

NORTH DAKOTA

GEOGRAPHIC TARGETING SYSTEM FOR GROUNDWATER MONITORING

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INTRODUCTION

North Dakota Administrative Code (NDAC) Section 33.1-16-02.1-02 states that it is public policy to protect and maintain all waters of the state, including groundwater. In North Dakota, nearly 75 percent of public water systems utilize groundwater as the source of their water supplies. The North Dakota Department of Environmental Quality (NDDEQ) Groundwater Protection Program's mission is to ensure that North Dakota's groundwater supply remains safe for public use.

The Groundwater Protection Program includes several sub-programs: the Agricultural Ambient Groundwater Monitoring Program (AAMP), the Western Ambient Groundwater Monitoring Program (WAMP), the Underground Injection Control (UIC) Program, and the Source Water Protection Program (SWPP). Together, these four programs protect groundwater through active monitoring, control of contamination sources, and public engagement in groundwater protection.

As of July 2016, the North Dakota State Water Commission (SWC) had defined and named more than 200 shallow glacial drift aquifers within North Dakota, encompassing more than 11,000 square miles (mi²) (Attachment 3). A method of assessing an aquifer's pollution potential and monitoring priority is vital to ensuring that state resources are efficiently utilized. In 1997, the NDDoH developed the North Dakota Geographic Targeting System for Groundwater Monitoring (GTS) to accomplish this task.

The purpose of the 1997 GTS was to ensure that monitoring efforts be focused on the highest priority aquifers (Radig, 1997). To accomplish this, the GTS utilized a three-component system that produced an ordinal ranking of aquifer monitoring priority. The three components defined by the GTS were Vulnerability, Sensitivity, and Risk. Each component carried an equal weight, was assigned a score between 1 and 3, and was then combined with other components to produce a final monitoring score ranging from 3 to 9. The aquifer was then designated as Low Priority (final score of 3-4), Moderate Priority (5-7), or High Priority (8-9). This ranking and some of the intermediate outputs of the GTS were then used to design aquifer monitoring plans, designate sensitive groundwater areas, and develop the generic State Management Plan for Pesticides.

Since the completion of the GTS in 1997, North Dakota has experienced an increase in oil and gas development, increased agricultural production, and an increase in population (U.S. Census Bureau, 2016). Additionally, in the early 2000s, the SWC began to reassess aquifer boundaries, which significantly changed the regulatory geography of North Dakota's groundwater resources. In the face of so much social and economic change, it is necessary to reassess monitoring priorities to ensure that state resources continue to be used most efficiently. Consequently, this new iteration of the GTS was completed to reassess monitoring priorities for existing glacial drift aquifers, assign monitoring priorities to new aquifers, and update the methods of the GTS to include new geographic information system (GIS) capabilities.

GOAL

The goal of the 2019 GTS was to reassess monitoring priorities for existing glacial drift aquifers, assign monitoring priorities to new aquifers, and update the methods of the GTS to include new geographic information system (GIS) capabilities.

PROJECT DESIGN

The 2019 GTS followed the three-component system established by the 1997 GTS. These components — Vulnerability, Sensitivity, and Risk — were used to generate a composite monitoring score. Data was collected from existing sources such as borehole logs, county groundwater studies, U.S. Department of Agriculture publications, and the SWC Appropriations Division. Aquifer boundaries are determined by SWC hydrologists and are being continually updated. The shallow aquifer dataset used in this study was retrieved on July 1, 2016 and does not reflect any changes made after that date.

There are three components to the monitoring score: Vulnerability, Sensitivity, and Risk. Each component is assigned a value, then combined to produce the final monitoring score. A total of 213 surficial aquifers were examined individually and assigned scores and ratings based on their individual component results. Each component had a range of results that yielded a Low, Moderate, or High rating, with a corresponding score of 1, 2, or 3. Rating thresholds were determined by creating three approximately equal-sized categories of 71 members. Vulnerability was the only component that had unevenly sized categories; the nature of the ratings allowed more than one aquifer to have identical results.

