# Wells and Increased Infant Sensitivity and Exposure (WIISE) Study

## A pilot project conducted by Dakota County and the Minnesota Department of Health to understand well users' exposure to manganese and other contaminants of concern for children's health

Deanna Scher, Ph.D., Principal Epidemiologist, Minnesota Department of Health Environmental Health Division
Vanessa Demuth P.G., Geologist, Dakota County Environmental Resources

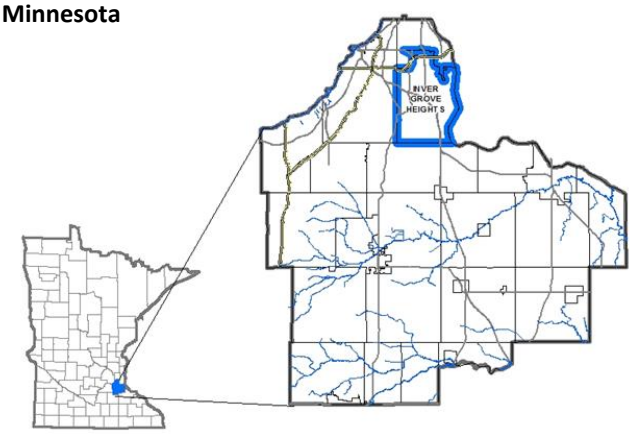
### Background

Dakota County Environmental Resources Department and the Minnesota Department of Health (MDH) conducted the Wells and Increased Infant Sensitivity and Exposure (WIISE) study from June 2015 through June 2016. The WIISE study is a pilot project to evaluate potential exposure of households on private wells to manganese. Manganese is a naturally-occurring element found in water, food, air, and soil. It is widespread in Minnesota groundwater. The study was carried out in northern Dakota County, specifically Inver Grove Heights (IGH), because previous groundwater monitoring conducted by Dakota County suggested that higher levels of manganese may occur in this area compared to other parts of the county. Other common well water contaminants such as nitrate, arsenic, and bacteria were also measured in the WIISE Study.

The main goals of the WIISE study were to:

1. Characterize manganese levels in IGH groundwater;
2. Determine how groundwater concentrations translate into actual drinking water exposures to manganese; and
3. Identify water treatment options that private well users can use to reduce exposure to manganese.

**Figure 1- Location of Study Area in reference to Dakota County and Minnesota**




### Manganese Health Concerns

Too much manganese can affect the nervous system. Children and adults who drink water with high levels of manganese for a long time may have problems with memory, attention, and motor skills. Recent studies have found that manganese may cause subtle changes in neurodevelopment in infants and children. Of greatest concern are infants who drink formula reconstituted with tap water because they are more vulnerable to the harmful effects of manganese and consume the most water on a body-weight basis. MDH has developed a health-based recommendation ("guidance value") for manganese in drinking water. For infants who drink tap water or formula made with tap water, manganese should not exceed 100 micrograms per liter of water (µg/L). For everyone else, a safe level of manganese in water is higher: 300 µg/L or less.

### Phase 1

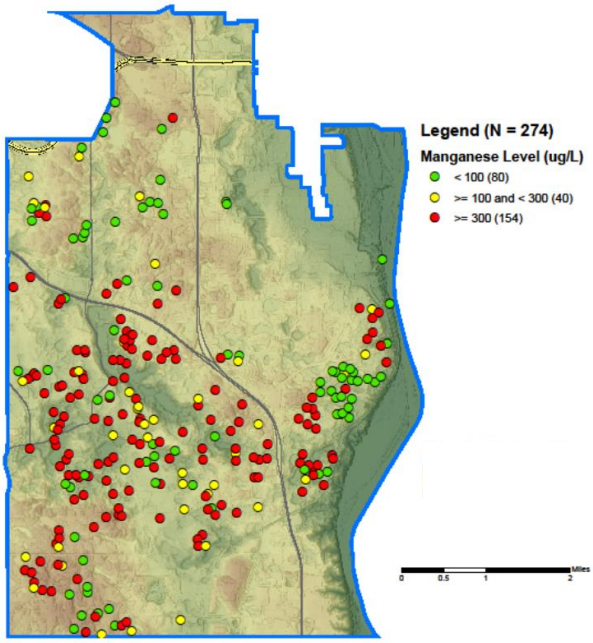
In the first phase of the study, County staff collected untreated water samples from outdoor faucets at 274 homes served by private wells in IGH. These samples were tested for manganese and other contaminants of health concern.

#### Phase 1 results

*Manganese:*

- 71% of household wells had a manganese result above 100 µg/L (above the level considered safe for infants drinking the water)
- In homes with infants, 62% of wells were over 100 µg/L
- 56% of household wells had an manganese result above 300 µg/L (above the level considered safe for everyone else)
- The median ("middle") concentration of manganese was 344 µg/L

**Figure 2 – Manganese levels in untreated water from private wells in IGH**




*Results for other contaminants of health concern:*

- No wells exceeded MDH's drinking water guidance value for **nitrate** of 10 milligrams per liter.
- **Arsenic** was found in 57% of samples; 3 samples (1%) exceeded 10 µg/L. MDH highly recommends treating water with arsenic above 10 µg/L or finding an alternative source of water.
- **Lead** was found in 53% of samples. Any level of lead in drinking water may be harmful. Follow-up testing at homes with high lead in the outside sample found no detectible lead in the inside tap water after first letting the water run.
- **Coliform bacteria** was present in 25% of samples. Any level of bacteria in drinking water may be harmful.

