Groundwater / Drinking Water Protection Practices for Agricultural Lands

April 2021

MINNESOTA

Contents

This document was developed to provide guidance to local governments on a range of drinking water/groundwater protection programs and initiatives, including grants from state and federal agencies and public and private conservation easement programs. It will be updated periodically as new information becomes available.

Authors: Annie Felix-Gerth and Suzanne Rhees, Minnesota Board of Water and Soil Resources (BWSR)

Contributors and Reviewers: Tabor Hoek, Tim Koehler, Dave Weirens, BWSR; Steve Robertson; Mark Wettlaufer, Carrie Raber, Jenilynn Marchand, Department of Health; Scott Hanson, Aaron Meyer, Minnesota Rural Water Association; Margaret Wagner, Larry Gunderson, Patrick Nash, Minnesota Department of Agriculture

Introduction

Purpose

This guide was developed to assist local government and watershed staff, water utilities, and other interest groups in identifying the most effective groundwater and drinking water protection strategies for agricultural land in their regions. It draws on the findings of the *Minnesota Nitrogen Fertilizer Management Plan (NFMP)*, the *Minnesota Agricultural BMP Handbook*, and related research to suggest practices – both agricultural and non-agricultural – that will minimize risks to drinking water and public health.

Nitrogen fertilizer (including both artificial fertilizer and manure) is used in current agricultural crop production systems to increase the productivity of these systems. However, nitrate that is not utilized by the crop may leach into the groundwater, where it is a public health concern, especially for pregnant women and infants under six months of age. The drinking water standard, known as the Health Risk Limit, is 10 milligrams of nitrate (measured as nitrogen) per liter of drinking water (mg/L).[1]

Note: *This guide focuses on groundwater as a drinking water source, rather than surface water. Likewise, the focus is on nitrate that originates from agricultural sources, not from other potential nitrate sources such as septic systems.*

The practices in this guide are applicable to public water suppliers, to owners of private wells, and to farmers and agricultural landowners with an interest in managing the land to protect the quality of their drinking water.

The susceptibility of groundwater to contamination from nitrate and other chemicals depends on multiple factors, including properties of soils and geologic materials, land use practices, and climate factors such as the amount and intensity of precipitation.

The practices emphasized in this guide are targeted to protect highly vulnerable drinking water supplies and groundwater resources on soils that are coarse-textured, have shallow depth to groundwater or bedrock, or are located in karst geology. Some of the practices may also be appropriate for marginal soils – those that are erosive, flood-prone, or otherwise less well-suited to row crop agriculture. Many practices align with the Alternative Management Tools[2] (AMTs) identified in the NFMP, defined as "locally developed solutions for addressing groundwater nitrate problems that are implemented on a site-specific basis." AMTs fall into four major categories:

1. **Utilizing new technologies**, such as controlled release fertilizers and precision agriculture;
2. **Developing new crop varieties**, such as varieties that use nitrogen more efficiently;
3. **Increasing continuous cover** through use of perennial crops, cover crops and diversified crop rotations; and
4. **Retiring cropland** through conservation easements and other means.

Managing Risks to Drinking Water Supplies

Groundwater is the source of drinking water for approximately 75% of Minnesota's population, with 54% served by public water systems and 20% by private wells. Based on MDA and MDH monitoring data, elevated nitrate levels in drinking water may indicate the presence of other contaminants, such as

[1] Minnesota Department of Health, "Nitrate in Drinking Water." https://www.health.state.mn.us/communities/environment/water/docs/contaminants/nitratefctsht.pdf

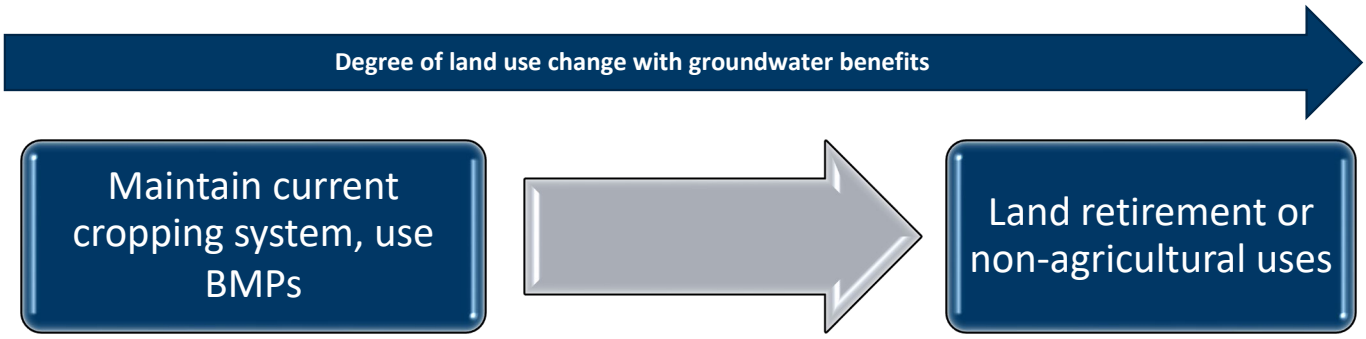
[2] Minnesota Department of Agriculture, "Alternative Management Tools." https://www.mda.state.mn.us/chemicals/fertilizers/nutrient-mgmt/nitrogenplan/nitrogenmgmt/amts

bacteria or pesticides. Preventing nitrate contamination of drinking water supplies is typically much more cost-effective than removing the contamination.[3]

In 2016-2017, 27 public water systems recorded a source water sample between 5 and 10 mg/L of nitrate and 10 systems recorded levels over 10 mg/L. Raw (source) water that exceeds the health risk limit of 10 mg/L nitrate-N is typically blended with water at a lower concentration. However, blending water from deeper wells can also increase the concentration of naturally-occurring chemicals such as iron, manganese, and radium. Some public water suppliers have had to install reverse osmosis treatment systems to remove nitrate and other contaminants to meet state and federal drinking water standards.

