DEPARTMENT OF HEALTH

Nitrate Report for 2023-2024

DRINKING WATER PROTECTION

September 2025

Nitrate Report for 2023-2024: Drinking Water Protection

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Executive Summary

The 2023-2024 Nitrate Report, prepared by the Drinking Water Protection (DWP) program at the Minnesota Department of Health (MDH), offers an assessment of nitrate levels in Minnesota's public drinking water systems and examples of proactive measures taken to mitigate contamination. This report emphasizes the public health implications of nitrate contamination.

Key Findings

Nitrate is a naturally occurring compound, but its levels can become harmful due to human activities, such as agricultural runoff and septic leakage. Elevated nitrate levels in drinking water can present significant risks, particularly for vulnerable populations, including infants, who are susceptible to serious health effects such as methemoglobinemia, commonly known as “blue baby syndrome.” The U.S. Environmental Protection Agency (EPA) sets the Maximum Contaminant Level (MCL) for nitrate in drinking water at 10 mg/L. This report indicates that while most public water systems comply with this standard, nitrate contamination poses a threat to source water quality.

Compliance and Monitoring

In 2023 and 2024, approximately 875 community water systems (CWSs) and 6,000 noncommunity water systems (NWSs) in Minnesota were tested at least once per year. The report shows that over 99% of these systems were less than the nitrate MCL, with only four CWSs and 16 NWSs receiving a notice of violation for exceeding the limit. MDH plays a critical role in monitoring these systems, requiring public notification and corrective action when nitrate levels exceed the MCL, and recommending alternative drinking water sources when necessary.

Source Water Protection Programs

The report highlights collaborative efforts among MDH, CWSs, NWSs, other agencies, and environmental organizations to implement source water protection initiatives aimed at preventing nitrate pollution at its origin. These proactive strategies include land-use strategies, sealing unused wells, and education for landowners in vulnerable areas. Regulatory measures further support these efforts by regulating animal feedlot practices and limiting nitrogen fertilizer application, such as the Groundwater Protection Rule that limits fertilizer application in Drinking Water Supply Management Areas (DWSMAs) with high-nitrate wells.

Infrastructure Support and Health Equity

MDH assists communities through the Source Water Protection Grants Program, prioritizing systems serving disadvantaged populations. The Drinking Water Revolving Fund (DWRF) provides financial and technical assistance to public water systems, enabling them to meet compliance standards effectively, particularly in underserved areas. This funding is essential for enhancing infrastructure and ensuring compliance with drinking water regulations.

Future Directions

By applying a health equity lens, this report underscores the necessity of addressing disparities in access to safe drinking water. The report highlights the need for ongoing monitoring, targeted

interventions in high-risk areas, and enhanced public engagement to address nitrate contamination effectively in the future. By fostering partnerships and employing innovative treatment technologies alongside source water protection programs, Minnesota is working to ensure a healthy and sustainable water future.

The insights gained from this report can guide policymakers and community leaders in developing targeted strategies to protect public health and ensure safe drinking water for all Minnesotans, with a commitment to advancing health equity throughout these efforts.

Introduction

The nitrate annual report summarizes nitrate monitoring results and the measures taken to reduce nitrate levels in Minnesota's public water systems. This report focuses on 2023-2024 data, with historical nitrate information available in the 2020-2022 Nitrate Annual Report (https://www.health.state.mn.us/communities/environment/water/docs/contaminants/nitrpt20202022.pdf)

This document highlights nitrate concentrations in drinking water and emphasizes the importance of ongoing efforts to ensure drinking water safety. Nitrate contamination is a growing concern with significant public health and environmental impacts, making this report beneficial for assessing the effectiveness of current water management practices and of actions to meet regulatory standards.

Scope of the Report

- **Public Water Systems (PWSs)** are defined as systems with at least 15 service connections or that regularly serve an average of 25 or more people for at least 60 days each year.
  - **Community water systems (CWSs)** are PWSs that serve the public in the places they live, typically year-round, such as cities, manufactured home parks, or senior living facilities.
  - **Noncommunity water systems (NWSs)** are PWSs that serve nonresidential populations at places such as schools, workplaces, and recreational facilities.
- **Source Water Protection (SWP)** refers to the strategies and practices implemented to safeguard water sources from contamination and ensure their long-term water quality.

The report includes data from CWSs, NWSs, and SWP efforts.

The report also explores the sources of nitrate contamination, emerging trends, and strategies for managing and reducing nitrate levels, with a focus on health equity.