Dakota County
DEPARTMENT OF HEALTH
CLEAN WATER LAND & LEGACY AMENDMENT

## Phase 2

In the second phase of the study, homes with an outside spigot manganese level above MDH's guidance value of 100 µg/L in Phase I were offered additional manganese testing from their inside drinking water faucet. Ninety-nine households participated. The majority reported that their inside tap water went through at least one well water treatment system/device.

**Phase II results**

*Manganese:*

- 37 of 99 test inside tap results (37%) were still above MDH's guidance value of 100 µg/L; 26 of 99 test results (26%) were still above 300 µg/L.
- 78% of households with manganese levels above MDH's guidance value report that they regularly drink the water.

*Impact of treatment systems/devices on manganese levels:*

- Water softeners effectively reduced manganese concentrations below the MDH guidance value.
- Reverse-osmosis systems have also been shown to
- reduce manganese in other studies, but could not be evaluated in the WIISE Study.
- Carbon filters lowered manganese levels in some cases, but did not show a consistent and reliable ability to reduce concentrations below MDH's guidance value.
- Iron filters and sediment filters did not show treatment effectiveness.

## WIISE Study Conclusions

Manganese is commonly found in the drinking water aquifers in IGH. Seventy-one percent of water samples collected from outside spigots exceeded MDH's health-based guidance value of 100 µg/L to protect infants less than 12 months old, which is greater than what has been found in statewide sampling (49%). Fifty-six percent of outside spigot samples exceeded the recommended level of 300 µg/L for older children and adults.

Among households that participated in the inside faucet sampling, 37% of results were still above MDH's guidance value of 100 µg/L. Since the majority of households with an inside faucet result above 100 µg/L reported drinking the water, this suggests that consumption of water with elevated levels of manganese could be a common occurrence in Minnesota.

## Manganese Recommendations

- Well owners in Minnesota should test their water for manganese. A manganese test at an MDH-accredited lab typically costs $20 or less and only needs to be done once.

Manganese treatment recommendations are based on age:

**Adults and children at least 1 year old:**

If there is no infant in the household, the goal is to achieve a manganese level lower than 300 µg/L at all drinking water faucets. A water softener is a relatively inexpensive device that can reduce manganese concentrations. Drinking softened water Is considered safe for adults according to the Mayo Clinic and the U.S. Environmental Protection Agency. However, people with sodium-sensitive hypertension should first consult their health care provider. High iron and manganese can reduce softening and filtering capacity, as well as plug components of the softener. Therefore an iron filter may need to be installed to treat water that will go to the softener. If the taste of softened water is objectionable, a reverse osmosis system installed on the main drinking water faucet is another option to reduce manganese. Treated water should be tested for manganese to ensure that the treatment device is functioning properly. Users must follow the manufacturer's maintenance instructions.

**Infants <1 year old:**

If an infant will be drinking the well water, the goal is to provide water with manganese below 100 µg/L. Due to the additional sodium added by a water softener, we do not recommend using softened water for formula feeding. Bottled water (not labeled "mineral" water) is recommended for reconstituted formula feeding and drinking, if drinking water exceeds 100 µg/L. A reverse osmosis system is a treatment option: Test the water for manganese at the main drinking faucet after installation to ensure that the device is achieving the manganese goal of the household. Maintain the device per the manufacturer's directions.

## Recommendations for other well water contaminants

- All wells should be tested for arsenic at least once. MDH recommends treating the water to remove arsenic, especially if the concentration is above 10 µg/L.
- Many wells in the WIISE study tested positive for coliform bacteria. MDH recommends that private well users inspect their wellhead and test annually for coliform bacteria. If the bacteria test is positive, the well should be disinfected and retested for coliform bacteria. It is also prudent to test for coliform bacteria before adding a water treatment system to avoid introducing bacteria into a new device.
- All well owners should test for lead at least once at the main drinking water faucet.
- While nitrate levels were not elevated in the WIISE Study wells, MDH recommends that well users test for nitrate every 2 years.
- The City of IGH municipal wells have naturally occurring radium, a radionuclide, above the federal standards for radionuclides in drinking water. The city's water treatment plant reduces the level of radium to acceptable levels. Radium was not measured in the WIISE study and the level in private wells in IGH is unknown. Consuming water with radionuclides every day for many years increases the risk of cancer. If you are concerned about radionuclides in your private well water you can test your water using an MDH-accredited lab. The cost can be as high as $200. A certified ion-exchange water softener or reverse osmosis water treatment system can be installed to reduce radionuclides.

## Study Funding

Funding for the WIISE Study was provided by Clean Water, Land, & Legacy Amendment funding to MDH, and by the Dakota County Environmental Resources Department.

To read the full WIISE study report, go to www.co.dakota.mn.us and search on "WIISE". To request water test kits with instructions, call Dakota County at (952) 891-7000. For general information on well water quality and testing, go to www.health.state.mn.us/wellwater. To search for accredited laboratories, go to: www.health.state.mn.us/labsearch.