Groundwater Protection Practices

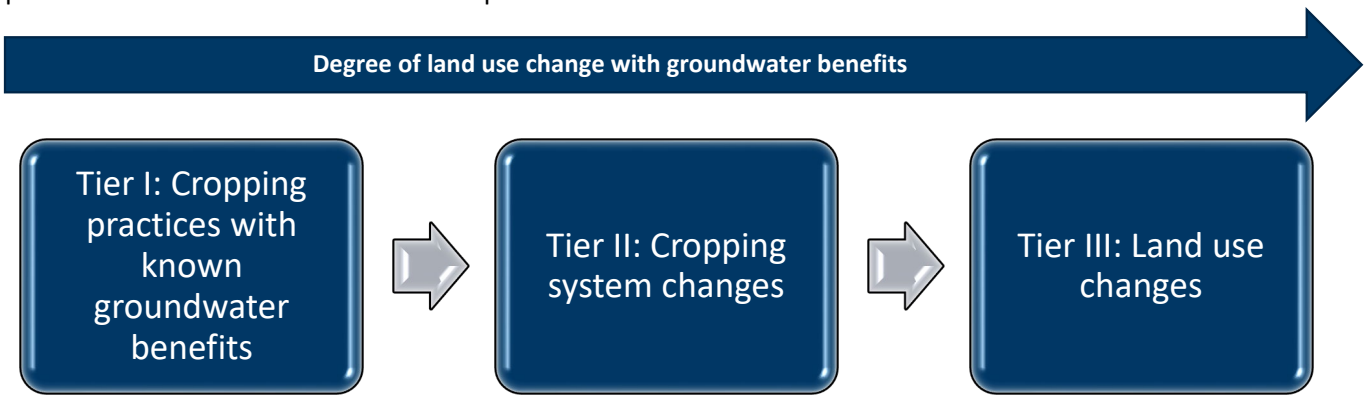
Conservation programs tend to focus mostly on two ends of the groundwater protection spectrum: best management practices (BMPs) applied to the existing cropping system, or land retirement, whether temporary or permanent, often through a conservation easement or conversion to a non-agricultural land use.



In practice, protecting or improving drinking water often depends on efforts made by many individual landowners employing a variety of BMPs, land retirement, and other practices in a given area.

There is increasing interest among conservation professionals and local governments, including public water suppliers, in practices that transition from a system based solely on annual row crops toward one that incorporates perennials and extended crop rotations to improve water quality and soil health.

Agricultural cost-share programs and easement programs can provide technical and financial assistance. However, technical and financial assistance is not always available or adequate for these mid-spectrum practices. The enhanced version of the spectrum looks like this:



[3] https://www.health.state.mn.us/communities/environment/water/swp/reqrec.html#Wellhead

The three tiers are discussed below under "The Groundwater/Drinking Water Protection Spectrum."

Selecting the Right Groundwater Protection Practices

Applicability to Local Water Plans and Watershed Planning

Both local water management plans traditionally developed by counties and the major watershed-scale plans now being developed under the One Watershed One Plan Program must address both surface water and groundwater resource issues. Groundwater Restoration and Protection Strategies (GRAPS) are interagency reports prepared by the Department of Health to inform the One Watershed One Plan process. The GRAPS report compiles information on groundwater resources in a particular watershed to help identify key groundwater quality and quantity concerns.

Water management plans establish a framework for future implementation. If a plan identifies specific groundwater protection strategies, those strategies are more likely to be funded under state and federal grant and cost-share programs.

Working with Producers

The practices outlined in this document may also be helpful to local governments, conservation district and watershed district staff, and others who work with individual producers interested in exploring alternatives to their current mix of crops and methods. Each practice should be evaluated for use at both a farm scale and a field scale for applicability. A variety of conservation programs and practices can be deployed across a single property, depending on its specific mix of resources and vulnerabilities.

Regional Effectiveness

Some of the practices described in this guide are broadly applicable across all agricultural landscapes, while others are likely to be most effective in specific areas. For example, nutrient management practices are most critical on the coarse-textured soils that are most susceptible to leaching of nitrate into groundwater. These soils are primarily found in Minnesota's Central Sands region. Areas of karst topography in southeastern Minnesota are also highly vulnerable, since the fractured limestone bedrock in this region allows nitrate to readily move downward into groundwater.

In highly vulnerable Drinking Water Supply Management Areas (DWSMAs), the most effective practices for reducing nitrate pollution are those that convert land from annual row crops to perennial crops or non-agricultural uses. In less vulnerable areas, practices such as cover crops or crop rotations may be appropriate. A localized assessment of soils, geology, and the mix of crops and livestock in each DWSMA can help to determine an appropriate balance of conservation practices to minimize nitrogen loss.

