NORTH Dakota | Environmental Quality

Be Legendary.™

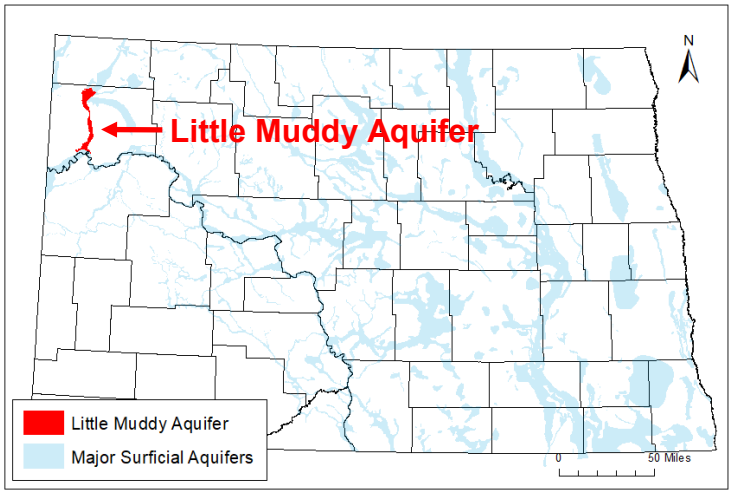
**Western Groundwater Monitoring Program**

# Little Muddy Aquifer

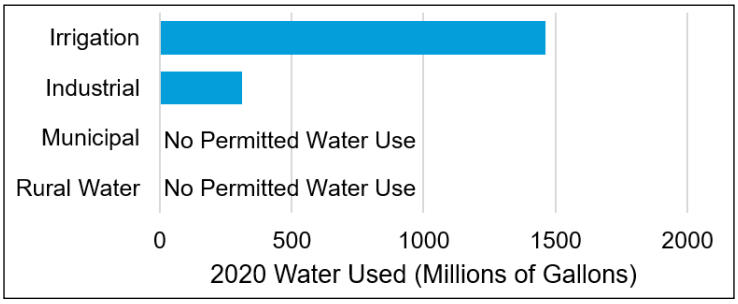
## Williams County

| Aquifer At-a-Glance | |
|---|---|
| Area | 89.5 square miles |
| Aquifer Type | Unconfined and Confined Surficial |
| Major Land Uses over Aquifer (percentage of aquifer area covered in 2017)[1] | Crops (36%)<br>Grassland/Pasture (30%) |
| Depth to Water (2021)* | 2-62 feet |
| Total Unique Wells Sampled | 40 |
| Wells Sampled in 2021 | 39 |
| Years Sampled | 2014, 2015, 2017, 2018, 2020, 2021 |

*Depths to water may vary seasonally, year to year, and across the aquifer




*2020 Little Muddy aquifer permitted water use (from North Dakota Department of Water Resources (dwr.nd.gov))*




- Aquifer materials consist of sands and gravels that were deposited by streams in an ancient river valley carved in the region's bedrock. The valley is currently occupied by Little Muddy Creek. The valley has two major aquifer layers separated by 11-225 feet of clay. Aquifer sediments in the upper layer were deposited by streams carrying meltwater away from glaciers. They are coarsest at the northern edge and become finer to the south. The lower layer is also considered part of the Yellowstone Buried Channel aquifer.[2]
- The upper aquifer deposits range from 0 to 116 feet thick and average around 43 feet thick. The deeper part of the aquifer averages around 28 feet thick but may be up to 110 feet thick.[2]
- Domestic, stock, irrigation, and industrial wells are common in the aquifer. Several commercial wells are also installed in the aquifer.
- In North Dakota, permits are required to withdraw large quantities of groundwater. In 2020, 1.8 billion gallons of permitted water were drawn from the aquifer; irrigation use consumed the largest quantity of water. For more information on water use and permits, contact the North Dakota Department of Water Resources (dwr.nd.gov).

## About the Western Groundwater Monitoring Program

- The North Dakota Department of Environmental Quality (NDDEQ) monitors a network of wells in approximately 20 surficial aquifers that are at elevated risk of oilfield contamination.
- Aquifers are sampled on a 1.5-year rotation.
- Monitoring began in 2013.
- The monitored aquifers are all within the oil-producing counties of northwestern North Dakota.
- Water is tested for general chemistry parameters, trace metals, diesel and gasoline range organics, benzene, toluene, ethylbenzene, and xylenes.


**References**

(1) US Department of Agriculture, 2017, National Agricultural Statistics Service Cropland Data Layer.

(2) Armstrong, C.A., 1969, Geology and Ground Water Resources of Williams County, North Dakota. North Dakota State Water Commission County Ground-Water Studies 9-Part 3, North Dakota Geological Survey Bulletin 48.