Nitrate in Drinking Water

Nitrate is a naturally occurring compound found in water, but its concentration can increase due to human activities. In Minnesota, nitrate levels in drinking water are measured as milligrams per liter (mg/L) of nitrogen and categorized as low (0-3 mg/L), moderate (3-5 mg/L), and elevated (5-10 mg/L). Natural processes, such as plant decay, typically result in nitrate concentrations below 3 mg/L[1]. Levels above 3 mg/L, as indicated during regular monitoring by MDH and public water systems, suggest potential contamination from human sources.

Human-made sources of nitrate can include runoff from fertilized agricultural land, leakage from wastewater, landfills, animal feedlots, septic systems, or urban drainage systems.

[1] Madison, R.J., and J.O. Brunett. 1985. Overview of the occurrence of nitrate in ground water of the United States. In National Water Summary 1984: Hydrological Events, Selected Water-Quality Trends, and Ground-Water Resources, USGS Water Supply Paper 2275, 93–105. Washington, D.C.: U.S. Government Printing Office.

Public Health Impact

Elevated nitrate levels in drinking water pose significant health risks. Nitrate is converted to nitrite in the digestive system, which can potentially result in methemoglobinemia, commonly known as "blue baby syndrome," a condition that impairs oxygen transport in the blood and can be life-threatening. Bottle-fed infants under six months old are at the highest risk for this illness. In addition, there is increasing evidence that longer-term exposures to nitrate in drinking water (even below the current MCL) may result in negative health effects, including gastrointestinal cancers, thyroid dysfunction, birth defects, and prematurity. Continued research will be important for understanding the nature and the severity of these risks.

For more information, please visit Nitrate in Drinking Water (https://www.health.state.mn.us/communities/environment/water/contaminants/nitrate.html).

Regulatory Compliance

Regulatory Standards and Compliance Strategies

To safeguard the public's health, the EPA set the Maximum Contaminant Level (MCL) for nitrate in drinking water at 10 mg/L, which is equivalent to 10 parts per million (ppm). To guarantee adherence to this requirement, CWSs and NWSs are required to conduct nitrate monitoring on at least an annual basis.

CWSs, which serve residential populations, can use treatment methods like ion exchange, reverse osmosis, and biological denitrification to manage nitrate levels. They may also blend water or drill new wells if nitrate concentrations exceed the federal standard. Public notice is required when nitrate levels exceed the MCL, particularly to protect vulnerable groups such as infants and pregnant people.

NWSs, which serve nonresidential populations (e.g., schools, restaurants, campgrounds), must also comply with the MCL though under very specific circumstances may receive State Discretionary Releases (SDRs) allowing nitrate levels between 10 and 20 mg/L, as long as the system doesn't serve infants under six months and constant public notice is provided. Corrective actions for NWS may include connecting to a municipal supply, drilling a new well, installing treatment, or blending water to lower nitrate concentrations.

Data Sources and Analytical Framework

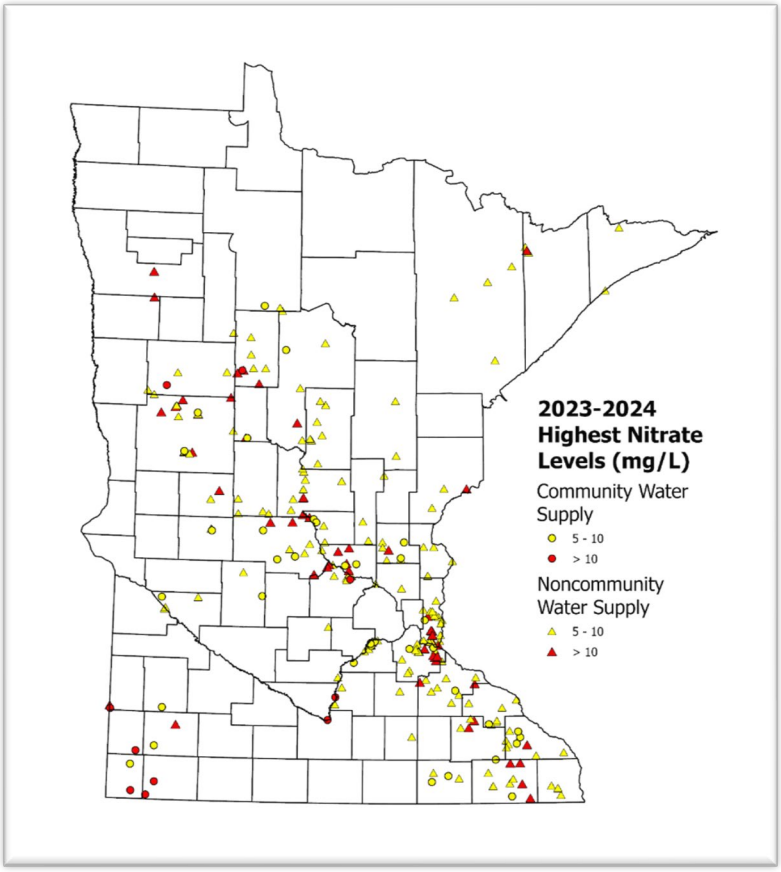
The data for this report primarily comes from the Minnesota Drinking Water Information System (MNDWIS) database, which compiles results from water samples collected in accordance with the federal Safe Drinking Water Act (SDWA). The report includes nitrate sampling data from January 1, 2023, through December 31, 2024, focusing on CWSs and NWSs that exceed specific nitrate thresholds. Systems with samples above 8.0 mg/L are flagged for potential risk of exceeding the MCL of 10 mg/L, allowing for proactive follow-up and mitigation efforts. The report excludes emergency-only wells and incorporates various data sources related to noncommunity systems and source water protection efforts.