Method Used to Determine Vulnerability Component

The GTS uses the term “Vulnerability” to refer to the physical ease with which a contaminant can enter an aquifer (Pettyjohn et al., 1991). It was decided that the DRASTIC model, created by the U.S. Environmental Protection Agency (EPA) in 1985, would serve as the method of evaluating this component. DRASTIC is an acronym that stands for **D**epth to water, **R**echarge, **A**quifer media, **S**oil media, **T**opography, **I**mpact of the vadose zone, and hydraulic **C**onductivity (Aller et al., 1987). Based on correlations between DRASTIC scores and incidents of contamination in municipal wells, Kalinski et al. (1994) state that DRASTIC can be a valuable tool for identifying supplies that are vulnerable to contamination.

Each component of the DRASTIC model is assigned a numeric value, based upon a set of ranges and conditions. A summary of DRASTIC ranges and ratings organized by component can be found in Table 1 through Table 7.

Table 1. Ranges and Ratings for Depth to Water

Depth to Water (Feet)	
Range	Rating
0 - 5	10
5 - 15	9
15 - 30	7
30 - 50	5
50 - 75	3
75 - 100	2
≥ 100	1

Table 2. Ranges and Ratings for Net Recharge

Net Recharge (Inches/Year)	
Range	Rating
0 - 2	1
2 - 4	3
4 - 7	6
7 - 10	8
≥ 10	9

Table 3. Ranges and Ratings for Aquifer Media

Aquifer Media	
Range	Rating
Massive Shale	2
Glacial Till	5
Bedded Sandstone and Shale Sequences	6
Massive Sandstone	6
Sand and Gravel	8

Table 4. Ranges and Ratings for Soil Media

Soil Media	
Range	Rating
Thin or Absent	10
Gravel	10
Sand	9
Peat	8
Shrinking and/or Aggregated Clay	7
Sandy Loam	6
Loam	5
Silty Loam	4
Clay Loam	3
Muck	2
Non-shrinking and Non-aggregated Clay	1

Table 5. Ranges and Ratings for Topography

Topography (Percent Slope)	
Range	Rating
0 - 2	10
2 - 6	9
6 - 12	5
12 - 18	3
≥ 18	1

Table 6. Ranges and Ratings for Impact of the Vadose Zone

Vadose Zone Media	
Range	Rating
Confining Layer	1
Silt/Clay	3
Shale	3
Bedded Sandstone and Shale	6
Sand and Gravel w/Significant Silt and Clay	6
Sand and Gravel	8

Table 7. Ranges and Ratings for Hydraulic Conductivity (Gallons Per Day)

Hydraulic Conductivity (GPD/Ft²)	
Range	Rating
1 - 100	1
100 - 300	2
300 - 700	4
700 - 1000	6
1000 - 2000	8
≥ 2000	10

Each of the assigned ratings is then multiplied by a weight constant (Formula 1). This produces a final numeric value that represents the aquifer's vulnerability to contamination; a higher number indicates more vulnerability, while a lower number represents less vulnerability.

Formula 1: DRASTIC Formula

$$DrDw + RrRw + ArAw + SrSw + TrTw + IrIw + CrCw = \text{DRASTIC Score (Unitless)}$$

(r = rating, w = weight, D = Depth to water, R = Recharge, S = Sensitivity, T = Topography, I = Impact of vadose zone, C = hydraulic Conductivity)

The GTS produces two DRASTIC scores for each aquifer — a Generic DRASTIC score and a Pesticide DRASTIC score. This is done by applying a different weight constant to each DRASTIC parameter (Table 8). A Generic DRASTIC score provides a general indication of aquifer vulnerability but may be less accurate for different contaminants. The Pesticide DRASTIC score has been adjusted to account for the chemical behavior of pesticides. For example, the weight value assigned to “Soil Media” in the generic DRASTIC model is 2, indicating a relatively low significance. However, in the Pesticide DRASTIC model, “Soil Media” is given a weight of 5, indicating a much higher significance. The Pesticide DRASTIC score was used as the Vulnerability component of the GTS.

