available for the agency. USDA- Farm Service Agency (FSA) holds this information as non-public data, available only to FSA staff and the cropland owner and/or operator. Cropland information could be provided by the landowner or land occupier, however there may not be an incentive for them to provide this, and this could create an extra step and unreasonable burden to the landowner/land occupier and the agency. The agency considered determining crop field area through using USDA NASS (n.d. (b)) CropScape since this source provides statewide coverage on an annual basis. Claire et al. (2011) reported the mapping accuracies were 85%-95% correct for the major crop categories. Reitsma et al (2016) found crops were mapped correctly between 43% and 95%, with the largest errors occurring in landscapes with many different crop types present, making field boundaries indistinguishable. Reitema (2016) further stated that errors at this magnitude introduce uncertainty in land use calculations. Based on these findings, the MDA determined that the errors in the CropScape estimates are too high for this purpose.

Subp. 1. Prohibitions. A. (3) – Fall application of nitrogen fertilizer to frozen soils in vulnerable groundwater area or DWSMA

Applications of nitrogen fertilizer to frozen soils are not recommended by U of M nitrogen fertilizer BMPs. Nitrogen fertilizer products not properly incorporated on frozen soils are more likely to run off or be lost to the atmosphere thus lowering fertilizer use efficiency and possibly increasing groundwater contamination.

Rationale for vulnerable groundwater areas and DWSMAs is provided in this SONAR in 1573.0010 Definitions.

In vulnerable groundwater areas, nitrogen applications should be made much closer to the time period when the crop needs the nitrogen. This is why it is needed and reasonable for the agency to prohibit nitrogen fertilizer application in fall and on frozen soils in these vulnerable groundwater areas.

In many areas across the state, 75% of deep percolation and subsequent nitrate losses occurs between the spring thaw and early June (Struffert et al, 2016). Excessive nitrate leaching will occur most years with fall applications in these areas.

Subp. 1. Prohibitions. B. and C. – Vulnerable groundwater areas map

The map will be reviewed periodically to allow for adjustments to be made to account for new information in the rare instances where soils and karst geology information is updated. Additionally, the list of public water suppliers restricted from applying nitrogen fertilizer in the fall and to frozen soils will change as nitrate concentrations fluctuate above and below 5.4 mg/L nitrate-nitrogen. This indicates that the parties in charge of cropland in the areas shown on the map are responsible for meeting the requirements in this part of the proposed Rule.

Subp. 2. Exclusions. A. – Fall application restriction

During the comment period on the draft rule (summer of 2017), the agency heard many concerns from farmers in the western and northern parts of the state about the importance of fall nitrogen applications because of the short application window in the spring. Additionally, there were concerns that climate factors were not factored into the draft rule. The agency responded by evaluating statewide climate information to determine various factors that potentially impact fall nitrogen fertilizer management decisions. This statewide evaluation also reviewed climate factors that influenced leaching potential and nitrification rates. This evaluation confirmed that there is significant climatic variation across the state that must be considered when drafting the fall restriction rules. For example, in southeast Minnesota there is more precipitation, resulting in more water available to movie through the soil profile, and warmer spring soil temperatures resulting in a greater potential for fall-applied nitrogen to be converted to nitrate and potentially lost. In contrast, the cooler spring soil temperatures in tandem with less precipitation found in northern and northwest Minnesota create conditions of reduced risk of nitrogen loss to the groundwater.

After evaluating a variety of climate variables, the agency determined the following criteria when used in tandem provided meaningful metrics for guiding fall nitrogen fertilizer management restrictions:

- leaching index
- spring frost-free date

Leaching Index: The leaching index is defined as the daily rainfall minus daily evapotranspiration summed to annual values. This index provides a very broad approximation of annual water movement through the soil profile. Nitrate will not move through the soil without water, so it is relevant to evaluate the nitrate leaching risk based on the amount of water available to move through the soil (Lamb et al., 2008). Therefore it is reasonable to exclude areas of the

state from the fall application restriction where water movement is minimal under typical climatic conditions.

The leaching index was a core concept factored into the early recommendations for fall nitrogen applications. For years, the general U of M guidelines were that the use of the soil nitrate test worked west of Highway 71 (except for coarse-textured soils) because the leaching index was low. Corresponding, similar logic for fall nitrogen applications was used.

Spring Frost-free Date: Using the spring frost-free date provides some general guidance on spring soil temperatures. The later the date, it is more likely that spring soil temperatures will be cooler. This date also provides general guidance on the amount of time available for getting spring field work completed. The later the date, the narrower the timeframe for applying spring fertilizer, tillage and planting. There is a northwest to southeast gradient when the last frost-free date in the spring occurs (Figure VI-2). The spring frost free date intervals were derived by the MDNR State Climatology Office (MDNR, 2018).