While the report does not include a demographic analysis, it emphasizes the regional distribution of nitrate contamination, identifying areas with higher nitrate concentrations, particularly in agricultural regions. It also highlights trends in compliance with nitrate standards across different system types and provides an overview of the actions taken to address elevated nitrate levels in drinking water.

Nitrate Levels Across the State

Nitrate levels in Minnesota drinking water can vary significantly across different regions due to a variety of factors, including land use practices, natural geological formations, and local water management. The nitrate data provide an overview of elevated nitrate concentrations in drinking water across various municipalities.

Map of CWSs and NWSs with Elevated Drinking Water Nitrate, 2023-2024



Nitrate Exceedances and Mitigation

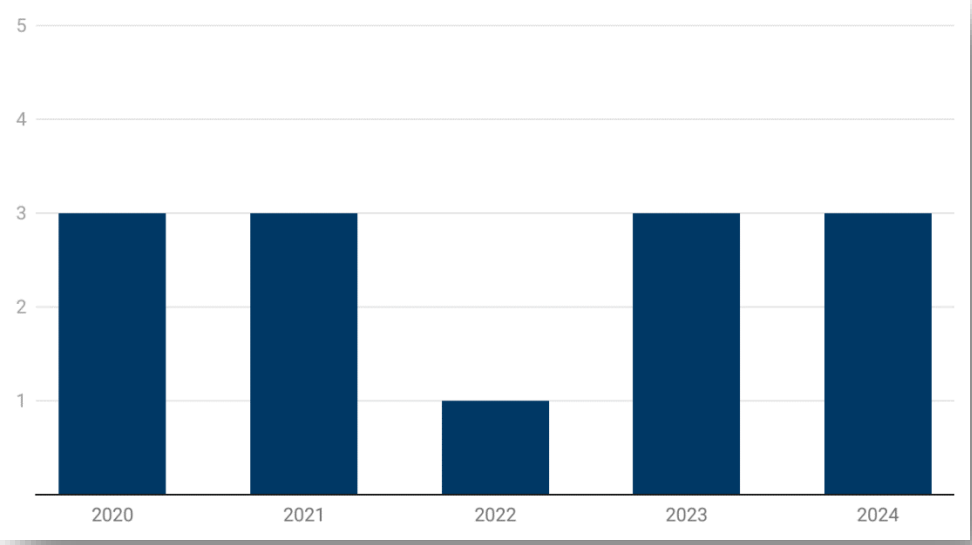
CWSs are required to test for nitrate annually, and if levels exceed 10 mg/L, corrective actions must be taken. Actions may be drilling new wells or blending high-nitrate water with lower-nitrate

sources. CWSs can also use treatment methods like ion exchange, reverse osmosis, and biological denitrification to reduce nitrate levels.

Minnesota has approximately 6,000 NWSs, which also undergo annual nitrate testing.

The following graphs show CWS and NWS active nitrate violations from 2020-2024.