Table 8. DRASTIC Parameter Weights for the "Generic" and "Pesticide" Iterations

Parameter	Generic	Pesticide
Depth to Water	5	5
Net Recharge	4	4
Aquifer Media	3	3
Soil Media	2	5
Topography	1	3
Impact of the Vadose Zone	5	4
Hydraulic Conductivity	3	2

The static nature of geologic characteristics permitted the reuse of certain 1997 GTS DRASTIC components. Some characteristics such as depth to water, soil media, and net recharge were reassessed to account for changes in precipitation patterns. This information was obtained from a variety of sources developed and maintained by the SWC. Once the data was located, it was entered in a spreadsheet that generated the final vulnerability scores using Formula 1. Once a Pesticide DRASTIC score had been calculated, a Vulnerability rating was assigned according to the ranges in Table 9.

Table 9. Vulnerability Rating for Pesticide DRASTIC Scores

DRASTIC Score Range	Rating
0-129	1 (Low)
130-159	2 (Moderate)
160+	3 (High)

Method Used to Determine Sensitivity Component

In the context of the GTS, “Sensitivity” refers to the usage of agricultural chemicals (fertilizers, pesticides, herbicides, etc.). County data for the sale and use of agricultural chemicals was not available at the time of the 1997 GTS. Instead, a surrogate value of the sum of total market value of crop and livestock sales per acre was used, based on information summarized in the 1992 National Pesticides Survey Phase II Report (U.S. EPA, 1992). The agricultural surrogate was used again in 2019; however, there were changes to the methods of obtaining and transforming the data.

The United States Department of Agriculture (USDA) publishes county-level agricultural census data every five years (UDSA, 2014). The data used in the 2019 GTS was taken from the 2012 Agricultural Census. A total agricultural production value was calculated by summing crop and livestock sales for all counties. Production was then divided by the number of farmed acres within a county to produce a production-per-farmed-acre (production/acre) value. This was a slight change from the 1997 GTS, which used total county acres. The change was made to better account for intensity and density of agricultural practices within a county.

Once a value had been generated for each county, the data was transformed to the aquifer scale. In cases where an aquifer lay entirely within county boundaries, the production/acre value was assigned to the aquifer. However, many aquifers cross county boundaries, requiring new production/acre values to be calculated. In these instances, a partial production value was assigned to each portion of the aquifer present in a different county, and the partial production values were then summed to obtain a single production/acre value (Formula 2).

Formula 2: Aquifer Production Value Calculation

$$AQ_{PAR} = CO_{PROD} * AQ_P \quad \dashrightarrow \quad AQ_{PROD} = \sum AQ_{PAR}$$

(*AQ* = Aquifer, *AQ_{PAR}* = Partial production/acre value, *AQ_{PROD}* = Aquifer production/acre value,
CO_{PROD} = County production/acre value, *AQ_P* = Proportion of aquifer in county)

The large number of aquifers being analyzed would have made this an impractical task to complete by hand. Instead, a model was developed using ArcGIS 10.3 that automatically assigned production/acre values based on these methods. This model generated a data table that could be uploaded into Excel 2007 for use in calculating the final monitoring score. The range thresholds were determined by creating three approximately equal-sized categories of the aquifers based on their respective sensitivity surrogate values in dollars/farmed acre (Table 10).

Table 10. Sensitivity Rating for the Market Value of Production Per Farmed Acre

Range (dollar/farmed acre)	Rating
0-202.14	1 (Low)
202.15-356.91	2 (Moderate)
356.92+	3 (High)

Method Used to Determine Risk Component

“Risk” is defined as the economic value of the loss of the groundwater resource should contamination occur. The 1997 GTS used the total amount of water appropriated from an aquifer in acre-feet, but this was changed in the 2019 GTS. Contamination of a groundwater resource is not likely to occur evenly throughout an aquifer, especially those with large surface areas. To account for this, the Risk component was redefined as the amount of water appropriated per square mile (acre-feet/mi²) (Table 11).

Table 11. Risk Rating for Appropriated Water Per Square Mile

Range (acre-feet/mi²)	Rating
0-1.24	1 (Low)
1.244-33.51	2 (Moderate)
33.52+	3 (High)

For example, the Central Dakota aquifer has a total surface area of approximately 683 mi², with a total permitted water volume of 77,015 acre-feet. The Central Dakota aquifer is the single largest aquifer analyzed and has the greatest appropriated water volume. When the permitted water

volume is examined on a square-mile basis, it has a value of approximately 112.81 acre-feet/mi², ranking 37th.