Isolines indicating late to very late spring conditions with spring frost-free dates after May 22 are illustrated on the provided map. It is very difficult to grow long season crops like corn in these cooler regions and any unnecessary delays must be avoided. There are logistical problems such as with an insufficient numbers tender trucks and spreaders to complete all fertilizer applications in this compressed spring period.

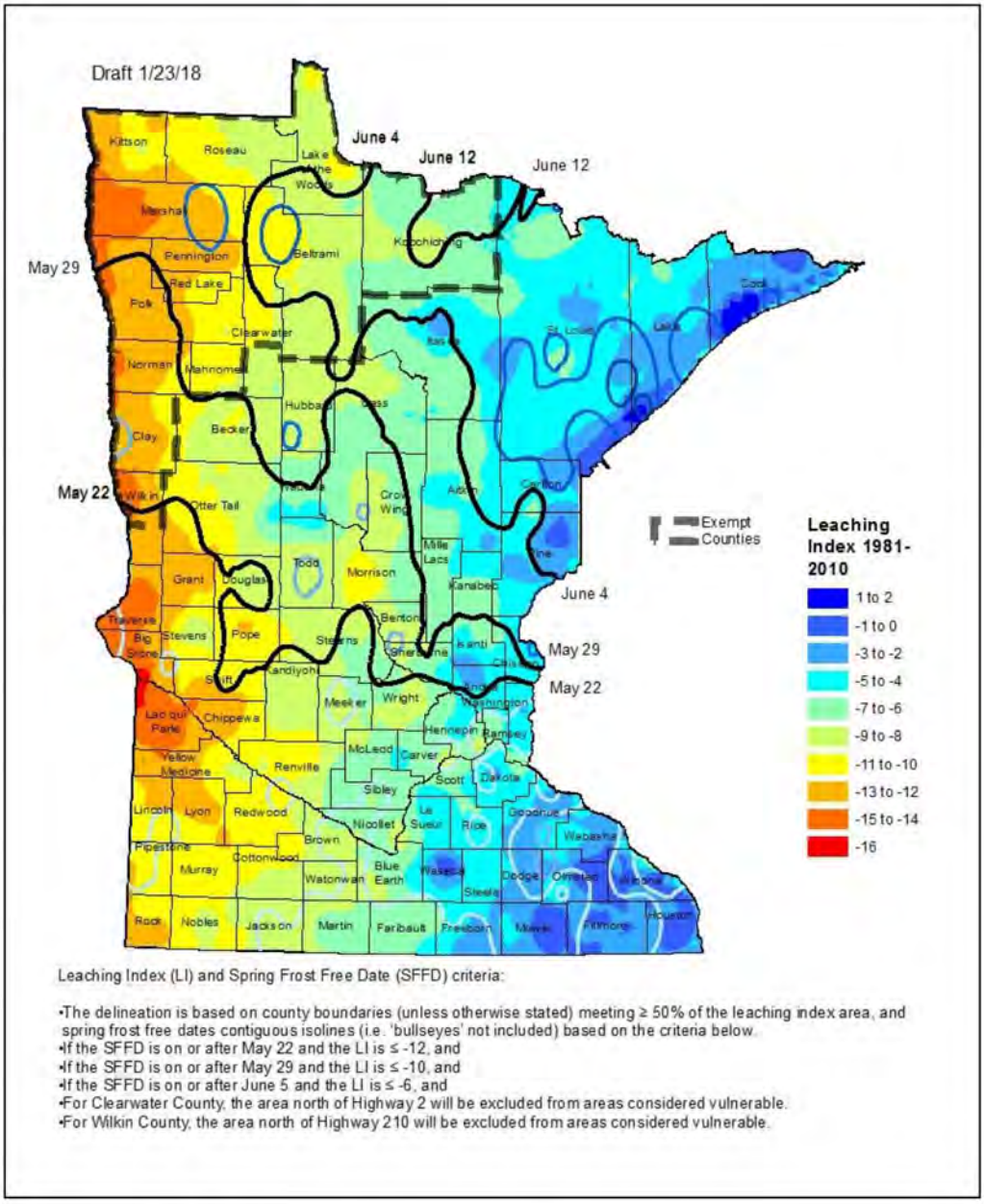

Figure VI-2. Spring frost-free dates and leaching index.