The Groundwater / Drinking Water Protection Spectrum

As noted above, the major practices discussed in this guide are grouped into three tiers – a generalized set of categories based on the degree to which they change or depart from conventional cropping systems and practices. The level of groundwater protection provided by each practice will vary depending on many factors, including the land area covered, the vulnerability of that land to contamination, and the intensity of the practice. Individual practices may not be sufficient to protect groundwater on their own, but stacking of complementary practices can increase their effectiveness. For example, cover crops combined with crop rotation can reduce the amount of nitrogen fertilizer needed in subsequent years. Practices that improve soil health also improve water retention, enhancing

the effectiveness of irrigation and drainage water management. Note that *practices that primarily benefit surface water quality, such as riparian buffers, conservation tillage and prescribed grazing, are not included in this groundwater/drinking water-focused spectrum*.

Tier I – Cropping Practices with Known Groundwater Benefits. These include management practices that provide measurable benefits within conventional cropping systems that have high potential for nutrient/pesticide leaching, such as continuous corn and/or irrigation.

1. Integrated Pest Management (595)
2. Irrigation Water Management (442) and Irrigation System Sprinkler (449)
3. Irrigation Water Nitrogen Credits
4. Karst Sinkhole Treatment (525)
5. Nutrient Management (590)

Tier II – Cropping System Changes. These involve practices that change or modify cropping systems to lower the inherent risk of nitrogen loss, such as introducing crop rotations with perennial crops.

1. Agroforestry, including Tree Crops / Silvopasture
2. Cover Crops (340), including Harvestable Cover Crops
3. Conservation Crop Rotation (328)
4. Forage and Biomass Planting (512)
5. Perennial Crops for Food, etc.
6. Pollinator Conservation Planting/ Honey Bee Production
7. Specialty and Short-Season Crops (with Cover Cropping, Nutrient Management)

Tier III – Land Use Changes. These practices take land out of agricultural production, transitioning to land retirement or non-agricultural land uses. Land may be converted to natural vegetation and wetlands under several federal and state easement programs, to energy development or to limited urban development combined with open space.

1. Conservation Cover (327), Critical Area Planting (342)
2. Open Space Design/Limited Development
3. Outdoor Recreational Uses
4. Solar Farm with Pollinator Habitat/Perennials

For each of the listed practices, NRCS practice numbers are noted as applicable. Goals are drawn from the "Purposes" section for each NRCS conservation practice standard, focusing on the groundwater-related goals.

Grant, Loan and Easement Programs

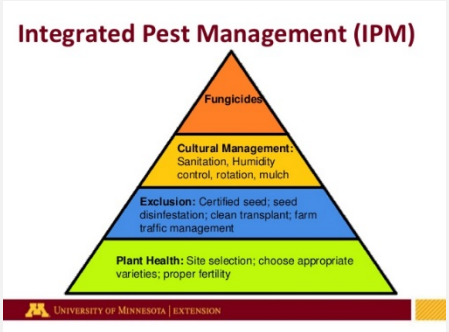
A selection of state, federal, and related programs that support these practices are profiled below under "Grant, Loan and Easement Programs for Groundwater/Drinking Water Protection." Funding is available for most practices through the federal NRCS programs such as the Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program (CSP). Other state and federal programs include:

- AgBMP Loan Program (MDA)
- Minnesota Agricultural Water Quality Certification Program (MAWQCP)
- Conservation Reserve Program (CRP)
- Conservation Reserve Enhancement Program (CREP)
- Other Easement Programs
- Outdoor Heritage Fund (Lessard-Sams Outdoor Heritage Council)
- Projects and Practices (Clean Water Fund) Grants: Drinking Water Subprogram

- Reinvest In Minnesota Reserve (RIM) Program (stand-alone)
- Source Water Projection Grants (MDH)
- Wellhead Protection Partners Grants (BWSR)

Tier I: Cropping Practices with Known Groundwater Benefits

The management practices in this tier are considered to provide measurable benefits within conventional cropping systems that may have naturally high potential for nutrient and pesticide leaching, such as continuous corn and or irrigation.

Practice – Tier I	Regional Effectiveness
Integrated Pest Management (595): Site-specific evaluation and plan for pest management to avoid unnecessary use of pesticides. Methods include herbicide banding rather than broadcast application, conservation tillage, and use of biological pest controls. • Funding: EQIP can provide 50-90% of establishment cost. • NRCS guidance includes practices for mitigating potential negative impacts of pesticides on pollinators using IPM, in *Agronomy Technical Note 9*, 2014. The MDA is responsible for development, promotion and evaluation of pesticide management BMPs. For further information: https://www.mda.state.mn.us/protecting/waterprotection/pmp *Goals: Prevent or mitigate off-site pesticide risks to water quality from leaching, solution runoff, etc. Prevent or mitigate risks to ecosystems from drift and volatilization, and risks to pollinators from contact.* **Impact on groundwater:** By increasing the efficiency of application, IPM can reduce the amount of pesticide and herbicides infiltrating into groundwater by avoiding unnecessary application and reducing rates of application. (MDA 2017).	 All regions
Irrigation Water Management (442) and Irrigation System Sprinkler (449): Determining and controlling the volume, frequency and application rate of irrigation water in a planned, efficient manner. Irrigation sprinkler systems are modified under this practice (449) to use lower-pressure nozzles to improve efficiency and reduce energy use. *Goals: Improve irrigation water use efficiency, minimize soil erosion, decrease degradation of surface and groundwater resources, etc.* **Impact on groundwater:** Research shows that by reducing irrigation water use, irrigation water management can reduce nitrate leaching to groundwater. Split fertilizer applications also reduce loss of nitrate from corn crops on irrigated sandy soils (MDA 2017).	 Most applicable to Coarse-Textured Soils