Active CWS Nitrate Violations 2020-2024



This graph shows nitrate levels (mg/l) over the years. All CWSs that have experienced a nitrate exceedance are placed on quarterly nitrate monitoring. In 2023 and 2024, three CWSs had nitrate exceedances. Oak Grove Mobile Home Park, The Meadows manufactured home park, and the City of Ellsworth exceeded the MCL. One additional community, the City of Atwater, measured nitrate at the MCL of 10 mg/L, but through the end of 2024, did not exceeded the MCL.

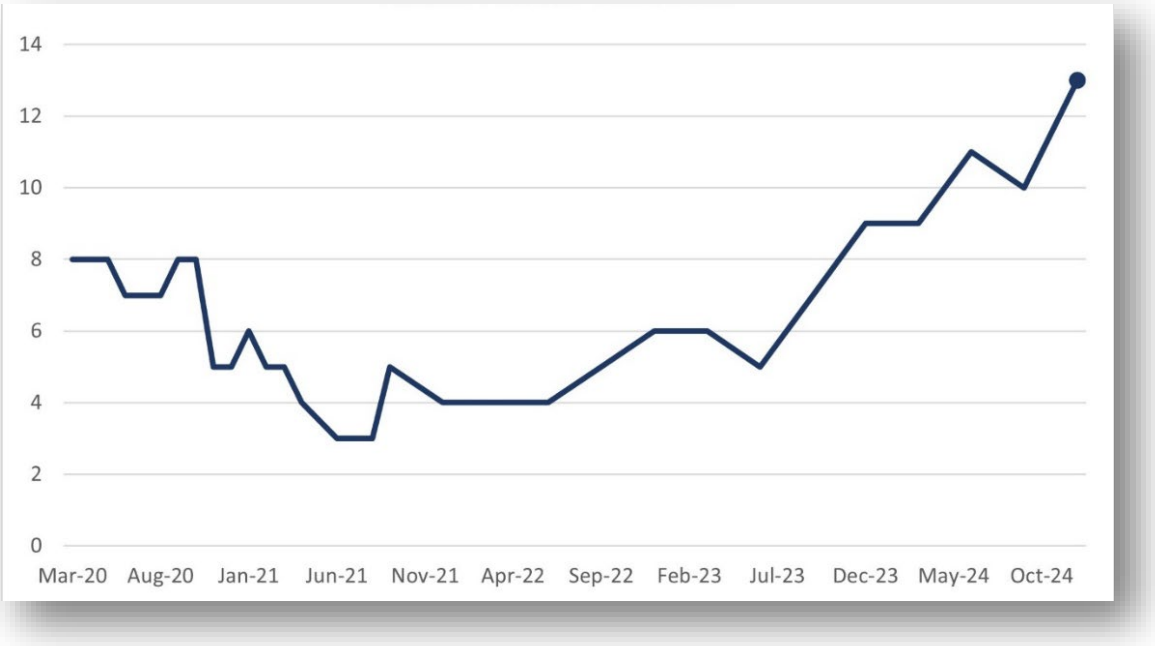
In all of these communities, the water systems are taking active steps to reduce their nitrate levels in a variety of ways:

- Oak Grove installed a treatment system for nitrate in 2024.
- The City of Ellsworth chose to discontinue use of their wells and purchase water from another water system in 2024.
- The Meadows is working to address their MCL violation through a compliance agreement with MDH.
- The City of Atwater is monitoring their levels closely and working on solutions, which may include a new well and treatment plant.

To find the level of nitrate detected at a particular CWS, read the system's Consumer Confidence Report (CCR). Search for your Consumer Confidence Report (CCR)

(https:/mnccr.web.health.state.mn.us/index.faces) online or contact the public water system for a paper copy.

