NDEE NITRATE STUDY

EXECUTIVE SUMMARY

During the 2023 legislative session, the Nebraska Legislature, at the request of Governor Jim Pillen, appropriated funding for the Nebraska Department of Environment and Energy (NDEE) to conduct a statewide water quality study (LB 814). The focus of the study is limited to nitrate in groundwater being used for drinking water. This document summarizes the findings of the study, gives background information on nitrate in Nebraska groundwater used for drinking water, and provides recommendations to address elevated nitrate concentrations in drinking water.

The overall goal of the water quality study is to provide an analysis and recommend viable solutions for nitrate-affected drinking water, including drinking water not regulated by the Safe Drinking Water Act (SDWA) (i.e. private domestic wells).

OBJECTIVES OF THE STUDY:

- Provide free nitrate test kits to private well owners to collect additional data on nitrate concentrations in private domestic wells.
- Analyze nitrate concentrations in Nebraska groundwater and identify trends and data gaps.
- Develop guidance and tools that prioritize areas of the state for program outreach with the goal of proactively addressing rising nitrate concentrations in community water systems (CWSs), including a guidance document for public water systems (PWSs).
- Develop a guidance document to assist private domestic well owners in evaluating their risk of nitrate in drinking water and provide solutions to mitigate nitrate-affected water.
- Develop a risk communication-based outreach toolbox that NDEE and other partners can use to promote awareness of nitrate in private domestic drinking water supplies. This includes modeling to identify high-risk areas, and an interactive, web-based geographic information system (GIS) tool for internal NDEE and key agency partner use.

This document is broken into three sections with corresponding border colors:

OVERALL NITRATE STUDY INFORMATION

INFORMATION RELATED TO PUBLIC WATER SYSTEMS

INFORMATION RELATED TO PRIVATE DOMESTIC WELLS

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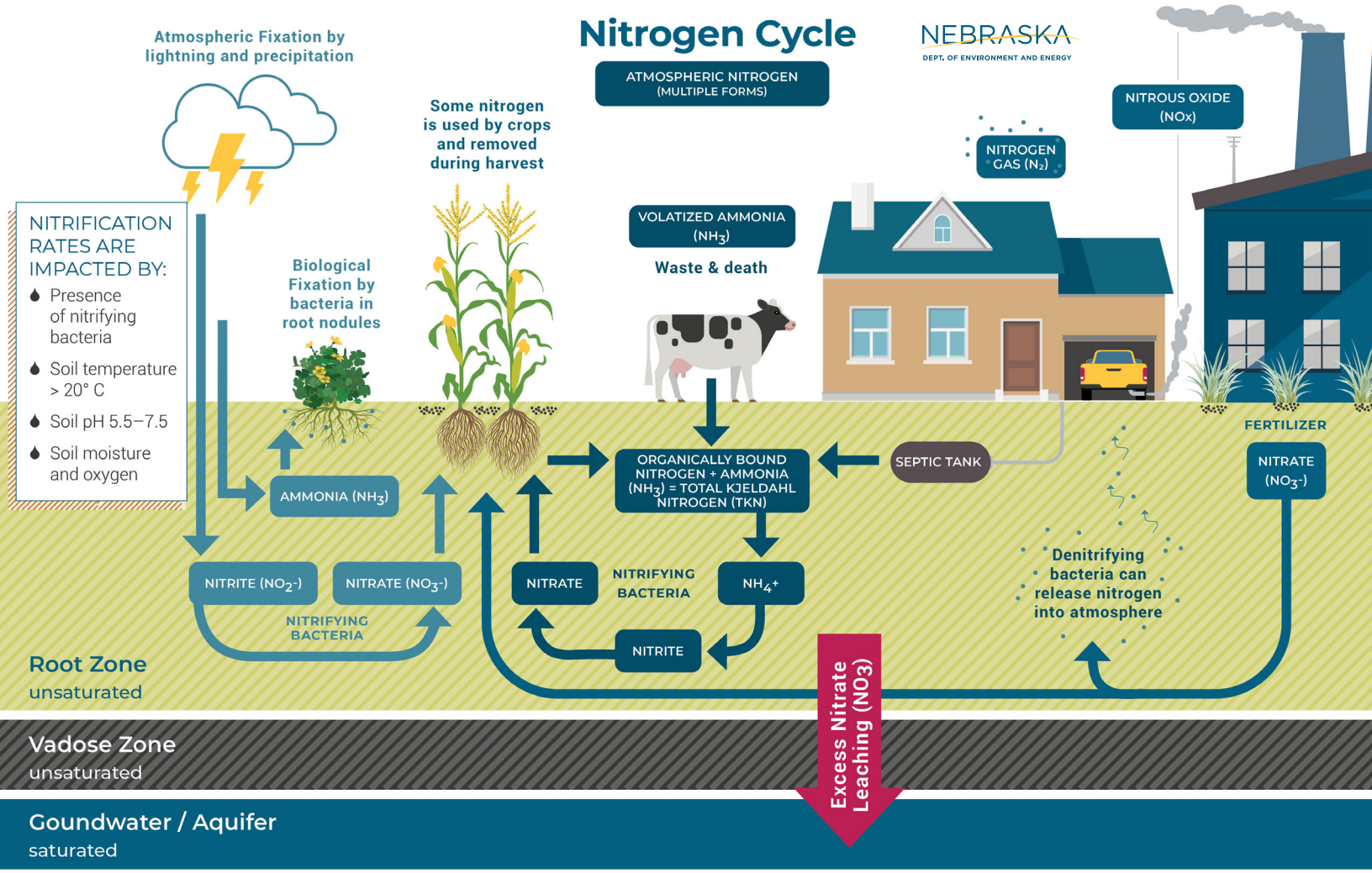
WHAT IS NITRATE?