Using Leaching Index and Spring Frost-free Date in Tandem: It is necessary and logical to create this dual criteria approach due to major climate variability across the state. Both leaching index and spring frost free date factors are significant contributors to affecting nitrogen fertilizer management. A graduated combined approach that corresponds the different risk frost free date and leaching index is needed to address this.

Taken together, the leaching index and the spring frost free dates show the risk of nitrate-nitrogen leaching loss and movement to the groundwater is greatly reduced in counties in the

northern and western parts of the state. The criteria listed in the proposed Rule are based on the combined risk of nitrate-nitrogen leaching loss explained by the leaching index and the spring frost free dates.

The years 1981-2010 were used for the leaching index and spring frost free dates because this was the most recent decadal period of record that was available. A 30-year time period was used to be consistent with common practice within climatological contexts where 30-year periods are used to define 'normal' conditions (MDNR, 2018).

Since both of these are significant factors and in combination have greater influence on water movement, these were combined into one map (Figure VI-2) which was used to exclude the indicated counties from the fall application restrictions.

Subp. 2. Exclusions. B and C. – County lines or other geographical boundaries

While the criteria identified to exclude areas from the fall application restriction do not necessarily follow identifiable boundaries, boundaries are needed for the proposed Rule so that the regulated parties and the agency have clarity in understanding where the regulations apply. The criteria used as a basis for the exclusions to Part 1 of the proposed Rule are reflected on a map as isolines, meaning they are not based on a constant value. Isolines shown on the map of the exclusions are not easily identifiable or known on the ground or may be in the middle of a field. Therefore, the agency believes the leaching index and spring frost free date exclusion criteria largely should follow county boundaries. Using county boundaries and (Highway 2 in Wilkin County) will provide complete clarity for the regulated parties as to where the exclusions are in place. It is reasonable to use these geographic features versus the leaching index and spring frost free date isolines, which will in most cases be unidentifiable 'on the ground.'

Subp. 2. Exclusions. D. – DWSMAs

The exclusion listed under Subp. 2, A does not apply to DWSMAs. As described under 1573.0030, Subpart 1. A. (1), communities of more than 25 people rely on the public wells in DWSMAs for safe drinking water. The agency will have water quality monitoring results showing that there are water quality problems in the DWSMAs public well and therefore it is needed and reasonable that fall application should be restricted in DWSMAs with nitrate-nitrogen concentrations greater than or equal to 5.4 mg/L.

Subp. 2. Exclusions. E. – Counties with less than 3% agriculture

USDA NASS (n.d. (a)) provides statistics for agricultural cropland in every county. The agency has used this data to exclude counties with very low agricultural intensity from the fall application restriction. This proposed exclusion is reasonable because in these identified

counties, there is a low concentration of crops grown and therefore low nitrogen fertilizer use. Since nitrate in groundwater is associated with cropland acres, it is reasonable to exclude areas where minimal cropland acres exist. The agency used 3% because this value represents very few acres compared to the total county acres. It is reasonable that the agency allocates limited resources to counties with higher areas of land in cropland, where the public health and environmental risks are greater.

Subp. 2. Exclusions. F. – Point sources of pollution

In some cases, elevated nitrate levels within DWSMAs are due to point sources of nitrogen. Examples of point sources could include but are not limited to an improperly sealed well, animal feedlot or an agricultural chemical incident. This exclusion is needed and reasonable to exempt land owners within DWSMAs from the fall application restriction if the agency determines that elevated conditions where induced by a point source.

Subp. 2. Exclusions. G. – Partial DWSMA Exclusion Based on Low Risk

The commissioner may exclude part of a drinking water supply management area from the fall application restrictions if the commissioner determines that the area is not contributing significantly to the contamination of the public well in the drinking water supply management area. This provision in the rule is necessary to allow the commissioner to exempt parts of a DWSMA which are not contributing significantly to the groundwater contamination in the public well from fall application restrictions.

Fall application restrictions statewide are based on areas where 50% of more of a quarter section is vulnerable to groundwater contamination. This criteria was developed, in part, based on feedback from the public comment period that the previously proposed size, which was based on a full section, was unreasonable because sufficiently detailed information exists to better refine the areas subject to the restriction and not impose those restrictions on areas where it they will provide limited environmental benefit. This concern regarding an appropriate scale for the restrictions applies similarly to DWSMAs. MDA will be focusing more closely on DWSMAs and should be able to more precisely define areas that should be exempt from fall restrictions due to lower risk to groundwater based on a more precise analysis of the characteristics of the DWSMA.