Active NWS Nitrate Violations 2020-2024

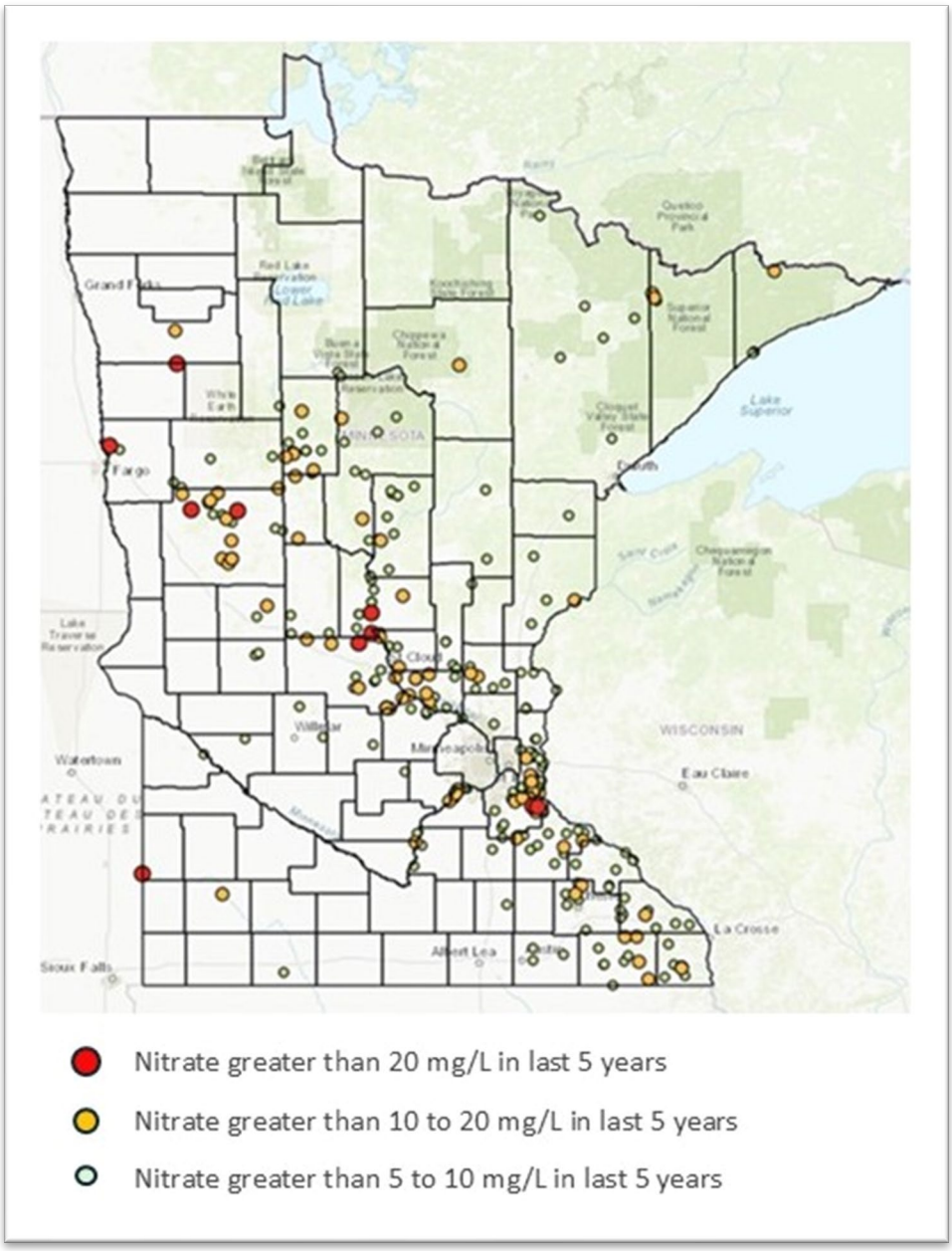


This graph shows the number of nitrate violations from March 2020 to October 2024. During this four-year period, the number of systems with active nitrate violations in a given month fluctuated between 3 and 13, meaning that over 99% of systems consistently complied with the nitrate MCL.

Additionally, 20 NWSs operated under a state discretionary release (SDR), allowing higher nitrate levels (10-20 mg/L) under specific conditions, provided they do not serve infants. An SDR is granted as a corrective action option only after a system exceeds the nitrate MCL and meets specific criteria. Systems under an SDR must post public notices to keep the community informed. These notices must be updated annually.

The following map shows nitrate results for active NWSs in Minnesota. The values displayed are based on the highest nitrate result of the entire system within the last five years (as of 12/31/24).

NWS Highest Nitrate in Last Five Years (2019-2024)



Public Notification

Nitrate contamination is a public health concern, especially for vulnerable populations like infants and pregnant people. MDH requires public notification when levels exceed the EPA's MCL of 10 mg/L. The people who use the water are notified and advised not to use the water for mixing infant formula or other uses that might result in the consumption of the water by infants under six months of age. The advisory is kept in place until steps can be taken to reduce nitrate levels in the

water. In such cases, MDH provides assistance for potential remedial measures, such as drilling a new well or treatment options to remove nitrate.