Irrigation Water Nitrogen Credits: Taking nitrogen fertilizer credits for nitrate present in irrigation water. This is an accompanying practice to Irrigation Water Management – crediting nitrogen from irrigation water reduces the amount of nitrogen fertilizer needed and related costs. "The University of Minnesota recommends crediting nitrogen from irrigation water as part of nitrogen fertilizer best management practices (BMPs) on irrigated soils. Proper nitrogen crediting and use of nitrogen BMP's are tools that will help the irrigator make profitable production decisions and that will also help protect water quality."[4] **Impact on groundwater:** Crediting can reduce fertilizer use, thus reducing potential nitrate leaching to groundwater.	 Most applicable to Coarse-Textured Soils
Karst Sinkhole Treatment (525): Treatment with a vegetated buffer (25 ft. min.) around the sinkhole and management of nutrients and pesticides within the surrounding watershed. *Goals: Improve ground and surface water quality, conserve soil and water resources.* **Impact on groundwater:** Localized impact avoiding leaching and intrusion of nutrients and pesticides around sinkholes.	 Applicable in karst topography - Southeast
Nutrient Management (590): The 4Rs of nutrient management – apply the Right nutrient source at the Right rate at the Right time in the Right place – to improve nutrient use efficiency by the crop and to minimize nutrient losses to the surface and groundwater. The Nitrogen Fertilizer BMPs form the core of the Minnesota Nitrogen Fertilizer Management Plan (NFMP) for groundwater protection. The Alternative Management Tools listed in the NFMP include detailed descriptions of advanced nutrient management such as variable rate applications and remote sensing (i.e., precision agriculture), sub-surface banding and controlled-release fertilizer methods. The Groundwater Protection Rule and extensive guidance materials outline practices for each Nitrogen BMP Region and for Coarse-Textured Soils (Sand Plain and localized areas). The rule: • Restricts the application of nitrogen fertilizer in the fall and on frozen soils in areas with vulnerable groundwater and in DWSMAs with elevated nitrate (≥5.4 mg/L) • Can require mitigation practices in DWSMAs with elevated nitrate greater than 8.0 mg/L if BMPs are not followed or if	 Most applicable to Coarse-Textured Soils

[4] http://www.chsprairielakes.com/about-us/latest-news/irrigation-water-nitrogen-crediting-service/

nitrate in groundwater increases.[5] Localized planning, assessment and modeling work may all be needed to determine the actual need for N reduction. *Goals (NRCS): Minimize pollution of surface and groundwater resources; conserve nutrients for plant production, improve soil health, etc.* **Impact on groundwater:** Nitrate loss to groundwater is high in coarse-textured soils, especially with irrigation. Reducing N rate (through use of in-season split applications, appropriate N source and inhibitors) and eliminating N applications during periods of little or no plant uptake (such as Fall through Preplant) will have the greatest impact on N leaching. However, it can be difficult to achieve sufficient reductions without reducing N application below the economically optimum rate (MDA 2017). Manure management methods to reduce water quality impacts include techniques such as stacking solid manure on a concrete pad and using water diversion systems, catch basins, and grass buffer strips to hold and filter runoff.[6] Land application of manure must meet setbacks from water features and use agronomic rates. Proper crediting of N in manure can reduce the need for fertilizer application. See MPCA guidance on land application of manure.	

Tier II: Cropping System Changes

These practices modify or change management of conventional summer annual crops to include longer crop rotations with small grains or perennials, forage and biomass planting, cover crops, and grazing practices that utilize forage crops. Because the return on these practices is more uncertain, higher incentives – and longer contracts with farmers – than those available through EQIP or other federal programs may be necessary. State funding programs have generally not been oriented toward establishment of harvestable perennial crops, but this approach is now being used in a few key wellhead protection areas to support planting of Kernza[7] and alfalfa and has potential for broader applicability.

[5] Groundwater Protection Rule has exceptions and detailed provisions not captured in this summary. See https://www.mda.state.mn.us/nfr for details.

[6] See https://extension.umn.edu/manure-management/tips-reduce-water-quality-issues. State rules (MR 7020.2125) establish requirements for manure stockpiling sites and MPCA provides detailed technical guidelines for this practice.