DWSMAs vary in size from very small, less than a hundred acres, to relatively large, on the scale of tens of thousands of acres. For most DWSMA the soils types and vulnerability to groundwater contamination are likely to be fairly uniform across the DWSMA and this exclusion will not be needed. But for large DWSMAs it is reasonable to expect that there will be areas with significantly different soils types and groundwater vulnerability such that some parts of the

DWSMA may not be contributing significantly to high nitrate-nitrogen concentrations in the public well. For large DWSMAs there may be differences in soils types, land features or groundwater vulnerability such that the implementation of fall application restrictions may provide little environmental benefit to the public well with some cost for implementation to the farmer.

This provision is necessary to ensure that the commissioner does not impose requirements and related costs in areas where they will not significantly help reduce nitrate-nitrogen concentrations in the public well. It is reasonable because the Groundwater Protection Act directs that Water Resource Protection Requirements should be practicable and consider factors such as economics, implementability and effectiveness, and implementing fall application restrictions uniformly across a DWSMA including in areas where they may provide limited environmental benefits would not meet this requirement.

Supb. 3. Exceptions. A. - Fall application

In many cases, nitrogen applied in the fall increases the risk of groundwater contamination. The agency recognizes that in some cases, the practice of fall nitrogen application is a necessary agricultural practice despite being located in a vulnerable area. There are a few agricultural crops and practices that require an exception to the proposed Rule. The agency met with U of M staff as well as with internal experts to determine all possible exceptions. This list was then narrowed down based on applicability, feasibility, and relevance to applying nitrogen to crops in the fall. The list of possible exceptions was included when the agency released the request for comments in winter of 2015-2016. Many comments were received on this topic during the comments on the proposed Rule (summer 2017). The agency reviewed these comments and determined it was reasonable to include the following exceptions.

None of these exceptions apply to the application of nitrogen fertilizer to frozen soils. No benefit were identified from the application of nitrogen fertilizer to frozen soils.

Subp. 3. Exceptions. A. (1). Winter grains planted in the fall.

Phosphorus fertilization serves an important role in the winter hardiness of small grains. Since the common forms of phosphate fertilizers contain some ammonium, it is also considered a nitrogen fertilizer and it is needed and reasonable to have an exception to ensure that the proper phosphorus amounts are available. (Kaiser, 2011). Therefore it is reasonable to create this exception.

Subp. 3. Exceptions. A. (2). – Pasture fertilization

Under most production systems using cool season grasses (bromegrass, orchardgrass and reed canarygrass), an early spring nitrogen application is the recommended timing. However, in a high yield system, split applications are recommended with ¾ applied in early spring and the remaining ¼ in late summer/early fall. (Kaiser, 2011). Therefore it is reasonable to create this exception.

Subp. 3. Exceptions. A. (3). – Perennial crops

Research has shown that the most effective time to fertilize perennial crops is during the late summer and early fall (Kaiser, 2011 U of M Extension Service). Prior to freeze up, much of the fertilizer nitrogen will be absorbed by the root system and not subject to leaching. The net result is a healthier, more productive crop the following spring. Therefore it is reasonable to create this exception.

Subp. 3. Exceptions. A. (4). – Grass seed production.

Regarding grass seed production, the U of M Extension recommendations (Kaiser, 2011) provide criteria for rate selection but are silent on the timing. South Dakota State University (Gelderman et al., 1987) provides guidance for the cool season grasses. Adequate nutrition during the initiation of the tiller buds is important. For this reason, either a fall application or very early spring application is recommended and it is reasonable to create this exception.

Subp. 3. Exceptions. A. (5). – Cultivated wild rice.

Fall is also the most effective time to apply nitrogen to cultivated wild rice, but for very different reasons than perennial grasses or winter grains. Minnesota grows about 20-30,000 acres of cultivated wild rice with the majority grown in the north-central portion of the state. Cultivated wild rice is grown as an annual. Frequently the rice is seeded in the fall, nitrogen is then applied in the ammonium form, and then the field is flooded. The ammonium does not convert to the mobile nitrate form because it lacks oxygen needed for the bacteria to live. That bacteria is are necessary for the nitrification process. Because the nitrogen fertilizer does not convert to nitrates, there is no leaching risk when the rice fields are flooded in the fall. Additionally, the rice is protected in the flood conditions and will germinate the following spring. In the spring, water levels are lowered and the nitrification and germination process begins. (Kaiser, 2011). Therefore it is reasonable to create this exception.

Subp. 3. Exceptions. A. (6). – Cover crops to reduce the use of soil fumigants.