What Is Being Done

Addressing nitrate contamination in Minnesota's drinking water involves coordinated efforts across government agencies, PWSs, environmental organizations, and local communities. Key actions include source water protection planning, water treatment solutions, and drinking water monitoring, all aimed at ensuring safe drinking water for Minnesotans. By focusing on prevention, treatment, and public education, Minnesota is working to protect both public health and water resources for future generations.

Source Water Protection

Preventing nitrate pollution at the source is a proactive approach that includes protecting the watersheds and aquifers that supply drinking water. In 2023 and 2024, the collaborative efforts among MDH, CWSs, NWSs, well owners, federal regulatory authorities, and environmental organizations led to successful source water protection initiatives and reduced potential for nitrate contamination of drinking water supplies.

Source water protection initiatives focus on protecting Drinking Water Supply Management Areas (DWSMAs) from contamination and are often more cost-effective than addressing contamination through treatment after it has occurred. Examples of SWP activities that help reduce nitrate levels include drilling wells into deeper, cleaner aquifers; promoting land-use changes to minimize agricultural runoff; and providing education and outreach to landowners on best practices for preventing groundwater contamination.

In addition to working with communities to implement source water protection best practices, there are several regulatory forces that support these initiatives. The Groundwater Protection Rule restricts the application of nitrogen fertilizer in the fall and on frozen soils in areas vulnerable to contamination, and outlines steps to reduce the severity of the problem in areas where nitrate in PWS wells is already elevated. The Feedlot Rule governs the application for and issuance of permits for construction and operation of animal feedlots and manure storage facilities, and regulates the storage, transportation, disposal, and utilization of animal manure and related wastewater. Both of these pieces of legislation regulate practices to significantly reduce the leaching of nitrate into groundwater.

There are also barriers to successful implementation of source water protection strategies. Sometimes, the land in vulnerable DWSMAs is privately owned, and it is necessary to negotiate with landowners to implement actions that support source water protection while protecting their livelihood and maintaining community priorities. Additionally, source water protection activities are often long-term, sustainable solutions; it is difficult to produce significant short-term results to help secure funding for future initiatives.

The Source Water Protection Grants Program (https://www.health.state.mn.us/communities/environment/water/swp/grants.html) helps fund efforts in areas with the greatest demonstrated need, particularly low-income communities.

Effectiveness of Mitigation Strategies in Addressing Nitrate Contamination

The Drinking Water Revolving Fund (DWRF) offers financial assistance to PWSs, especially those in rural or underserved areas, to meet compliance standards.

Community vs. Noncommunity Systems: Addressing Unique Challenges

CWSs: Serve residential populations and have more stable funding and infrastructure. However, CWSs in agricultural areas may still face nitrate challenges, particularly in the southwestern, southeastern, and central regions.

NWSs: Serve nonresidential populations and face greater challenges, including limited resources. About 6% of untreated water samples from NWSs exceed 3 mg/L of nitrate, particularly in agricultural areas.

Mitigation Efforts and Targeted Interventions

Several strategies are in place to address nitrate contamination in both CWSs and NWSs:

- **Proactive Communication**: MDH alerts systems to rising nitrate levels to encourage early action.
- **Source Water Protection and Alternate Source Water Evaluation (ASWE)**: For systems with nitrate levels nearing 9 mg/L, DWP staff conduct an ASWE to guide corrective actions. The ASWE provides a comprehensive report, summarizing local hydrogeology, water quality data, and well construction recommendations to guide the selection of corrective actions.
- **Tailored Solutions**: MDH works with other agencies and local partners to reduce nitrate pollution, especially in agricultural areas. For example, MDH collaborates with the Minnesota Department of Agriculture (MDA) in southwestern Minnesota to reduce agricultural runoff. In southeastern Minnesota, where higher concentrations of nitrate are found in untreated water samples, targeted interventions, such as adding water treatment infrastructure and using appropriate nitrate-reduction technologies, are particularly critical.

MDH uses data to refine mitigation strategies and ensure health equity by prioritizing vulnerable communities. In 2023, 4% of PWSs in agricultural regions had nitrate levels above 3 mg/L, guiding targeted interventions in these areas.

Collaborative Efforts to Protect Drinking Water

MDH collaborates with several partners to address nitrate contamination:

- **Regulatory Oversight and Technical Assistance**: MDH approves construction and treatment plans, monitors water quality, provides technical assistance, and enforces SDWA standards.
- **Partnerships**: MDH collaborates with the MDA, local governments, and the University of Minnesota Extension to promote sustainable agriculture and educate communities about nitrate reduction.
- **Groundwater Protection**: The Minnesota Pollution Control Agency's Groundwater Protection Recommendations Report (https://www.pca.state.mn.us/sites/default/files/lrwq-gw-1sy16.pdf) outlines steps to reduce nitrate contamination in groundwater, contributing to broader water quality efforts statewide.