Nitrate is a naturally occurring compound, but **elevated nitrate concentrations in groundwater used for drinking water are a risk to public health.** Excess nitrogen application at the surface impacts groundwater over time.

Depending on local geology, it can take as little as a year or more than 50 years for nitrate to reach groundwater. **Once it reaches groundwater, nitrate can persist for decades.**

Inorganic and organic sources of nitrogen can become nitrate over time. In the soil and water this material combines with oxygen to form nitrate. The figure below shows the pathways nitrogen can take in the environment to become nitrate in the aquifer.



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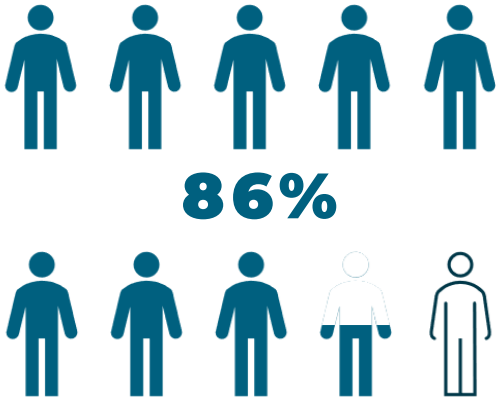
NITRATE IN NEBRASKA GROUNDWATER

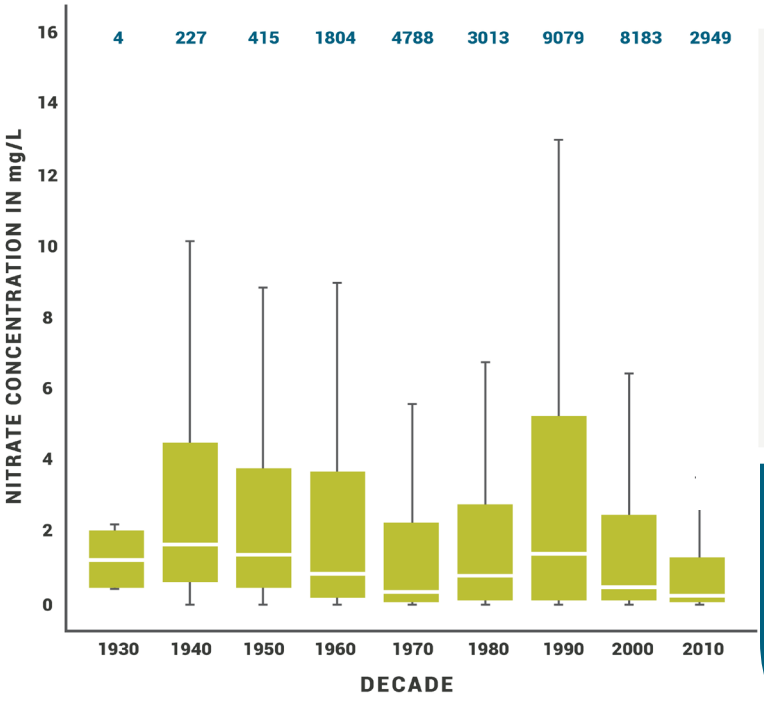
Many Nebraskans rely on groundwater for drinking water. Nitrate contamination in groundwater has been a persistent issue in Nebraska. Increases in nitrate concentration have been reported since the 1930s in areas like the Upper Elkhorn and Central Platte River basins. Because of oxygen levels in groundwater across much of Nebraska, when nitrate leaches past the root zone, it can remain in groundwater for decades. This study largely affirms the existing research into the extent of the problem and seeks to provide viable solutions for nitrate-affected drinking water.