Cover crops are typically not fertilized, since the general concept of cover crops revolves around the concept of tying up any residual soil nitrates left after the growing season. However, one

special situation was identified within a potato rotation. Soil fumigants are typically applied in the fall to fields scheduled for potatoes the following spring. The residual chemical compounds from cover crops such as brown mustard and other brassica plants have been found to reduce the need for the fumigants. However, to create enough biomass, it is recommended to fertilizer the cover crops with 25-50 lb N/acre. Therefore it is reasonable to create this exception.

Subp. 3. Exceptions. B. – Nitrogen fertilizer rates

When applying fall nitrogen to the exempted crops in a vulnerable groundwater area, nitrogen fertilizer application rates must follow the rates in the nitrogen fertilizer BMPs under Minn. Stat. § 103H.151, subd. 2. This information has taken in consideration both economic and environmental factors and the agency can be confident that nitrate leaching losses are minimized. Therefore it is reasonable to create this exception.

Subp. 3. Exceptions. C. (1). – Exception for ammoniated phosphates, micronutrient formulations

Growers frequently need to apply phosphorus fertilizer to maintain optimal yields with most traditional crops. In some areas of the state, phosphorus is commonly applied in the fall in tandem with the tillage operation. With Minnesota's short growing seasons, it is important to get as much soil fertility work completed in the fall as possible so that there are minimal delays with the spring planting operation.

In a corn-soybean rotation, growers typically will apply 100-120 pounds of phosphate (P205) to satisfy crop needs for the two-year rotation (i.e. it is applied in one year to meet the crop needs for 2 years). Phosphorus is very immobile in soil so applying it in the fall does not pose environmental issues as long as it is incorporated to reduce runoff risks and soil erosion is minimized. However, both MAP and DAP, the two dominate forms of phosphorus fertilizer, contain ammonium in the formulation. When applying 100 pounds of phosphate (a common application rate for a two-year corn-soybean rotation), 21 pounds of nitrogen will be applied with MAP and 39 pounds of nitrogen will be applied with DAP, per acre. Like all nitrogen fertilizer products, eventually the ammonium will be converted to the more soluble nitrate form and subject to leaching losses.

The purpose of the 40-pound nitrogen limitation is to guide producers to use practices that minimize unnecessary nitrogen losses without putting complete restrictions on fall applied phosphate in vulnerable groundwater areas. .

The forty-pound nitrogen limit was selected because:

- It satisfies phosphorus needs across all yield goal ranges when using the U of M Fertilizer Recommendations under medium soil testing levels (or higher) for either broadcast or banded (the two most common) application methods;

- It satisfies phosphorus needs across the majority of yield goal ranges when using either MAP or a private label product (e.g., 12-40-0-10, containing 12% nitrogen);

- For growers who can only purchase DAP in their region, they can still achieve the forty-pound ceiling limit by using the common standard of 100 pounds of phosphate within a corn-soybean rotation, recognizing that they may have to add supplemental phosphate prior to the soybean year if they have high crop removal values;

- Cropping scenarios have been analyzed to estimate yield goal of corn in a corn-soybean rotation while accounting for nitrogen input contributions from ammoniated phosphate and micronutrient formulation (Table IX-1). The example scenario illustrates an estimated yield goal of 200-219 bushels soils with a phosphorus (P) test in the medium range. Method One is the U of M recommendation for a broadcast application, Method Two is the U of M recommendation for a banded application, and Method Three uses phosphorus crop removal values across the rotation. Table IX-1 illustrates nitrogen inputs from MAP (11% nitrogen), DAP (18% nitrogen), AMS (ammonium sulfate ;) and Micro Essentials. The yellow cells represent combinations that result in summations that are below the 40-pound rate restriction. Conversely the red cells represent combinations exceeding the proposed restriction;

- The vast majority of Minnesota fields test “medium” or higher in (S. Murrell, IPNI. Personal Communication, 2015). Fields testing “Low” or “Very Low” need to address P deficiencies in order to use nitrogen and other inputs more efficiently. These fields are temporarily exempt from the nitrogen restriction. Once the soil P test moves into the medium range or higher, the restriction becomes active.