Compare this to the Jamestown aquifer, which has a surface area of 10.45 mi², 17,993 permitted acre-feet, and a value of 1,715 acre-feet/mi². The Central Dakota aquifer is six times the surface area of the Jamestown aquifer, but the Jamestown aquifer permits 15 times more water use per square mile. By this reasoning, contamination would impact water use in the Jamestown aquifer more than in the Central Dakota aquifer.

Method Used to Calculate Total Monitoring Score

Each monitoring score component was divided into three equally sized categories with a corresponding numeric value: Low (1), Moderate (2), and High (3). The three numeric values were added together, resulting in a total monitoring score (Table 12).

Table 12. Total Monitoring Score and Priority

Score	Priority
3-4	Low
5-7	Moderate
8-9	High

Using the Inkster aquifer as an example, the determinations of the pesticide DRASTIC score and total GTS monitoring score are shown in Table 13.

Table 13. Example of Geographic Targeting System Scoring for the Inkster Aquifer, North Dakota

SETTING: Inkster Aquifer, Grand Forks County				
FACTOR	VALUE	RATING	WEIGHT	SCORE
Depth to Water	28'	7	5	35
Net Recharge	5.604"	6	4	24
Aquifer Media	sand and gravel	8	3	24
Soil Media	sandy loam	6	5	30
Topography	1%	10	3	30
Impact of Vadose Zone	sand & gravel	8	4	32
Conductivity	1,500 gpd/ft ²	8	2	16
Pesticide DRASTIC score		HIGH		191
Chemical Use Surrogate	\$525.20/acre	HIGH		3
Permitted Water Use	28.27 ac. ft.	HIGH		3
Total GTS Monitoring Score	9	HIGH		9

Comparison to 1997 Results

GTS monitoring scores are not directly comparable to other iterations. However, it is valuable to understand how an aquifer may have changed in overall monitoring priority. A total of 180 aquifers were assessed in both the 1997 and 2019 GTS. Many of these aquifers experienced changes to boundaries, appropriations, and land use. In cases where multiple aquifers were merged into one (e.g., the Central Dakota aquifer being created from the Marstonmoor Plain and Tappen aquifers), the highest monitoring priority value was used. In the Central Dakota aquifer example, the Marstonmoor Plain aquifer had a total monitoring score of 8, while the Tappen aquifer had a score of 5. When comparing the Central Dakota aquifer 2019 monitoring score to the 1997 score, the Marstonmoor Plain score of 8 was compared to the 2019 Central Dakota score of 8, showing that the aquifer had not changed in priority.

Changes in Methodology from the 1997 GTS Study

The slight changes in methodology for the Sensitivity and Risk components were made to improve the effectiveness of the total monitoring score. Once the changes were implemented, and the component and final monitoring scores had been calculated, the scores were evaluated using Spearman's correlation. This non-parametric correlation statistic supported the changes made to the methods by showing an increase in correlation to historic pesticide detections, in comparison to the original 1997 methods.

RESULTS

A total of 213 aquifers or aquifer sections were assessed in the 2019 GTS. DRASTIC inputs and results can be found in Attachment 1. The GTS inputs and results can be found in Attachment 2. Of the 213 aquifers, 139 were designated as Moderate Priority, 40 Low Priority, and 34 High Priority. A total of 115 aquifers evaluated in both the 1997 and 2019 GTS studies had differing monitoring scores. Seventy-eight aquifers increased in overall monitoring score, and 37 decreased. Of the 115 aquifers that changed monitoring scores, 50 changed monitoring priorities, 25 increased in monitoring priority, and 25 decreased in monitoring priority.

DISCUSSION

The GTS is a relative, ordinal classification system used as an administrative tool for directing sampling activities of the AAMP. While components of the GTS are used for regulatory purposes by other programs, such as the North Dakota Underground Injection Control Program, the total monitoring score of the GTS has no regulatory implications. Instead, it is a summary of surficial groundwater resources across the state at the time of completion. A Low monitoring priority in the 1997 GTS is not directly comparable to a Low monitoring priority in the 2019 GTS. However, it is useful for assessing how monitoring importance has changed over time and to ensure that state resources are utilized effectively.