Successful Initiatives in Addressing Nitrate Contamination: Health Equity Perspectives

Nitrate contamination in Minnesota can disproportionately impact vulnerable populations, including low-income communities and small water systems with limited access to funding, and communities of color. This section highlights successful initiatives focused on prevention, treatment, and promising practices to address these disparities in health outcomes related to nitrate exposure.

Prevention

Empowering communities through education and practical measures is crucial for preventing nitrate contamination. In 2023, Minnesota launched several public awareness and education projects, integrating treatment technologies, source water protection, and agricultural best practices to reduce nitrate levels. Notable success stories include Battle Lake Mobile Home Park and Altura, where communities took targeted steps to reduce exposure through proactive strategies and collaboration with state agencies.

- **Battle Lake Mobile Home Park**: After discovering elevated nitrate levels in a well in the late 2000s, the community secured funding and received technical support from MDH and Minnesota Rural Water Association (MRWA) to abandon the problematic old well. In 2012, Battle Lake installed a deeper, safer well. However, six years later, nitrate levels in the new well began to rise. An investigation revealed that the original unsealed well might have holes in its casing, allowing nitrate-laden water to seep into the new supply. A district engineer from DWP recommended sealing the original well to eliminate this contamination pathway. The sealing project effectively eliminated the pathway for nitrates, resulting in a significant drop in nitrate levels. There was a 2.5 mg/L decrease within six months, bringing the water quality below the MCL, and an impressive 6 mg/L decrease over the following two years.

- **Altura**: Altura, a city in Winona County, has struggled with high nitrate levels in its drinking water over the past decade. Altura partnered with MDH, MDA, and MRWA to amend its Wellhead Protection Plan and reduce nitrate runoff from agriculture. MDA formed a local advisory team to identify and implement practices to decrease nitrate leaching from agricultural lands within the city's DWSMA.

  Meanwhile, city officials worked with MDH and MRWA to identify potential contamination sources that could affect drinking water quality, including the original, unsealed city well. In the fall of 2015, the city applied for an MDH Source Water Protection Plan Implementation Grant, initially receiving $3,000 for the well's location. After discovering obstructions that needed removal, Altura secured further funding of $9,825 in the fall of 2016 to clear debris, followed by an additional $2,500 in the spring of 2018 to seal the well. In 2024, Altura sealed another 700-foot deep old municipal well that spanned several aquifers with a $68,000 Drinking Water Subgrant from the Board of Water and Soil Resources Projects and Practices Grant (https://bwsr.state.mn.us/grant-profile-projects-and-practices), made possible by the Clean Water Fund. The project, which included a 25% match from the city, is vital for protecting local aquifers. Through leveraging these various grant opportunities, Altura improved its water infrastructure and resilience.

Effective treatment of nitrate contamination is another means to reduce nitrate levels in drinking water. Challenges persist, especially for transient systems, but targeted interventions are making a difference.

- **Becker Public Schools Transportation Facility**: In October 2023, routine nitrate monitoring revealed levels at this facility exceeded the MCL of 10 mg/L with average results of 18 mg/L. In response, the facility applied for a Source Water Protection Transient Grant. Since the facility is located in an area with a median household income (MHI) at or below the state average, the grant application was given priority to health equity point. The funding award enabled the Becker Public Schools Transportation Facility to install a state-approved nitrate treatment system. Subsequent testing in 2024 showed levels dropped well below the MCL, with results showing <0.05 mg/L.

Promising Practices

Innovative solutions and community engagement are key to tackling nitrate contamination in Minnesota. Examples of promising practices include:

- **Cold Spring**: The first city in Minnesota to use biological filtration for nitrate removal, Cold Spring implemented a cost-effective, two-stage fixed-bed biological treatment system that

uses natural bacteria to reduce nitrates. This approach, launched in May 2023, has shown promise in lowering nitrate levels while being environmentally friendly.