GROUNDWATER IS THE PRIMARY DRINKING WATER SOURCE FOR NEARLY NINE OF EVERY TEN NEBRASKANS.



NEBRASKA NITRATE CONCENTRATIONS BY DECADE

USGS Monitoring Wells 1930-2019



EXPLANATION
NUMBER OF SAMPLES: 500

- Highest sample within 1.5 times interquartile range above 75th percentile
- 75th percentile
- 50th percentile *(Median)*
- 25th percentile
- Interquartile range
- Lowest sample within 1.5 times interquartile range above 25th percentile

NDEE collaborates with Natural Resource Districts (NRDs) and the University of Nebraska to maintain a Clearinghouse database for water quality data from wells across the state. Data in the Clearinghouse spans 1969 to 2023, however, due to process changes, the record from 2020 to 2024 is incomplete and is a data gap identified by this study.

Nitrate samples have been collected in monitoring wells in Nebraska since the 1930s. Concentrations have increased in most areas of the state since then.

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NDEE NITRATE STUDY

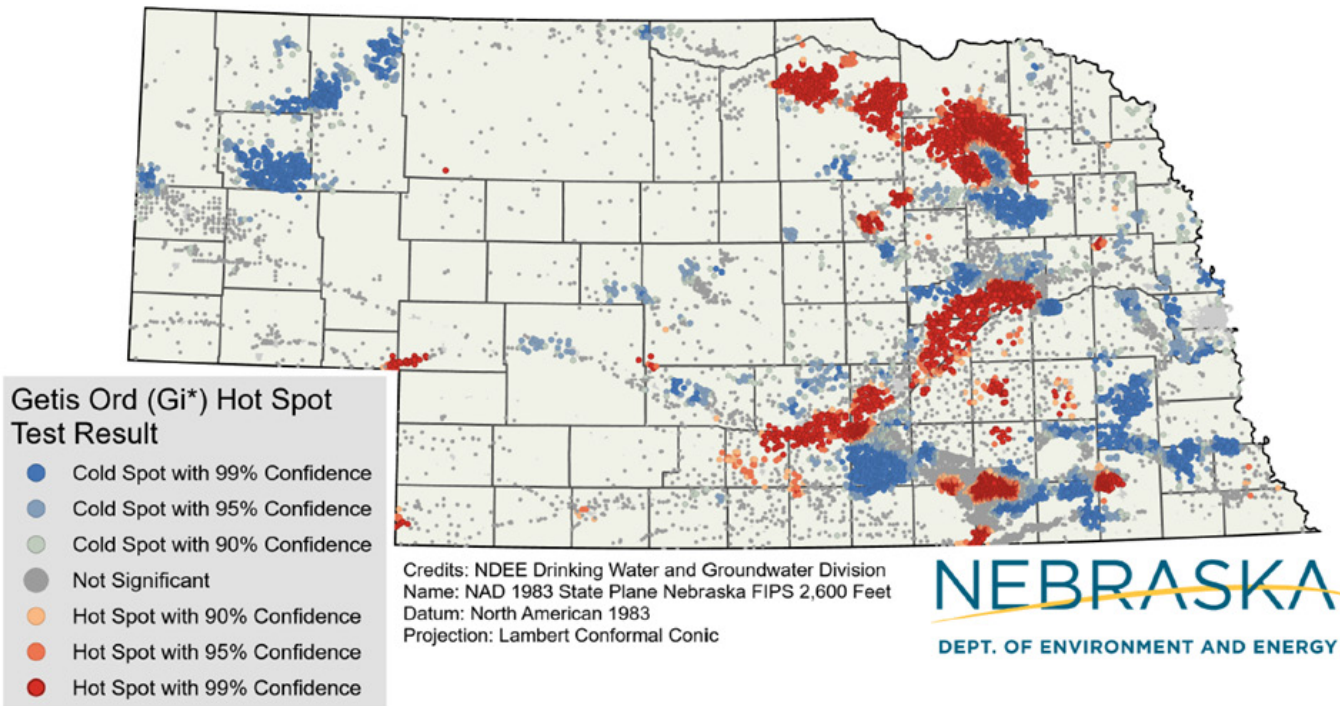
NITRATE STUDY DATA ANALYSIS

The water quality study analyzed available nitrate samples from wells across Nebraska to identify areas of concern, collected additional data on nitrate in private domestic wells, and identified trends in nitrate concentrations in community water systems.

Statistical analysis conducted during the water quality study identified areas with elevated nitrate concentrations consistent with the existing body of research in Nebraska. Relative nitrate hot and cold spots in the state are shown in the figure shown below. Clusters of dots in red represent high concentration nitrate samples taken from wells grouped together based on location and concentration. Blue dots represent low concentration samples taken from wells grouped in the same way. Grey dots represent samples not identified as hot or cold spots by this test.

- NITRATE DATA & TREND ANALYSIS
- REVIEW BY AGENCY EXPERTS & PARTNERS
- DATA-INFORMED RECOMMENDATIONS TO ADDRESS NITRATE-AFFECTED DRINKING WATER

RELATIVE NITRATE HOT & COLD SPOTS IN NEBRASKA



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NITRATE IN DRINKING WATER REGULATORY BACKGROUND

- NDEE is the primacy agency responsible for enforcement of the Safe Drinking Water Act (SDWA) in Nebraska.
- Nitrate is a regulated contaminant under the SDWA.