[7] https://www.mda.state.mn.us/2020-2021-forever-green-projects

Practice – Tier II	Regional Effectiveness
Agroforestry, including Tree Crops / Silvopasture: See Alley Cropping (311), Tree and Shrub Establishment (612) and Woody Residue Treatment (384) "Agroforestry is the intentional combining of agricultural and forestry practices to improve environmental quality, productivity, and economic returns." (UM Extension). • Practices include alley cropping, windbreaks, living snow fences, silvopasture (integrating livestock grazing and tree planting), riparian buffers • Alley cropping may be used to improve soil health, reduce runoff and erosion, increase carbon storage, etc. Plantings include fast-growing woody species or nut or fruit trees, nursery stock trees, etc. • No cost information is available – length of time to maturity is obstacle for some tree crops. *Goals (NRCS): Enhance or diversify a farm enterprise, improve water quality, reduce excess nutrients in runoff and groundwater, reduce soil erosion, increase carbon storage, wildlife habitat, etc.* **Impact on groundwater:** Similar impacts to riparian forest buffers (390, 391) and vegetative filters. Riparian vegetation can promote the settling of sediment and associated pollutants, including nitrates. However, Nitrogen removal varies widely by buffer width, hydrological flow path, and vegetative cover (MDA 2017).	 Potentially valuable against wind erosion in western MN Potential in SE, SC, historically forested "Big Woods" region
Cover Crops (340): Grasses, legumes, and forbs planted for seasonal vegetative cover, soil health, water retention, etc. Many cover crops are grazed and some can be harvested for food or forage. • Funding availability: EQIP, CSP, AgBMP Loan Program, and several SWCD and other LGU programs • NRCS-MN offers a detailed Cover Crop Seeding Guide (Technical Note 33) and calculation tool. • Additional cover crop calculator tools are available that quantify costs and benefits.[8] • Minnesota Cover Crop Research from the Minnesota Office for Soil Health • Growing season length, lack of needed equipment and logistics, and the trial-and-error nature of practice are frequently-cited obstacles to widespread adoption. • Cover crops have great potential in combination with short-season crops, e.g., canning crops, small grains. • Harvestable cover crops include winter camelina, pennycress, winter rye. Many cover crops can also be grazed. (Winter	 

[8] http://mccc.msu.edu/selector-tool/

Practice – Tier II	Regional Effectiveness
camelina is approved by NRCS as a recommended cover for MN.) *Goals: Reduce erosion, reduce water quality degradation by utilizing excessive soil nutrients, improve soil health and organic matter, etc.* **Impact on groundwater:** Cover crops can take up nutrients that would otherwise be lost from the field through surface or drainage water or infiltration. Studies in Minnesota and Iowa show reductions in nitrate loads in drainage water by over 60% with rye and oat cover crops (MDA 2017). Studies of winter camelina in particular show large decreases in nitrate loads in groundwater.	All regions, currently most widely used in South, Southeast
Conservation Crop Rotation (328): Planned succession of crops on the same field, including at least one low nitrogen input crop or two or more years of hay in a 5-year rotation. Studies suggest crop rotation leads to more efficient recovery of N by crops and is more effective at limiting nitrate leaching than timing of N fertilizer applications. • Various models of crop rotation include: 1) Adding perennials; 2) Extended rotation with small grains; 3) Grazed pasture in a 6-7 year rotation (consider no-till planting alfalfa after soybeans).[9] • Funding: EQIP; AgBMP Loan Program for capital costs. CSP also funds crop rotation to address soil erosion, organic matter improvement, and other soil health improvements. • If goal of practice is to reduce water quality degradation due to excess nutrients, NRCS practice standard recommends deep-rooted crops with quick germination and root system formation. *Goals: Reduce erosion and water quality degradation; improve soil moisture efficiency; provide feed and forage for livestock, food and cover habitat for wildlife, etc.* **Impact on groundwater:** Research indicates that perennial grasses and alfalfa have substantially less nitrate loss than row crops in a corn-soybean rotation (MDA 2017). A 4-year rotation incorporating alfalfa has been shown to have greater benefits than a 2- or 3-year rotation. Conservation crop rotation can lead to more efficient use of nitrogen (N) by crops, requiring less N input and less N susceptible to leaching.	  All regions, but most important for Central Sands, SE, SW

[9] NRCS, Iowa: Cropland Conservation Practices https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcseprd332005.pdf

Practice – Tier II	Regional Effectiveness
Forage and Biomass Planting (512): Perennial vegetation utilized for pasture, hay, or biomass production. • Funding availability: EQIP, CSP, AgBMP Loan Program • Costs will differ widely depending on crop and practice. • Often in combination with Prescribed Grazing (528), and Forage Harvest Management (511) for hay, silage, haylage. *Goals: Improve livestock nutrition, health, soil and water quality, reduce erosion, produce feedstock for biofuel, etc.* **Impact on groundwater:** Similar to Conservation Crop Rotation above, planting of forage and biomass crops can reduce nitrate leaching compared to row crops in a corn-soybean rotation. According to an NRCS study, "once established, these perennial species… improve water infiltration, reduce runoff, retain nutrients that might otherwise enter a waterway… build soil organic matter [and] increase soil nitrogen through root and nodule turnover."[10]	 Central Sands, SE, SW – link to cattle on landscape and markets for hay / biomass
Perennial Crops for Food, etc. (Conservation Crop Rotation (328); not included under forage and biomass crops above): • Alfalfa • Kernza for food (the grain of intermediate wheatgrass, already classified as a forage crop) is now recognized by NRCS as part of Conservation Crop Rotation (328); allows grazing and grain harvest in one season. • Other emerging crops such as tree crops (hazelnuts, elderberries), perennial sunflowers, etc. • Small grains (oats, barley, flax) • Funding availability is uncertain but is becoming available in wellhead protection areas under approved watershed management plans (One Watershed One Plan). The potential for incorporating perennial crops into additional NRCS conservation practices is being explored. (Practice has been available for organic transitions but not conventional crops.) **Impact on groundwater:** Research indicates substantial reductions in nitrate leaching from Kernza and alfalfa (FGI, 2020). Small grains if followed by cover crops/relay crops can maximize cover crop benefits.	 Potentially all regions, with variability by crop

