December 20, 2023

To: Co-chairs members and staff of the Minnesota Legislative Subcommittee on Water Policy

From: Jeffrey S. Broberg, LPG, Director Minnesota Well Owners Organization (MNWOO), brobergmnwoo@gmail.com

RE: Comments and data related to December 5 Subcommittee Hearing on nitrates in SE Mn karst.

First, I was grateful to see the presence of the Department of Health and Minnesota Ag Department and appreciate their rapid response to the USEPA, a plan to provide the details by January 15, including the budget recommendations. I understand the multi-agency and coordination. MNWOO supports the proactive urgency for drinking water protection at the kitchen sink in every household. But we still see major blind spots and a lot of missing information, misinformation, and misdirection. Some of these deserve a closer look.

I want to address several issues raised at the Subcommittee, including:

The successful public health efforts to prevent blue baby syndrome, acute acquired methemoglobinemia,

Updated health risks of nitrates and pesticides in groundwater.

Groundwater age as a drinking water risk factor

The widespread use of old wells predates the 1974 Well Code and Safe Drinking Water Act.

Nitrates from rainfall/snow and natural background levels of nitrate in groundwater.

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New Nebraska initiatives to test and treat widespread nitrate contamination,

Blame v responsibility for providing safe drinking water for people who now share contaminated aquifers.

Blue Baby Syndrome is preventable due to public health efforts.

Preventing blue baby syndrome is one of the best examples of effective public health communication. Despite rising nitrate levels in groundwater exposing more women to nitrate-contaminated water, there are no modern cases of blue baby syndrome.

Since the 1960s, doctors, clinics, health departments, extension services, and almost every aspect of neonatal and pediatric care have alerted families of the risk of nitrates in drinking water. Public health convinced mothers to drink safe nitrate-free water and use safe water for baby formula. These public health efforts prevented this fatal disease for 50 or 60 years. The lack of blue babies is not from reducing the groundwater hazard; it is due to wise risk management and public health communication about the imminent risks of our contaminated groundwater.

Prevention must become the norm as drinking water continues to be contaminated with nitrates and pesticides in the karst region.

The Health Department made clear in response to USEPA that this communication and outreach is an urgent need, and they will be proposing even more risk communication targeted toward pregnant women and families with infants. The measure of success will continue to be prevention by avoiding untreated groundwater.

Updated health risks from nitrates and pesticides in drinking water – the current Nebraska data

Current health risk and epidemiological data show that nitrate levels and nitrates combined with pesticides in drinking water are linked to other health risk outcomes and other preventable diseases.

The Health Risk Limit (HRL) and Maximum Contaminant Level of nitrate in drinking water (10mg/L) were set to address acute acquired methemoglobinemia, not for other health outcomes, and the standards do not take the co-occurrence of pesticides when considering adverse health outcomes.

Nebraska studies show that even low concentrations of nitrate in drinking water have been linked to other adverse health outcomes and that pesticides in groundwater compound the risk of disease[1].

- Strongest links:
    - Minor health ailments –
    - Preterm birth issues
    - Congenital disabilities
    - Pediatric and adult cancers

The Nebraska congenital disability studies found that the national average of congenital disabilities was 3.3% of live births but was 5.8% in Nebraska, 1.75 times higher. The studies found a greater prevalence of agrichemicals in drinking water in NE Nebraska, where counties report 9-12% of newborns have preventable congenital disabilities[2]. Everyone in Nebraska was alarmed when public health researchers found that one in sixteen families drinking nitrate and pesticide-laden groundwater have children with preventable deformities.[3]

Severe other health outcomes were identified in children drinking nitrate-contaminated water, including pediatric brain cancers and non-Hodgkin Lymphoma. The Child Health Research Institute at the University of Nebraska

[1] Oct 2018 10-2018 Birth outcomes and water: A multidisciplinary study Moses New-Aaron, L. Meza, Patrick J. Shea

[2] 2023, Augustine, Rhoades, Eskridge, Comparative analysis of agrichemical mixtures in drinking water and birth defects in Nebraska https://www.unmc.edu/search/index.html?s=nitrates

[3] https://sdn.unl.edu/article/birth-outcomes-and-water-bow-study

found that from 2003 through 2014, Nebraska had the highest pediatric cancer rates (183.2/million), and Minnesota was second highest at 179.9/million.[4]

The Nebraska study cited adult adverse health outcomes, including many minor health ailments, increased heart rate, nausea, headaches, abdominal cramps, and potentially associated cancers, including Colorectal cancer, kidney cancer, bladder cancer, non-Hodgkin Lymphoma, Thyroid disease, Alzheimer's, Diabetes and Parkinson's Disease, maternal/fetal health issues, miscarriages, preterm births, fetal growth restrictions, and congenital disabilities.