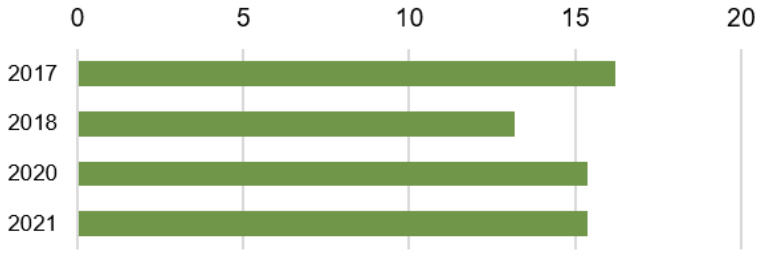
# Water Chemistry

| Is Aquifer Water High in…? | Analyte | Result | 2021 Median Concentration | Potential Effects |
|---|---|---|---|---|
| | **Arsenic** | **YES** | 0.014 mg/L | Skin or circulatory system damage, increased cancer risk |
| | **Iron** | **YES** | 7.55 mg/L | Metallic taste/odor, discoloration of surfaces |
| | **Manganese** | **YES** | 0.62 mg/L | |
| | **Sodium** | **YES** | 211 mg/L | Taste, people with certain health conditions may need to limit intake |
| | **Sulfate** | **YES** | 507 mg/L | Taste/odor, laxative effect for people not used to the water |
| | For more information about Maximum Contaminant Levels (MCLs), health effects, and treatment options for these contaminants and more, see the NDDEQ's fact sheets (deq.nd.gov/wq/1_Groundwater) or visit the US EPA website (epa.gov/ground-water-and-drinking-water). | | | |

| Dominant Water Type | Water Hardness |
|---|---|
| Sodium-Bicarbonate | Very Hard |

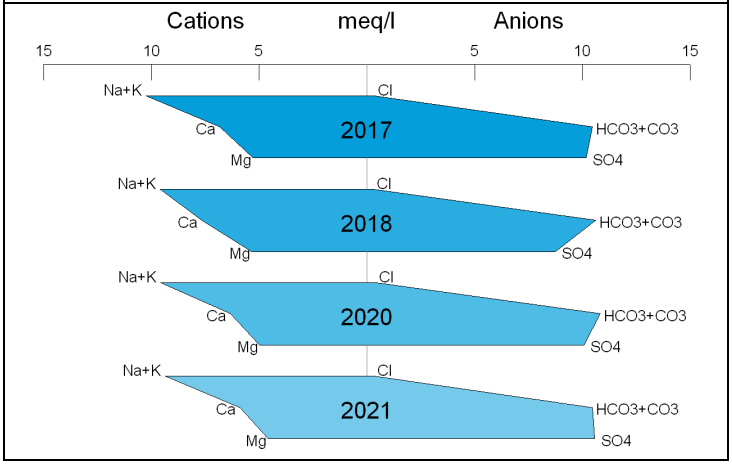
## Nitrate

*Percentage of Wells Exceeding the Nitrate Maximum Contaminant Level (MCL)* (10 mg/L as N).*




***Stiff diagram of aquifer median general water chemistry.***

*Changes in diagram shape represent changes in general chemistry.*




# Oilfield Compounds

## Gasoline and Diesel Range Organics

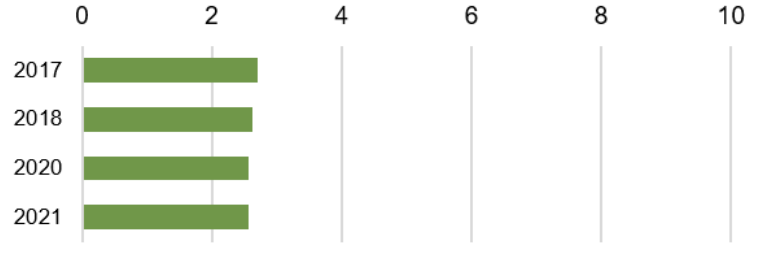
Gasoline and diesel range organics (GRO and DRO) are groups of chemical compounds containing carbon that are common in either gasoline or diesel fuel. Neither group has a regulatory limit, but the NDDEQ uses a screening level of 500 µg/L. Detections below this may be from other natural carbon sources such as decaying plant matter rather than oil byproducts.

| | |
|---|---|
| **GRO Screening Level Exceedances** | **None** |
| **DRO Screening Level Exceedances** | DRO were detected in one well at 811 µg/L in 2014. They have not been detected above the screening level since. |

## Chloride

Chloride is both a natural component of groundwater and a component of brine (salt water), a byproduct of oil production.

*Percentage of Wells Exceeding the Non-regulatory Chloride Secondary Water Quality Standard (250 mg/L).*




## BTEX

Benzene, toluene, ethylbenzene, and xylenes (BTEX) are a group of compounds that are naturally occurring in petroleum. All four have Maximum Contaminant Levels (MCLs)* that can be used as screening levels to determine the severity of any detection.

| | |
|---|---|
| **Benzene Detections** | **None** |
| **Toluene Detections** | Toluene was detected in one well in 2014 at 298 and 111 µg/L, below the MCL of 1000 µg/L. It has not been detected since. |
| **Ethylbenzene Detections** | **None** |
| **Xylenes Detections** | **None** |

## Bromide

Bromide is a natural component of groundwater and can also be introduced through oil and gas extraction.

| | |
|---|---|
| **Wells Exceeding NDDEQ's 3-5 mg/L Screening Level:** | One well has had concentrations decreasing from 22 mg/L in 2015 to 2.4 mg/L in 2021. Since this time, the same well has had high chloride concentrations (>500 mg/L). This spike in concentrations is a result of a nearby produced water spill. |

*Note that MCLs are for public drinking water systems; private wells are not regulated in North Dakota. MCLs still provide guidelines for drinking groundwater.

***Feel free to use this information, but please credit the NDDEQ.***