- The SDWA established maximum contaminant level (MCL) for nitrate in Public Water Systems (PWSs) is 10 milligrams per liter.
  - Concentrations of nitrate in drinking water above the MCL are dangerous to infants, who may develop methemoglobinemia, also known as blue baby syndrome.
  - Since the MCL for nitrate was originally established, additional research has examined other potential health effects from consuming nitrate in drinking water, such as cancer.

PRIVATE DOMESTIC WELLS ARE NOT REGULATED BY THE SDWA.

However, they are an important source of drinking water for many Nebraskans, and this study provides information and tools that private domestic well owners can use to evaluate their risk of elevated nitrate concentrations.

PWSs THAT REPEATEDLY VIOLATE THE MCL FOR NITRATE:

Must notify customers within 24 hours, and provide an alternate source of drinking water for vulnerable populations, including pregnant women and infants.

Can be legally compelled, by Administrative Order (AO), to provide SDWA compliant drinking water by NDEE. This often requires an engineered solution like a treatment plant or new well.

Engineered solutions are expensive, particularly for small water systems, which are the majority of systems in Nebraska.

Note: The public can access water quality data for their community at https://drinkingwater.ne.gov.

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INFORMATION RELATED TO PUBLIC WATER SYSTEMS

PUBLIC WATER SYSTEMS (PWSs)

THE WATER QUALITY STUDY ACCOMPLISHED THE FOLLOWING RELATING TO PWSs:

- Analyzed nitrate concentrations in Community Water Systems (CWSs) and summarized these results in an individualized report for each community.
- Identified earlier opportunities for state assistance than the current process.
- Developed a priority system NDEE can use to proactively connect CWSs with voluntary programs to address nitrate and avoid costly engineered solutions.
- Identified key data gaps:
  - Wellhead protection areas, used by communities to proactively address contaminants, are not up-to-date for all PWSs. Updates are ongoing.
  - Service areas for PWSs (where they serve water to customers) are not currently available for the state, which limits the study of regionalization. Regionalization, where two or more PWSs connect to each other, can be a cost-effective solution to address nitrate.