In Nebraska, a 2018 study, "Birth Defects and Water," concluded that mixtures of nitrates with pesticides were a public health problem. One of the study's conclusions stated that other contaminants, especially pesticides in drinking water, besides nitrates, may be a more significant public health concern. "The largest effect of agrichemicals on birth defect rates was found with nitrate + atrazine in public and domestic wells."

Minnesota Department of Agriculture continues reporting on pesticides in drinking water from private wells and monitoring wells and springs. Pesticides are pervasive.

The 2020 MDA Annual Report summarized the results from sampling since 2006[5]:

> *Private Well Pesticide Sampling As part of the Private Well Pesticide Sampling (PWPS) Project, the MDA collected 738 pesticide samples from private wells in 16 counties in 2020. Samples from the PWPS Project were analyzed by a contract laboratory for pesticides and nitrate. Wells sampled as part of the PWPS Project had previously indicated the presence of nitrate and are located in areas of vulnerable groundwater and row crop agriculture.*
>
> *At least one pesticide was detected in 84% of wells sampled.*
>
> *o as many as 18 pesticide compounds were detected in a single well.*
>
> *o Metolachlor ESA was the most frequently detected pesticide analyte.*

[4] 2019, Temkin, ∗Evansa , Manidisb , Campbella , Naidenkoa. Exposure-based assessment and economic valuation of adverse birth outcomes and cancer risk due to nitrate in United States drinking water, retrieved from: Exposure-based assessment and economic valuation of adverse birth outcomes and cancer risk due to nitrate in United States drinking water. - ScienceDirect

[5] June 2021, Minn Dept of Agriculture, 2020 Water Quality Monitoringt Report, Jan-Dec 2020, 285 p.

o Four neonicotinoid insecticides were detected infrequently: clothianidin (2%), dinotefuran (1%), imidacloprid (2%), and thiamethoxam (1%).

o Thirty-three wells indicated a pesticide concentration above an applicable health reference value. Thirty-two were for total cyanazine (HRL of 1,000 ng/L), while one was for total metribuzin (HRL of 10,000 ng/L) in Mower County. Detections above the HRL for total cyanazine occurred in Mower (2), Stearns (1), Swift (2), and Washington (27) counties.

The 2020 total pesticide detection frequencies were compared to nitrate concentration ranges, and a 90% probability of one or more pesticides in groundwater with only 3 ppm nitrates was found.

A chapter on "Cyanazine in groundwater, an herbicide mainly used on corn crops in Minnesota until it was discontinued in 2002. Some common trade names for Cyanazine included Bladex and Fortrol." The report cites that the SE karst region has the highest density of high Cyanazine in wells in Minnesota (pg. 206)

USEPA is not addressing the nitrate/pesticide link, but this is a growing public health concern.

Determining that the Minnesota karst aquifers are an imminent health risk is a public health call to action, not a time to fall back on old science and studies that only cite methemoglobinemia.

Groundwater Age:

Groundwater age captures the imagination of people who wonder, "How did my water get here." Groundwater infiltration, storage, and discharge studies have been used to compile Pollution Sensitivity Maps in the County Geologic Atlas, Part B[6].

Recently, we have heard of detailed groundwater age studies by USGS that show that researchers can determine precisely how old the water is from any well or spring using marker chemicals. Dye trace studies, isotopic studies, and detection of maker chemicals like freon, pharmaceuticals, and household products can tell when groundwater was last at the surface.

A large body of peer-reviewed scientific literature proves that there is no "average" groundwater age and that aquifer recharge processes in the karst pollute some

[6] https://www.dnr.state.mn.us/waters/groundwater_section/mapping/county-geo-atlas.html#W

aquifers in some areas in a matter of days or weeks following rainfall and infiltration. In other places, the water in wells is years, decades, centuries, or millennia old.

I have experience with wells in fractured karst aquifers where surface infiltration allows water to flow into wells after a spring melt or heavy rains. These households are drinking recent water where bacteria and high nitrate levels are expected. Shallow bedrock with underground cracks and fissures acts like pipes that feed surface water directly to old wells that people rely on for drinking water. Hydrologists see the same thing in soil infiltration studies and water quality in springs and caves.

Dramatic cases of dye trace studies across the karst prove that the dye poured on the surface often shows up in springs and wells within days. We know how the infiltration process works and can show how closely land use and nutrient loss are connected to water quality.

We can also see from isotope studies and the high correlation between nitrates and ag chemicals that most nitrates in groundwater are from chemical fertilizers with fewer feedlots and human waste inputs.