- **Mapleton Public Water System:** In Blue Earth County, the Mapleton public water system integrated biodegradable nitrate-absorbing filters into its water treatment process. These natural filters are cost-effective, require less frequent maintenance than conventional synthetic filter systems, and help reduce nitrates to safer levels. By adopting this approach, Mapleton has demonstrated that smaller communities can successfully implement eco-friendly technology without significantly increasing operating costs. These examples illustrate how innovative technologies and community collaboration can create sustainable solutions for reducing nitrate contamination and improving water quality in Minnesota.

Jon Stueve and Ryan Capelle in front of the filters in Cold Spring

Conclusion

The annual report on nitrate levels in Minnesota's drinking water provides a comprehensive overview of the issue, covering key aspects such as regulatory compliance, demographic disparities, sources of contamination, and financial implications. This report serves as a resource for policymakers, public health officials, and communities, providing a summary of the extent of nitrate contamination in PWSs, its impact on public health, and the critical measures required to ensure safe drinking water statewide. By offering actionable insights, the report empowers decision-makers to implement effective strategies that safeguard water quality and protect the most vulnerable populations.

Appendix: Community Water System Nitrate Summary

Table 1. Community Water Systems with Nitrate above 5.0 mg/L *(January 2023 – December 2024)*

Darker cell colors in the table indicate higher nitrate levels in finished water.

Community Water System	County	Current Population	Highest 2023-2024 Nitrate Level in Finished Drinking Water[1] (mg/L)	Highest 2023-2024 Nitrate Level in Source Water[2] (mg/L)
Adrian	Nobles	1211	4.4	13
Altura	Winona	493	8.4	8.4
Atwater	Kandiyohi	1133	10	10
Austin Mobile Home Park	Mower	59	5.6	5.6
Balaton	Lyon	639	5.4	5.4
Battle Lake Mobile Home Park	Otter Tail	31	6.9	6.9
Becker	Sherburne	5034	6	6
Belle Plaine	Scott	6901	3.8	5.4
Bethany Water Company	Winona	60	6.4	6.4
Bonnevista Terrace Mobile Home Park	Scott	579	5.7	5.7
Brookhaven Development	Scott	27	8.9	8.9
Cambridge	Isanti	9862	<0.05	8.9
Chandler	Murray	270	4.1	6.7
Chatfield	Fillmore	2997	5.3	5.3
Cold Spring	Stearns	4201	4.8	6.7
Edgerton	Pipestone	1171	6.2	13
Elgin	Wabasha	1115	9	10
Ellsworth	Nobles	462	19	19
Glenwood	Pope	2705	8.7	8.7
Goodhue	Goodhue	1200	6.9	6.9
Hardwick	Rock	198	buys water	8.1

Community Water System	County	Current Population	Highest 2023-2024 Nitrate Level in Finished Drinking Water[1] (mg/L)	Highest 2023-2024 Nitrate Level in Source Water[2] (mg/L)
Harmony	Fillmore	1042	5.2	5.2
Hastings	Dakota	23222	8.5	9.8
Isanti Estates	Isanti	267	4.7	5.3
Lincoln-Pipestone Rural Water System	Lincoln	13644	8.7	20
Mankato	Blue Earth	42803	3	13
Melrose	Stearns	3677	4.7	9.2
Mobile Manor Mobile Home Park	Scott	197	8.8	9.3
Oak Grove Mobile Home Park	Becker	60	12	12
Oakdale	Washington	28674	5.8	2.8
Perham	Otter Tail	3421	5.7	8.4
Rice	Benton	2161	6.6	6.6
Rock County Rural Water System	Rock	2919	6.4	16
Rockwood Estates	Benton	400	6.7	6.7
Roosevelt Court	Beltrami	60	4.6	5.4
Roscoe	Stearns	104	8.2	8.5
Rosemount	Dakota	26500	5.1	5.3
Saint Peter	Nicollet	11784	1.4	19
Shakopee	Scott	40610	5.8	5.8
Shores of Eagle Lake	Sherburne	160	7.4	7.4
Sundsruds Court	Hubbard	40	8.9	29
The Meadows	Wright	1000	11	11
Utica	Winona	293	8.9	8.9
Verndale	Wadena	504	2.4	8.8
Walker	Cass	990	1.9	6.6

[1] Finished drinking water is the water that reaches customers at their taps, after any treatment. [2] Source water is the water that comes from the drinking water source before any treatment and before it is distributed to customers.

Table 21. Community Water System Nitrate Summary *(January 2023 – December 2024)*

Maximum Nitrate Level (mg/L)	Number of CWSs
Below 3	795
3 to 5	35
5 to 10	35
Over 10	10

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