[10] Barker, D., et. al. 2012. Forage and Biomass Planting. Chapter 2 in *Conservation Outcomes from Pastureland and Hayland Practices: Assessment, Recommendations, and Knowledge Gaps*. NRCS. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1080494.pdf

Practice – Tier II	Regional Effectiveness
Pollinator Conservation / Honey Bee Production (multiple NRCS practices, but primarily Conservation Cover (327)): The Xerces Society has developed various guidance documents under 327[11]. See also "Conservation Work for Honeybees" – over three dozen NRCS conservation practices provide benefits to pollinators. EQIP funding provides additional incentives for including pollinator habitat as a supplement to other practices. **Impact on groundwater:** Research in this area is ongoing. Impacts are likely similar to those of Forage and Biomass Plantings (above).	 All regions
Specialty and Short-Season Crops (with Cover Cropping, Nutrient Management): Alternative small-scale specialty crops – including organic crops – can be part of a transition from a corn-soy monoculture.[12] If cultivated intensively, these crops can pose as great a concern as row crops for nitrate contamination. However, if combined with cover cropping and effective nutrient management, these practices can be effective in protecting groundwater. • Specialty crops are defined by the USDA as: fruits and vegetables, tree nuts, dried fruits, horticulture and nursery crops, floriculture, and processed products with 50% or more specialty crop content. • Canning crops and other short-season crops are considered "low-hanging fruit" for cover cropping, (due to longer time for cover crop establishment). • MDA offers Specialty Crop Block Grants (USDA-funded) to improve operational efficiencies, reduce costs or other barriers, increase access to distribution systems and new markets; and for research and development, compliance with federal standards. • Renewing the Countryside offers Specialty Crop Enhancement Teams in southeast and south central Minnesota. Program is intended to help edible specialty crop producers overcome obstacles, increase profits and grow operations. • U MN Extension Regional Sustainable Development Partnership Program works to develop supply chains for crops and systems that increase diversity on the landscape, by connecting U of MN researchers with community innovators.	  All regions, depending on crop and seasonal extension methods

[11] Biology Jobsheet #18: Establishment of Introduced Grasses and Legumes; Honey Bee Habitat (2016)

Biology Jobsheet #16: Native Habitat Development for Pollinators, Honey Bees and Monarchs (2018)

Biology Tech. Note No. 78: Using 2014 Farm Bill Programs for Pollinator Conservation (2015)

[12] USDA provides resources for small and mid-sized producers: https://www.usda.gov/topics/farming/resources-small-and-mid-sized-farmers

Practice – Tier II	Regional Effectiveness
• FSA Organic Certification Cost-Share funding available for organic certification, up to 75% of costs. • FSA microloan programs available for small, beginning, and non-traditional farm operations such as truck farms, CSAs, etc. **Impact on groundwater:** This strategy is designed to improve the economics of alternative practices, not to directly impact groundwater resources.	

Tier III: Land Use Changes

These practices take land entirely or partially out of agricultural production, placing it into wildlife habitat, protected open space, or other land uses, including options for limited development. Funding through federal and state easement programs and private not-for-profit land trusts and conservation organizations may be available. Funding through the Outdoor Heritage Fund (see below under Programs) is available for many habitat-related land retirement programs.

Practice – Tier III	Regional Effectiveness
Conservation Cover (327); Critical Area Planting (342): Conversion of land from an intensive cropping system to permanent native or non-native vegetation. Generally undertaken under one of the easement or land retirement programs listed below under "Programs." *Goals: Reduce soil erosion, soil quality degradation; improve water quality, develop wildlife habitat, reduce air quality impacts.* **Impact on groundwater:** Conservation cover reduces nitrate losses in surface runoff by significant amounts (MDA 2017). Additional research on groundwater impacts are needed; however, conversion of land in vulnerable DWSMAs from row crops to conservation cover has resulted in decreases in nitrate concentrations.	 All regions
Open Space Design/Limited Development: The concept of "limited development" is used by land trusts, other nonprofits, and private developers to protect significant natural areas or public open space while allowing development of less sensitive portions of a site. Leading organizations in this sphere include The Nature Conservancy (TNC), the Trust for Public Land, and the Minnesota Land Trust. These non-profits have partnered with DNR and other agencies to conduct land transactions, since they can often move more quickly than public agencies. Private developers have also employed conservation design techniques to protect significant open space, often using easements for permanent protection. • TNC – "has bought land in critical conservation areas (especially land that buffers and surrounds core natural areas), placed conservation easements on the land and then resold the restricted property. This is referred to as a "conservation buyer" project."	 All regions, given proximity to urban areas, sufficient development pressure Photo: Fields of St. Croix Conservation Development, Lake Elmo