KEY STUDY RECOMMENDATIONS RELATING TO PWSs:

Conduct a regionalization study on PWS consolidation to address nitrate issues. Larger consolidation efforts have been shown in other states to dramatically reduce the cost of regionalization on a per-service basis i.e., the cost borne by system ratepayers.

Incorporate the CWS priority system developed during the study into program planning and expand to other PWSs. It is a tool and set of metrics NDEE can use to proactively assist PWSs facing rising or elevated nitrate in drinking water.

Continue to encourage voluntary BMPs as a way of reducing or preventing elevated nitrate concentrations in groundwater used for drinking water.

STATE PROGRAMS ARE EFFECTIVE AT ADDRESSING NITRATE ON DIFFERENT TIMESCALES

0-3 Years

Short-term engineered solutions like new wells or treatment plants. Low interest rate financing and loan forgiveness are potentially available through the State Revolving Fund (SRF) program and partner agencies like USDA.

3-10 Years

Mid-term technical assistance (TA) and capacity building. Engineering planning grants may be available through the SRF program, and TA providers can work with systems to plan for improvements and upgrades over time.

10+ Years

Long-term source water and wellhead protection planning. Funding and TA are available through the Drinking Water Division to assist communities with long-term planning and voluntary management efforts that can prevent the need to implement expensive, engineered solutions.

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INFORMATION RELATED TO PUBLIC WATER SYSTEMS

COMMUNITY WATER SYSTEM (CWS) NITRATE PRIORITY TOOL

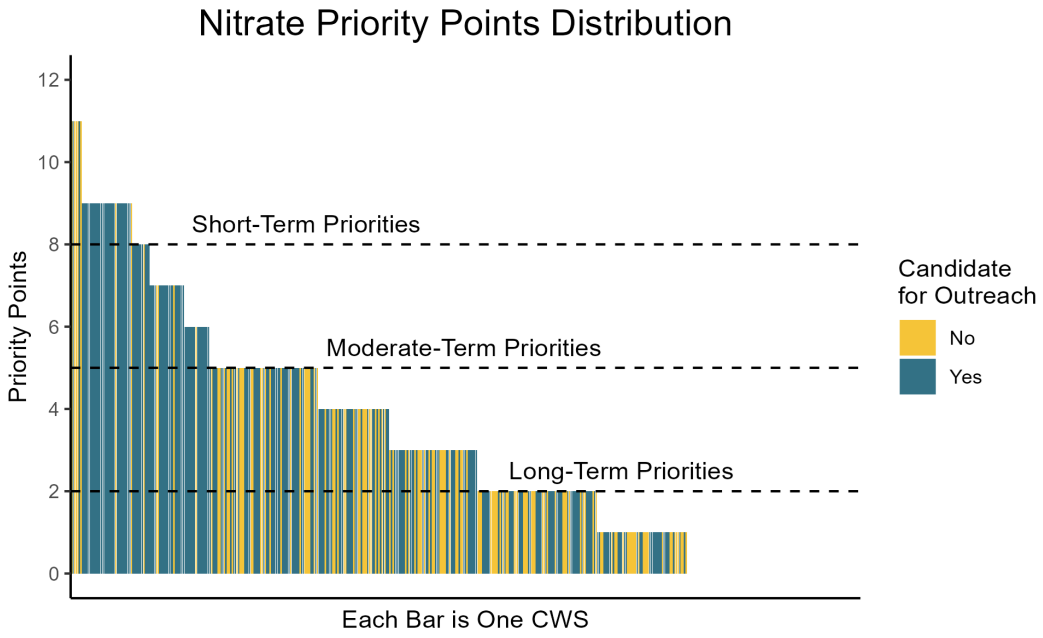
NITRATE DATA & TREND ANALYSIS

PRIORITY POINTS CALCULATIONS

RANKING BY TOTAL POINTS

1. SHORT-TERM PRIORITIES
2. MID-TERM PRIORITIES
3. LONG-TERM PRIORITIES

The CWS Nitrate Priority Tool is something NDEE can use to identify systems for state program assistance, such as targeted outreach to encourage long-term planning programs to help communities in Nebraska avoid expensive engineered solutions. This metric could also help NDEE track progress on the issue internally.



NDEE analyzed nitrate sample results from CWS to develop a priority score that includes long-term trend analysis and recent water quality data. Higher scores indicate a more immediate-term risk of falling out of compliance with the SDWA.