Our groundwater recharge is a continuum over time, and every well is different because of geology, well construction, and land use. The tracing, age dating, and isotopic data show that any statements that groundwater "is 60 years old" are false. The "60-year-old water" narrative is a misdirection trying to blame the past fertilizer use for our contaminated water. Still, nitrates are being detected in a wide range of old and new wells. Wells with vintage water over 65 years old do not have high nitrates. All other old and new wells have mixed or recent water and elevated nitrates and associated pesticides.

We can't ignore the data from the Field to Stream Partnership[7] in the Root River, where monitoring of springs shows a steady 15 ppm nitrates in the recent water. Despite decades of lip service for best management practices, we never see a nitrate decline. Unfortunately, there is still no evidence that current farm practices in the karst are reducing nitrates or restoring our contaminated aquifers.

[7] https://www.mda.state.mn.us/root-river-field-stream-partnership

Drinking Water Supply Management Areas estimate groundwater travel time from the surface to the well.

The concept of groundwater age is employed for community water systems where hydrologists define wellhead protection areas and drinking water supply management areas (DWSMAS). The DWSMAS are based on the predicted 10-year and 50-year travel times from rainfall and snow melting into a well. Public water supply managers never assume that water is an average age of 60, and they hope that best management practices will improve the water within three years. Unfortunately, Minnesota has made no progress in slowing the nitrate loss of the karst DWSMA.

The DWSMAS around communities like Hastings, Utica, Altura, Plainview, and Elgin are large because water flows quickly from the surface into the groundwater, and water from a large area can be in the wells in less than ten years. It is hoped that changes to farm practices in these areas will reduce nutrient loss and improve water quality in the short term, but this has yet to be proven.

Other communities with deeper wells have older water recharged far from the pumping wells, have small DWSMA, and have a lower risk of nitrate contamination.

Old "non-code" wells and the Minnesota Well Code of 1974

The total number of wells and the number of old "pre-code" wells are missing information. We do not know how many people are now at risk because of high nitrates in old wells or how many are facing a new risk because of rising nitrate levels in aquifers that used to be safe.

Counting the wells, the community, and individuals at risk is one of the first things the USEPA requires Minnesota to do to comply with the Safe Drinking Water Act.

Minnesota must complete an inventory of wells, count the number of people drinking from wells in the contaminated aquifers, provide water testing, and take immediate action for those households with unsafe drinking water.

All the community water supplies have a detailed count of the number of water service connections, the population served, and the water quality. Karst communities with over 30 years of nitrate testing data show continuously rising nitrate levels, and private well owners suffer the same fate as rising nitrates and pesticides. For all the private wells, there is no count, no record, only assumptions.

The Minnesota Well Code, passed in 1974, required registration of wells, water well construction standards, and professional standards for well drillers, ensuring the safe installation of all new wells. Olmsted County adopted well standards twenty years earlier.

The current Minnesota Well Index is a critical tool but is far from complete. In MNWOOS's experience, the karst area has more pre-code unrecorded wells than code-compliant registered wells. Still, the record of post-1974 wells in the karst is incomplete due to location errors, data management challenges, and the use of an antiquated software system that is no longer supported.

The Driftless area has many examples of old wells discovered following flash floods in Rushford, Zumbro Falls, and Elba, and we know of hand-dug wells still in use that date to the Civil War era; we still see wells and water systems with cisterns susceptible to bacteria, nitrates, and pesticides, and we still see households relying on springs. These old wells are most common in areas of declining investment and reliance on old housing.

The MDA Township Well Testing for Winona County found that 30% of wells from initial sampling did not conform to the Well Code. In Winona and Fillmore Counties, we believe that 40% to 60% of the current wells are registered, and most

wells are not on any Well Index. An up-to-date Well Index is essential to address the risk of nitrate-contaminated water.

Olmsted and Dakota Counties are the exceptions; both Counties have conducted surveys to locate as many wells as possible. Olmsted completed this as part of their County Hazard Management Plan due to the potential need to notify well owners of the risks of flooded wells, the risk from leaks and spills, or aquifer contamination that could pollute private wells. Dakota has a robust program to identify wells as part of property records. None of the other Counties (Mower, Fillmore, Houston, Winona, Dodge, Wabasha, or Goodhue) have reliable documents, and we have no idea how many wells or people are at risk from old wells.

Because we do not know how many households have wells, and we don't know how many wells are fifty years old, the USEPA ordered the state to count the wells and communicate the risks to well owners.