Table VI-1. Expected corn yield goal in a corn-soybean rotation on medium-P soils as affected by use of ammoniated phosphate and micronutrient formulations

Data from Table 9 in AG-FO-3790-D (Revised 2016) FERTILIZING CORN IN MINNESOTA : Important--Yield Goal in still used for non-Nitrogen nutrients. In this table, the Expected Yield Goal is 200-219 Bu/Acre AND a MEDIUM Soil P (Bray 11-15 PPM or Olsen 8-11 PPM)

Scenario #2: Average Yield Goals (200-219 Bushels) and Medium P Testing Soils

	Phosphorus and Sulfur Source	Phosphorus Approach	Method 1	Method 2	Method 3
	Yield Goal: 200-219		UM Recommendation for Broadcast Application	UM Recommendation for Banded Application	Based on P Crop Removal for Two Year Rotation (Slight Grow in Yield Goals)
Primary Phosphorus Sources	DAP (18-46-0)	N Input (lb/N/A) from DAP	21.5	11.7	47.7
		Total DAP Rate (lb/A)	120	65	265
		P205 Application Rate (lb/A)	55	30	121.8
	MAP (11-52-0)	N Input (lb/N/A) from MAP	11.4	6.2	25.3
		Total MAP Rate (Lb/A)	104	57	230
		P205 Application Rate	55	30	121.8
Phosphorus and Sulfur Sources	DAP (18-46-0) and AMS	N Input (lb/N/A) from DAP	21.5	11.7	47.7
		N Input (lb/N/A) form AMS	17.4	17.4	17.4
		Total N Input from DAP and AMS	38.9	29.1	65.1
	MAP (11-52-0) and AMS	N Input (lb/N/A) from MAP	11.4	6.2	25.3
		N Input (lb/N/A) form AMS	17.4	17.4	17.4
		Total N Input from DAP and AMS	28.8	23.6	42.7
	MicroEssentials SZ (12-40-0-10)	N Input (lb/N/A) from MESZ	16.5	9	36.5
		N Input (lb/N/A) form AMS	0	0	0
		Total MESZ Rate (Lb/A)	137.5	75	304.5
		P205 Application Rate	55	30	121.8
		Total N Input from MESZ	16.5	9	36.5

Subp. 3. Exceptions. C. (2). – Application of agricultural chemical contaminated soil and other media

Land application of contaminated soil and other media may be approved by the commissioner in accordance with Minn. Stat. § 18D.1052 if the commissioner determines that the land application will not cause unreasonable adverse effects on the environment. Land application of contaminated media is a critical component of the agency point source cleanup programs in the Incident and Emergency Response programs. Fertilizer-contaminated media is removed from agricultural chemical spill sites and samples of the contaminated media are analyzed and the number of pounds of nitrogen is determined. The contaminated media is typically applied at a rate less than or equal to 100 lb N/ acre and the most common crops utilized for land application are corn and soybeans. In order to prevent leaching to groundwater or runoff of contaminants, contaminated media cannot be applied within 200 feet of a well, abandoned well, or sinkhole; within 200 feet of intermittent or perennial surface water, on soil types prohibited by the label of a limiting pesticide, or on areas with slopes greater than 6%. The contaminated media is immediately tilled into the receiving soil. As part of the application approval process, the grower is asked to use the nitrogen in the contaminated media as an application credit for fertilizer applications for the following crop year.

Land application of contaminated media must occur in the spring before planting or in the fall after harvest. Most of the land application of contaminated media occurs in the fall because the longer timeframe between harvest and soil freeze up allows time to apply the media rather than in the very short window in the spring between soil thaw and planting. It is also difficult to store

contaminated media over the winter for spring applications. The cost for land application of contaminated media is lower than disposal in landfills or other treatment or disposal methods and is a very effective way to use the agricultural chemicals that are present in the contaminated media for their intended purpose. Because disposal of contaminated media is a critical component of the agency's duties, it is needed and reasonable to include this exception.

Subp. 3. Exceptions. C. (3). – Research

In review of past U of M research projects involving phosphorus research, the vast majority use "small plot" research trials with a large number of replications. Since most Minnesota soils are medium or higher in phosphorous, researchers are generally seeking plots or entire fields that are in the medium or lower phosphorous range, then superimpose a range of phosphate levels with small, replicated plots. It is conceivable that future Discovery Farms or other field scale activities may want to monitor a portion of the field with higher than normal phosphate inputs. The 20-acre ceiling provides ample opportunity for this scale of demonstration/research.

D. 1573.0040 Drinking Water Supply Management Areas; Mitigation Level Designations

This part of the proposed Rule is intended to reduce or mitigate the nitrate concentration in groundwater in areas where nitrate has been identified as a concern in DWSMAs. The approach to mitigation in the proposed Rule is comprehensive, consistent with the goals and direction outlined in the Groundwater Protection Act (Minn. Stat. chap. 103H) and follows the conceptual approach to mitigation which is outlined in the NFMP (MDA, 2015).