In conducting the analysis NDEE identified over 170 systems **(in yellow above)** who are working with or have worked with NDEE and partner agencies to address nitrate.

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INFORMATION RELATED TO
PRIVATE DOMESTIC WELLS

PRIVATE DOMESTIC WELLS: BACKGROUND

PRIVATE DOMESTIC WELL REGULATIONS:

- Private domestic wells are not regulated by the SDWA and in most counties, there is no requirement to sample them for nitrate. NDEE estimates fewer than 10% of domestic wells are sampled annually for nitrate.
- Prior to 1993, private domestic wells were **not** required to register with the state. Based on population data and registration records, NDEE estimates as many as 110,000 private domestic wells are unregistered in Nebraska.
- NDEE sets well construction standards and certifies well drillers. Natural Resource Districts and counties may set additional rules and requirements for domestic wells.
- Available data suggests around 17% of private domestic wells in the state exceed the SDWA nitrate standard.

ADDRESS NITRATE IN DRINKING WATER:

- Boiling water does not remove nitrate, it concentrates it.
- Home treatment systems, such as reverse osmosis filters, are effective at removing nitrate from drinking water.
- A rebate program provided financial assistance to private domestic well owners for installation of a reverse osmosis treatment system if the nitrate level in their well was above 10 mg/L. The application period opened in January 2023 and closed on June 30, 2024 with installations needing to be completed by September 30, 2024.

Private wells used for drinking water are known as Private Domestic Wells. They are not regulated under the SDWA, but they provide drinking water for nearly 20% of Nebraskans.

ABOUT ONE IN FIVE NEBRASKANS RELY ON A PRIVATE DOMESTIC WELL FOR DRINKING WATER.

NDEE ESTIMATES FEWER THAN 10% OF DOMESTIC WELLS ARE SAMPLED ANNUALLY FOR NITRATE.

PRIVATE DOMESTIC WELL OWNERS can use tools developed during the water quality study to evaluate their risk of elevated nitrate in drinking water. A guidance document was developed by NDEE to assist private domestic well owners.

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INFORMATION RELATED TO PRIVATE DOMESTIC WELLS

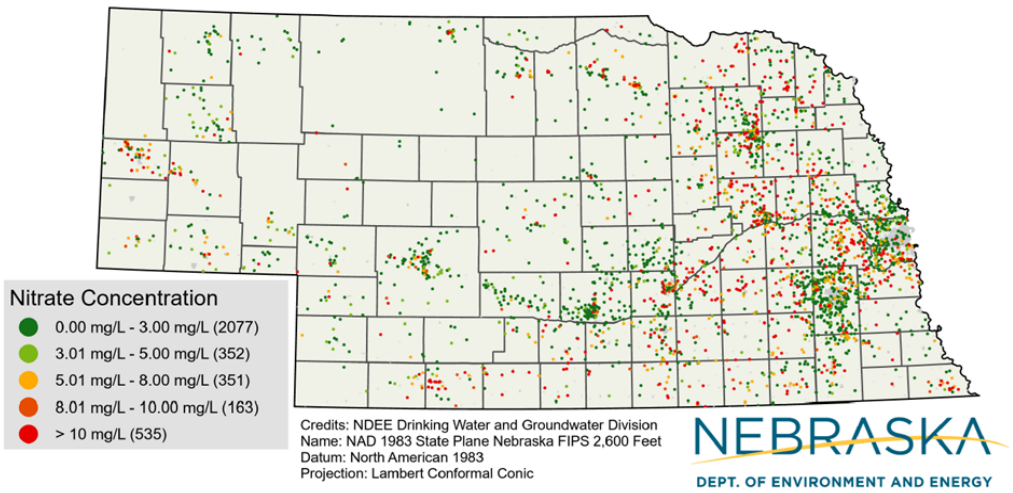
NDEE OVERSAW THE LARGEST PRIVATE DOMESTIC WELL NITRATE SAMPLING EFFORT IN NEBRASKA HISTORY.

Postcards were sent to 29,000 registered private domestic well owners inviting them to request kits. NDEE promoted the effort through press releases and the media to reach unregistered private domestic well owners.

Over 4,500 kits were requested and more than 3,400 were returned for analysis.