Nitrates from rainfall snow the natural background levels of nitrate,

Nitrates are formed in snowfall and rain during thunderstorms. The following UofM blog describes the natural nitrates:

And then it snowed. Is there any free N with that?

blog-crop-news.extension.umn.edu/2017/04/

"With the 5 inches of snow or so that fell overnight in Crookston, I was asked earlier this morning how much free N we received with that. Ron Gelderman, former Professor & SDSU Extension Soils Specialist, wrote an article a few years ago for iGrow on how much N is deposited when it snows in early spring. This is a re-posting of his original article. When it snowed in Brooking, SD in the early spring of 2013 they received 9 inches of snow. This contained the equivalent of about 2 inches of water. The nitrate-N content of the snow was 0.4 ppm while the ammonium-N content was 0.3 ppm. This was equivalent to only 0.3 pounds-per-acre of available nitrogen. Not exactly a windfall of nitrogen, but also very typical nitrogen precipitation concentrations for this area.

The National Atmospheric Deposition Program (NADP) has measured nitrogen and other nutrients in precipitation for a number of stations around the country for over 30 years. The annual level of nitrogen deposits from precipitation will range from about 5 pounds-per-acre on the Western edge of the Corn Belt to 12 pounds-per-acre in the Eastern Corn Belt.

Why the difference? Contrary to common perceptions, most of the nitrogen in precipitation does not come from lightning. There are two main forms of N in precipitation – nitrous oxides (nitrate-N) and ammonium N. About 5-10% of the nitrous oxide forms originate naturally (i.e. lightning) and the remainder comes from human activity, such as emissions from motor vehicles, electric power plants, and industrial sources. Ammonium –N in precipitation can originate naturally from soil microbe activity (about 20%) while the remainder comes from manure or fertilizer (mostly urea forms) emissions of ammonia. The ammonium forms can make up from 25 to 75% of the total N in precipitation. Since most N in precipitation is from human

activity, there tends to be higher levels occurring nearest large cities with industrial centers and near agricultural areas.

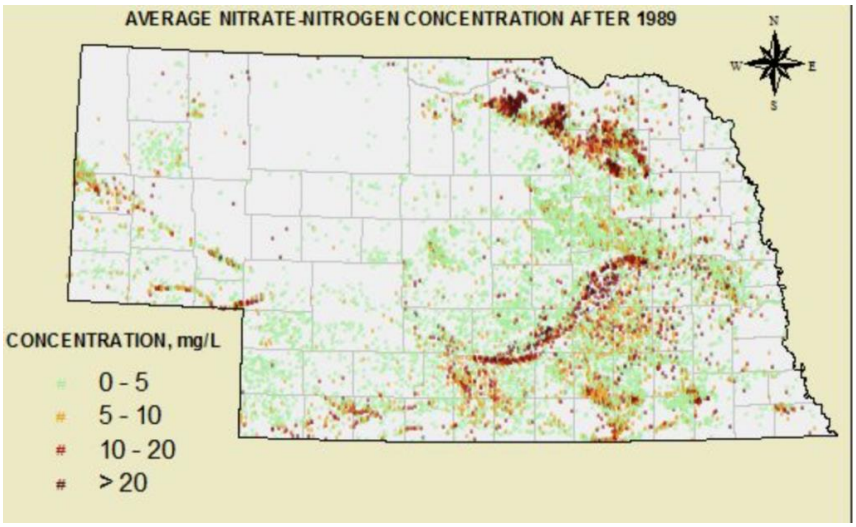
While the added N in precipitation is not a large contributor to the N needs of our major crops, it can cause large changes in some environments. Some plants can be favored over others by the larger N additions. Acid rain, which is a result of more N and S in rainfall, can cause changes in some freshwater ecosystems as well as harm some forest plant species. For more information on nitrogen deposition check out the National Atmospheric Deposition Program website.

The bottom line? Most snowfalls contribute little to our overall crop N needs but can significantly influence some sensitive ecosystems."

The natural nitrate deposition in the range of five to twelve pounds per acre should be compared to modern row cropping that uses 165 to 200 pounds per acre and has an unavoidable loss of 20 pounds per acre. It is difficult to predict or take credit for the natural nitrates; therefore, applications of commercial fertilizers are usually planned without taking credit for nitrates in snow melt and rain, leading to more nitrate leaching.

The new Nebraska initiatives,

The State of Nebraska also suffers from high nitrate in drinking water and has now addressed the health risks to private well owners. A news report from December 3, 2023, with links to Funding sources and Bills, asks private well owners to test their water:



The darker portions of this map indicate areas where nitrate levels exceed 10 parts per million, the standard for public drinking water systems. (Courtesy of the University of Nebraska-Lincoln Institute of Agriculture and Natural Resources)

State asks owners of private wells to test their water, to help with statewide study of nitrate in aquifers.