The proposed Rule is the end product of an effort that began in 2010 to revise and implement the state's approach to address nitrate from fertilizer in groundwater. This development process included significant stakeholder engagement with an advisory committee and three comment periods before reaching the point of this draft proposed Rule. The process began with the revision of the NFMP using an advisory committee with stakeholder participation from a wide range of stakeholder groups. This included strong participation from the agricultural sector in addition to other groups referenced in the Groundwater Protection Act. This advisory committee met 18 times over approximately two years and brought in multiple experts including a representative from Nebraska, where a similar approach is in use. The goal of this process was to ensure that the committee understood the opportunities and limitations of agricultural practices and policies related to the management of nitrogen fertilizer to reduce nitrate leaching to groundwater, and that the approach used in Minnesota would be effective and practicable as directed in the Groundwater Protection Act. Every member of the advisory committee was welcome to suggest policies and criteria for consideration in developing the plan and conversations of options were extensive and thorough. As an outcome from the advisory committee process the MDA developed a draft NFMP, which was submitted for a public comment period, and held a series of public meetings around the state.

The MDA finalized the NFMP in March 2015 and immediately began implementation of the voluntary parts of the plan and developing the proposed Rule. The proposed rule is designed to implement the regulatory components of the plan. The development of this proposed Rule included two public comment periods to ensure that comments from stakeholders were fully considered before finalizing the proposed Rule. Although the NFMP outlined a conceptual approach to addressing nitrate in groundwater, significant changes have been made during the drafting of the proposed Rule based on careful consideration of stakeholder comments. While the proposed Rule is intended to provide the regulatory components for the plan, the proposed Rule has been developed using a significant public development process separate from any specific requirements in the plan. The plan outlines the regulatory components in a very general sense whereas the proposed Rule has gone through an extensive review process and, in consideration of that input, provides detailed requirements for decision making and regulation.

The draft proposed Rule released for the public comment during the summer of 2017 included draft regulatory approaches based on a township scale for private wells and by DWSMAs for public water supply wells. For reasons stated in more detail under Subp 1 below, the MDA decided to focus regulatory efforts and limited resources on the highest priority areas, which are DWSMAs.

Subp. 1. DWSMA mitigation levels. – Application

Approximately 75% of Minnesotans (4 million) rely on groundwater either from public or private wells for their drinking water supplies (MDA, 2015). Over half of the state's population is served by public water suppliers that use groundwater as the source of drinking water (Figure VI-3).

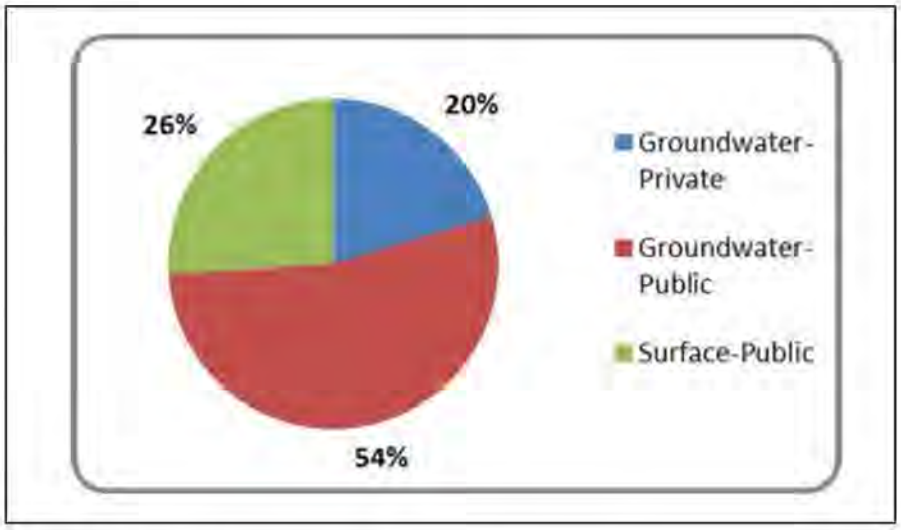

Figure VI-3. Drinking water sources in Minnesota.

Community and non-community public water supplies
Part 1573.0030, also referred to as Part 2 of the Proposed Rule, focuses on areas that provide groundwater to public water supplies or public wells. These areas surrounding public water supplies are called drinking water supply management areas (DWSMAs) The MDH is the lead agency dealing with public water suppliers (PWS). There are approximately 7,091 PWSs in Minnesota. These include those classified as "community" water suppliers, which include small to large communities. A community public water supplier by definition must serve at least 15 service connections used by year-round residents or regularly serve at least 25 year-round residents. There are currently 963 community water suppliers in Minnesota. The remaining systems are classified as non-community water suppliers. By definition, a non-community system must serve an average of at least 25 people at least 60 days a year at a place other than their home. Examples include restaurants, churches, schools, and businesses. Because of the large population in the state that public water supplies serve, it is needed and reasonable for the MDA to use the DWSMA scale for regulatory purposes in the proposed rule.