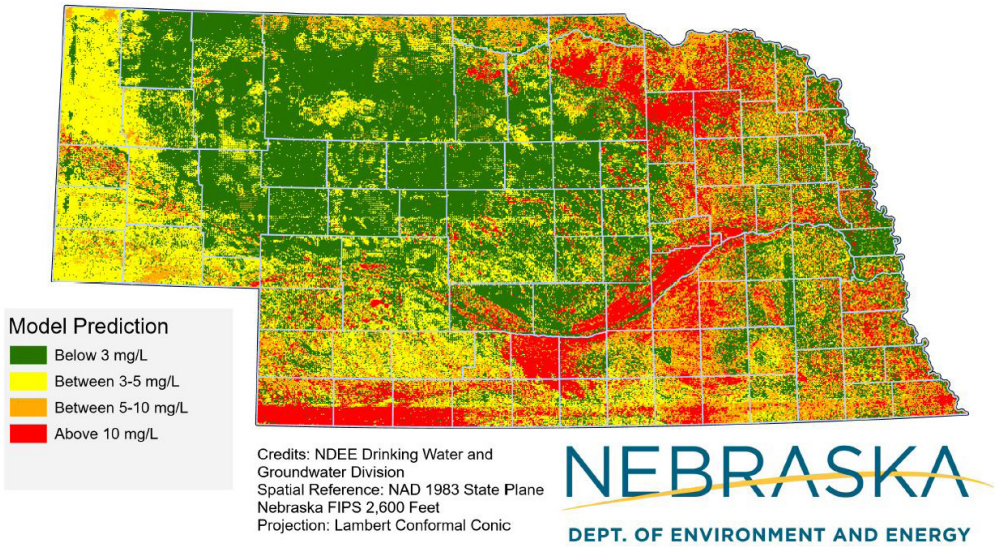
These data provide an invaluable snapshot of nitrate levels in private domestic wells across the state.

3,478 Private Domestic Well Nitrate Samples from the 2023-2024 Free Nitrate Sampling Effort



The average nitrate concentration for the samples collected as part of the free sampling effort was 4.83 mg/L. Around 15% of the samples were above the SDWA standard of 10 mg/L.

Predictive Nitrate Model Results: Composite Layer in Terms of Nitrate Concentration



NDEE conducted modeling to identify high-risk areas in Nebraska and developed a web-based nitrate risk assessment tool as an internal resource for NDEE and key agency partners.

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INFORMATION RELATED TO PRIVATE DOMESTIC WELLS

PRIVATE DOMESTIC WELLS

THE WATER QUALITY STUDY ACCOMPLISHED THE FOLLOWING RELATING TO PRIVATE DOMESTIC WELLS:

- Started a free, statewide sampling program for all private domestic well owners to help fill a needed data gap. Over 4,500 nitrate test kits were requested. NDEE staff fielded over 2,500 calls to discuss nitrate sample results and provide assistance to those who needed it.
- Analyzed nitrate concentrations in Nebraska groundwater and identified key data gaps including a large number of unregistered wells and ongoing updates to the Clearinghouse.
- NDEE and partners developed guidance documents and an outreach toolbox to assist private domestic well owners with sampling, interpreting results, and addressing nitrate contamination in drinking water.
- NDEE conducted modeling to identify high-risk areas where private domestic wells are likely to exceed threshold concentrations like the 10 mg/L SDWA limit and developed a GIS risk assessment tool as an internal resource for NDEE and key agency partners.

KEY STUDY RECOMMENDATIONS RELATING TO PRIVATE DOMESTIC WELLS:

- Updates to the Clearinghouse are ongoing and it is important they be completed. Currently, there is a 3-year backlog in this data, which is used by many stakeholders.
- Historic data for private domestic wells is limited, and many of the samples that have been taken are not currently publicly available. When the Clearinghouse changes are finalized, NDEE should make data collected during this study available. Additionally, work should be continued to increase private domestic well testing.
- Continue to develop and refine risk communication tools developed during the study to provide a clear, unified message from NDEE and its partners on nitrate. Identify funding to continue private well sampling and treatment programs.
- Create a database of likely unregistered well locations and owner contact information.
- Increase well registrations by reducing obstacles for registration.

NDEE encourages private domestic well owners to sample their well annually for nitrate and bacteria.

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