By: Paul Hammel - December 3, 2023, 4:02 pm

Editor's note: this story has been updated to include the source of funding for the groundwater study.

LINCOLN — As part of a statewide study of nitrate pollution in Nebraska aquifers, the state is asking owners of private drinking water wells to conduct a free test of their water.

Widespread, public participation in the free sampling program is key to ensuring that the nitrate study accurately encompasses private drinking water wells in the state, according to the Nebraska Department of Environment and Energy.

NDEE has sent postcards to more than 29,000 registered domestic well owners across Nebraska, inviting them to participate in the NDEE's study. The state doesn't regularly test such private wells, unlike municipal wells.

Free test kits available until January 31

The free sample kits and lab analyses are offered to all Nebraskans with a private drinking water well — not just those who received a postcard or have a registered well.

The free nitrate sample kits are available until January 31 by accessing the website https://dhhs.ne.gov/Pages/Lab-Price-List.aspx or by calling NDEE at 1-402-471-2186.

The kits come with sampling instructions and prepaid return postage.

Rebates for reverse osmosis devices

If a private well's results are above 10 parts per million nitrates, owners may be eligible for up to $4,000 in rebates to obtain a reserve osmosis treatment system.

Applications for the reverse osmosis (RO) system rebates must be submitted by June 30. Learn more about the RO Rebate Program on NDEE's website: http://dee.ne.gov/Publica.nsf/pages/22-051. Firefox https://nebraskaexaminer.com/briefs/state-asks-owners-of-private-wells-... 1 of 3 12/8/2023, 9:30 PM

Nitrate pollution in groundwater has been a long-running concern in Nebraska, where decades of use of nitrogen fertilizers and manure runoff from livestock operations have increased levels in aquifers.

The state has one of the highest rates of pediatric cancer in the nation, and nitrates in drinking water is one factor, according to state medical researchers.

Linked to blue baby syndrome.

Nitrates have also been linked to preventable birth defects, other cancers, and "blue baby syndrome," where babies' skin color changes and they become irritable or lethargic.

The state's 2022 annual report on groundwater quality found that nearly 30% of the state's public water systems — 157 out of 550 — were required to test nitrate levels four times a year due to concerns about high concentrations of nitrates. T

the level deemed unsafe for drinking is ten parts per million, and communities such as Hastings, Edgar, Trumbull, and Creighton have had to spend millions for treatment or to pipe water in from other communities.

The groundwater study was authorized under a bill passed by the Legislature this spring. Legislative Bill 814 allocated $1 million to NDEE to hire a third-

party consultant to collect data and develop a statewide plan to reduce nitrate in groundwater.

I have attached a PowerPoint presentation from Nebraska explaining the occurrence of high nitrates and their health impacts and links to the new state-wide testing and water treatment programs.

Blame shadows personal and public responsibility for providing safe drinking water.

To move the Minnesota Well Owners mission to ensure drinking water safety, it is not helpful to cast blame. We know why drinking water is unsafe and how this happens, but the narrative cycles of blame are punitive.

The stories about blame are most popular among local fear-mongering politicians, and they stand in the way of working together to find a solution to the imminent health risk of our drinking water.

When we have bad drinking water and are threatened with harm, people direct their attention to finding who is to blame, creating conflict from our anger and finding ourselves powerless to change.

With our contaminated aquifers tending to have higher nitrates and our continued reliance on old wells, we have compounded our risk by failing to test and treat our drinking water at our kitchen sink. Well, owners blame the farmers or "industrial age," and the farmers blame the owners of old wells. We all avoid our responsibilities.

Both casting blame and self-blame for our unsafe drinking water keep us stuck in the past. We get stuck in a pattern of being blameful or blaming ourselves, and for fifty years, we have not moved ahead to solve the problem in the karst of southeast Minnesota.

To solve this problem, we need to avoid blame and shift our energies to how we take responsibility for our groundwater. Taking responsibility is the path to solving our problems. If we make this change, the problem and the solution to our drinking water become our responsibility, and progress can begin.

The November USEPA order to address the imminent health risk of nitrate-contaminated drinking water in the Karst of SE Mn is a wake-up call: Cut the blame and solve these problems together.

Jeff Broberg is a Minnesota Licensed Professional Geologist who owns a small farm on the karst on Dakota Land in Elba Township. He is a founding Director of the 5-year-old Minnesota Well Owners Organization. He helps keep MNWOO focused on helping to ensure that private well owners have safe drinking water at their kitchen tap.