Practice – Tier III	Regional Effectiveness
• In a DWSMA, any development would need to treat all stormwater to a very high level or move it off the site for treatment. • Grants to LGUs and other consortiums could be used for this purpose. **Impact on groundwater:** Impacts are likely to be indirect but are contingent on the manner in which open space and other land uses are designed.	
Outdoor Recreational Uses: Includes game farm/hunting preserve, wildlife management areas, waterfowl production areas, etc. • Worthington Wells WMA is one example of conversion of cropland to public wildlife management area. (Pheasants Forever, DNR, and multiple partners protect over 95% of highly vulnerable acres in Worthington DWSMA.) **Impact on groundwater:** Similar to Conservation Cover.	 All regions; vulnerable DWSMAs
Solar Farm with Pollinator Habitat/Perennials: Many solar installations include native prairie plantings. BWSR offers a Habitat Friendly Solar Program that promotes the planting and management of wildlife habitat with an emphasis on pollinator benefits on solar projects Project sponsors must use DNR's Prairie Establishment & Maintenance Technical Guide for Solar Projects, fill out BWSR's Solar Site Pollinator Habitat Assessment form for Project Planning, and work with habitat restoration experts. A follow-up assessment is required after three years of vegetation establishment and every three years afterwards. **Impact on groundwater:** Research is ongoing, but impacts are likely to be similar to those of Conservation Cover and/or Forage and Biomass Planting.	 All regions, depending on access to power grid

Grant, Loan and Easement Programs for Groundwater/Drinking Water Protection

This section highlights several federal and state grant and loan programs that can be targeted toward groundwater protection. It does not encompass all programs and may not capture the most recent guidance (since programs can change from year to year), but rather is intended as a starting point for further exploration.

AgBMP Loan Program: This MDA program provides low-interest loans to farmers, rural landowners, and agriculture supply businesses to solve existing water quality problems. The purpose is to encourage agricultural Best Management Practices that prevent or reduce runoff from feedlots, farm fields and other pollution problems identified by the local government in water plans.	
MN Ag Water Quality Certification Program (MAWQCP): A voluntary program for farmers and agricultural landowners to proactively implement water quality conservation practices and management into comprehensive farm management systems. The program is a partnership with federal, state, public, and private collaborators. Certification systematically identifies and then mitigates risks to water quality on a field-by-field basis; every field and crop on a farm must meet MAWQCP's criteria. Participants receive priority for technical and financial assistance to implement practices and improve soil health. Farmers who become MAWQCP-certified obtain regulatory certainty for ten years as complying with any new water quality rules or laws during that time.	
Environmental Quality Incentive Program (EQIP): Voluntary conservation program from NRCS that helps agricultural producers in a manner that promotes agricultural production and environmental quality as compatible goals. Through EQIP, agricultural producers receive financial and technical assistance to implement structural and management conservation practices that optimize environmental benefits on working agricultural land. Eligible practices, payment rates, prioritization of resource concerns, and ranking criteria are developed based on input and recommendations from both the State Technical Advisory Committee (STAC) and Local Work Groups. Although EQIP is available statewide, eligibility criteria, complicated procedures and limited funding can all reduce participation. The 2018 Farm Bill specifies that 10% of financial assistance must be dedicated to source water protection.	
Conservation Stewardship Program (CSP): For producers already implementing conservation practices, CSP offers opportunities to expand on these efforts by offering enhancements and additional practices. In Minnesota, CSP applications are evaluated on a regional basis addressing priority resources concerns within four geographic regions. CSP contracts are for five years with an option to renew. CSP offers two types of payments: 1. Payments to maintain the existing level of conservation based on the land uses included in the contract and NRCS assessment of existing stewardship, and 2. Payments to implement additional conservation activities.	

Conservation Reserve Program (CRP): A program of the USDA's Farm Service Agency, CRP provides annual rental payments to producers to increase conservation practices on ecologically sensitive cropland and pastureland. Includes Continuous, General, Grasslands, and CREP (listed below). Under general CRP sign-up, producers submit competitive bids during specified enrollment periods, and contracts are scored and awarded based on an environmental benefits index. Under continuous sign-up, environmentally sensitive agricultural land can be devoted to conservation practices and enrolled in CRP at any time. The CRP Grasslands program allows grazing, but for a lower payment than typical CRP payments. Producers are generally given ten- to 15-year contracts with annual rental payments and restoration cost-share assistance. Haying, grazing, or other income-producing activities allowed, but with a significant penalty.

The disadvantages of CRP are its temporary nature, limited availability, and declining land base. In Minnesota, CRP has declined from 1.83 million acres in 2007 to 1.03 million acres in 2020.

CRP enrollment was capped at 24 million acres nationally by 2018 in the 2014 federal Farm Bill. The 2018 Farm Bill raised the cap to 27 million acres.

Conservation Reserve Enhancement Program (CREP): A state-level sub-program of CRP, with the federal government contributing up to 80 percent of the cost of the CREP. The current Minnesota CREP was approved in 2017 with the goal of taking marginal land out of production and replacing it with natural vegetation and wetlands that protect water quality and provide increased habitat. It includes $350 million from USDA and $150 million from the State of Minnesota. In this new CREP, up to 60,000 acres can be enrolled across 54 counties, primarily targeting riparian and marginal agricultural land. CREP combines an initial 15-year CRP contract with a permanent RIM easement. Payments are based on current CRP rental rates and RIM rates that approximate 90% of the value of the land. CREP payments will always be higher than those provided for BMPs or contracts for other practices. Payment rates were updated in 2018.

CREP encompasses four practices, one of which is wellhead protection (CP-2). The other three practices are Grass Filter Strips (Buffers) and Wetland Restoration (non-floodplain and floodplain).

In limited situations RIM-only cropland and non-cropland may be allowed as a part of a MN CREP application to make the easement area more manageable and to provide greater benefits to the landowner and the resources. (See also RIM stand-alone summary below).