Wellhead Protection Areas and Drinking Water Supply Management Areas
The terms "Wellhead Protection Areas" (WHPAs) and "Drinking Water Supply Management Areas" (DWSMAs) are important to the proposed rule. WHPAs and DWSMAs are defined in Minn. R. 4720.5100, subp.43 and Minn. R. 4720.5100, subp.13, respectively, and the process for how WHPAs and DWSMAs are delineated is outlined in Minn. R. 4720.5205. The WHPA boundaries are established using a ten year time of travel (Minn. R. 4720.5510, subp. 2), which is based upon multiple scientific criteria, including hydrologic boundaries, which may or may not be identifiable on the land surface. Since WHPA boundaries may not be easily identifiable, DWSMAs are established. DWSMAs help define the WHPA by providing readily identifiable physical or political features as specified in Minn. R. 4720.5100, subp. 13.

The MDA determined that the rule should focus mitigation efforts on DWSMAs. Under the Groundwater Protection Act the MDA is directed to take action to prevent and minimize pollution to the extent practicable and to prevent the pollution from exceeding the health risk limit (see 103H.275 subd. 1 (c)). Therefore it is necessary for the rule to support actions that will reduce contamination in groundwater to meet these goals. Under the federal Safe Drinking Water Act a public well cannot exceed the drinking water standard and as the source water starts to approach 10 mg/L the municipality or party responsible for the well will have to take steps to ensure they don't exceed that concentration. These steps may include blending water from multiple sources, drilling a new well if a suitable alternative aquifer is available, or installing a water treatment system. These steps can be very expensive, difficult to implement and burdensome, especially for smaller communities. They create an urgent need to take action in areas where the nitrate-nitrate concentration is approaching the drinking water standard. In addition public water supply wells have the largest population that will be directly impacted by high nitrate levels in drinking water. Further, DWSMAs were identified in the NFMP as the

highest priority areas for action. For these reasons it is reasonable for the rule to prioritize mitigation efforts in DWSMAs.

The DWSMAs also provide a useful regulatory boundary for protecting public water supply wells in the proposed Rule. It is necessary to define some geographic boundary for evaluation, implementation and regulatory purposes. It is reasonable to use the DWSMAs since they are already well-understood, and they are precisely defined by MDH hydrologists using computer modeling and other assessment tools to define the area where actions are needed to protect the source water for the well, and then applying it to a clear geographic boundary. If the MDA did not use the existing DWSMAs then the MDA would need to duplicate that effort in some manner in order to provide a technically defensible and easily explainable boundary for the area subject to this proposed Rule.

Alternatives considered: A significant effort was dedicated by the NFMP Advisory Committee to addressing private wells within the framework of the original 1990 NFMP. The 2015 NFMP focused on private well implementation on a township scale. In accordance to the revised NFMP (MDA, 2015), the MDA considered including regulation of private wells in townships in the MDA's Township Testing Program in the proposed Rule. That provision was included during the request for comment period during the summer 2017 listening sessions. After considering the comments from the request for comments and summer 2017 listening sessions, the MDA determined that the regulatory steps (mitigation levels 3 and 4) on a township scale would not be included. The MDA will continue to implement the NFMP with regard to townships designated as mitigation levels 1 and 2. Those activities are discussed briefly in a subsequent paragraph.

Some of the key factors influencing this decision were:

- The geographical area is involved if townships were included could be potentially extremely large. The MDA, through its preliminary results from the Township Testing Program, determined that at least twenty townships would more than likely be classified as a mitigation level 2 (NFMP, 2015) and a strong possibility that 10 to 20 additional townships would be added to the list. This would require a tremendous number of staff to focus on over 1 million cropland acres involving thousands of Minnesota producers;
- Installing the appropriate groundwater monitoring network across this number of townships that would be rigorous enough for regulatory purposes would be extremely expensive and the MDA currently does not have funding for establishing these networks;
- Comments from producers in the informal comment period during the summer of 2017 indicated that they are implementing a variety of practices beyond BMPs to address leaching, and they expressed strong support for a voluntary approach, rather than a regulatory approach, particularly in the townships.
- This will be the first rule promulgated by the MDA since the Groundwater Protection Act was passed in 1989. The proposed Rule creates a new regulatory structure, which will take