Applies in designated counties in southern and western Minnesota

Other Easement Programs:

- **Private and Local Easement Programs:** A number of private not-for-profit conservation organizations and LGUs work with landowners to restore high quality natural habitat on their lands, typically through conservation easement. Easement-holders in Minnesota include the Minnesota Land Trust, The Nature Conservancy, Pheasants Forever, and a number of local and regional foundations and governments. Dakota County operates an easement program to protect farmland and natural areas, and Washington County purchases conservation easements on high priority conservation areas.
- **Wetland Reserve Easements (WREP):** Under the Wetlands Reserve Easements program, NRCS helps to restore, protect and enhance enrolled wetlands. Eligible lands include:
    - Farmed or converted wetlands that can successfully be restored;
    - Croplands or grasslands subject to flooding; and
    - Riparian areas that link protected wetland areas.

https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/acep/

Photo: Vermillion River, Dakota County. Vermillion River Watershed JPO

Outdoor Heritage Fund (Lessard-Sams Outdoor Heritage Council)

The Lessard-Sams Outdoor Heritage Council (LSOHC) provides annual funding recommendations to the legislature from the Outdoor Heritage Fund, one of four funds created by the Clean Water, Land and Legacy Amendment. Funding is allocated to projects that restore, protect, and enhance wetlands, prairies, forests, and habitat for fish, game, and wildlife. Proposals must be consistent with the Council's visions for Minnesota's ecological sections. Agricultural regions of the state generally fall into the Prairie, Forest/Prairie Transition, and Southeast Forest ecological sections. Funding goes to state agencies, local governments, and conservation organizations for land and easement acquisition and habitat restoration programs.

Projects and Practices (Clean Water Fund) Grants: Drinking Water Subprogram: This competitive CWF grant administered by BWSR makes an investment in on-the-ground projects and practices that will protect or restore water quality in lakes, rivers or streams, or will protect groundwater or drinking water. Surface water activities are the focus of the primary Projects and Practices grant.

The Drinking Water Subprogram sets aside up to 20% of the total available funding for projects that protect drinking water. Appropriate practices could include soil health practices, perennial crops, increased incentives for conservation practice adoption, stormwater treatment and sealing of unused public or private wells. (See factsheet, Clean Water Fund Drinking Water Protection Grant).

All regions
Photo Minnesota River Basin Data Center

Reinvest In Minnesota Reserve (RIM) Program - stand-alone program: The primary land acquisition program for state-held conservation easements and restoration of wetlands and native grasslands on private lands in MN. Payment is a lump sum after the easement is recorded, based on Assessor's Township Average Market Values (ATAMV) for tillable land (updated annually by BWSR). RIM been primarily used in combination with CREP recently, since that maximizes leverage over federal funds. However, stand-alone RIM will be considered in situations where CREP is not feasible or acceptable.	 All regions
Source Water Protection Grants: These MDH-administered Clean Water Fund grants to public water suppliers provide funding in various categories: • Plan Implementation Grants: To implement MDH-approved wellhead protection plans for community or nontransient noncommunity water suppliers. Maximum $10,000; no match required. • Competitive Grants: To implement source water protection practices and manage potential contamination sources, whether or not a wellhead protection plan is in place. Maximum $10,000 ($30,000 for combined applications); match required. • Transient grants: To support wellhead protection measures addressing potential contamination sources for noncommunity transient systems such as campgrounds, lodging, etc. Maximum $10,000; match required.	 Activities within DWSMAs
Wellhead Protection Partner Grants: This pilot program from BWSR allows grants to local governments for perpetual or long-term protection of wellhead protection areas with very high or high vulnerability supplies. In cases where CREP or RIM-only easements are not feasible, grants can be used to protect the wellhead area by easement, fee acquisition, or other long-term (20-year minimum) protection mechanism.	 DWSMAs with high or very high vulnerability

References

MDA. 2017. (Lenhart, C., & Peterson, H.) *Agricultural BMP Handbook for Minnesota 2017*. Available through the Minnesota Digital Water Research Library: https://wrl.mnpals.net/islandora/object/WRLrepository:2955

MDA. 2015. *Minnesota Nitrogen Fertilizer Management Plan*. https://www.mda.state.mn.us/pesticide-fertilizer/minnesota-nitrogen-fertilizer-management-plan

MPCA. 2014. *The Minnesota Nutrient Reduction Strategy.* St. Paul. https://www.pca.state.mn.us/water/nutrient-reduction-strategy

NRCS. Cropland Conservation Practices for Protecting Groundwater. USDA, MN Rural Water, University of MN Extension, MN Departments of Agriculture and Health.

Warner, Richard. 2019. Policies and Programs Supporting Perennial Farming Systems to Protect Drinking Water Sources in Minnesota. Green Lands Blue Waters.

Acronyms

ACEP	Agricultural Conservation Easement Program
BMP	Best Management Practice
CRP	Conservation Reserve Program
CREP	Conservation Reserve Enhancement Program
DNR	Minnesota Department of Natural Resources
DWSMA	Drinking Water Supply Management Area
FSA	Farm Service Agency
MAWQCP	Minnesota Agricultural Water Quality Certification Program
MDA	Minnesota Department of Agriculture
MDH	Minnesota Department of Health
MPCA	Minnesota Pollution Control Agency
NRCS	Natural Resources Conservation Service
RIM	Reinvest in Minnesota Reserve Program
SWCD	Soil and Water Conservation District
USDA	U.S. Department of Agriculture