A High monitoring priority does not necessarily indicate that an aquifer is more likely to be contaminated. Of the three components of the GTS, only Vulnerability and Sensitivity directly address the contamination of an aquifer. Risk is purely an economic factor, but it remains an important consideration. Aquifers are utilized for many purposes in North Dakota including municipal water and irrigation, and it is important to consider these uses when selecting monitoring sites.

As an administrative tool, there are scientific limitations to the GTS. The large-scale nature of the project did not allow for an in-depth examination of all data collected. The geologic properties studied as part of the DRASTIC are primarily available only when detailed subsurface examinations are made. This study used existing data from the SWC; additional geologic investigations were not conducted for this study. In some instances, the methods used for data collection and analysis may be misleading. For example, depth to water can be downloaded from thousands of SWC monitoring sites, but this information may not be indicative of the actual depth to water-bearing material in confined or semi-confined aquifers. Therefore, a review of drilling logs associated with confined aquifers was conducted to determine the average depth to water-bearing material.

Sensitivity in the GTS is not a direct measurement of chemical applications but is instead a surrogate value. While this surrogate value is supported in research, a direct measurement of chemical application would be more appropriate but is unfortunately unavailable. In addition to chemical applications, the GTS does not take into consideration the fate of contaminants within an aquifer. Geochemical characteristics of the aquifers, which were not examined during the GTS, may have effects on the fate of contaminants within an aquifer.

Despite the limitations, the GTS is an excellent tool for assessing areas of high monitoring importance. The abundance and nature of the groundwater resources in North Dakota make monitoring of groundwater quality a necessity to protect human and environmental health. Using the GTS as a guide, the AAMP will be able to direct monitoring efforts where they will be most beneficial to the people of North Dakota.

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ATTACHMENT 1

2019 DRASTIC INPUTS AND RESULTS

Listed Alphabetically by Aquifer Name

ATTACHMENT 1: 2019 DRASTIC INPUTS AND RESULTS
Listed Alphabetically by Aquifer Name

Aquifer Name	Depth to Water (Feet)	Score	Recharge (Inches/Year)	Score	Aquifer Media	Score	Soil Media	Score	Topography (% Slope)	Score	Impact of Vadose Zone	Score	Hydraulic Conductivity (GPD/FT ²)	Score	DRASTIC	Pesticide DRASTIC
Adrian	138.56	1	1.00	1	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	3927.26	10	88	112
Antelope Creek	70.00	3	1.45	1	Sand and Gravel	8	Loam	5	9	5	Silt/Clay	3	480.00	4	85	103
Apple Creek	75.00	2	1.19	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	10000.00	10	103	125
Bantel	22.03	7	1.22	1	Sand and Gravel	8	Loam	5	4	9	Silt/Clay	3	775.00	6	115	139
Battle Creek	75.00	2	2.65	3	Sand and Gravel	8	Silty Loam	4	9	5	Sand/Gravel w/Sig. Silt/Clay	6	114.00	2	95	109
Beaver Creek N	49.50	5	2.52	3	Sand and Gravel	8	Silty Loam	4	12	3	Sand/Gravel w/Sig. Silt/Clay	6	340.00	4	114	122
Beaver Creek S	49.50	5	2.57	3	Sand and Gravel	8	Silty Loam	4	4	9	Sand/Gravel w/Sig. Silt/Clay	6	340.00	4	120	140
Beaver Lake	18.70	7	2.40	3	Sand and Gravel	8	Loam	5	7	5	Sand/Gravel w/Sig. Silt/Clay	6	570.00	4	128	143
Belmont	219.00	1	0.00	1	Sand and Gravel	8	Silty Loam	4	1	10	Confining Layer	1	1250.00	8	80	103
Bennie Peer	145.00	1	2.41	3	Sand and Gravel	8	Silty Loam	4	9	5	Sand/Gravel w/Sig. Silt/Clay	6	598.00	4	96	108
Big Bend	22.00	7	2.50	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	1309.09	8	145	166
Bismarck	20.00	7	1.21	1	Sand and Gravel	8	Silty Loam	4	1	10	Silt/Clay	3	4600.00	10	126	145
Braddock	55.00	3	2.49	3	Sand and Gravel	8	Silty Loam	4	1	10	Sand/Gravel	8	1000.00	8	133	149
Brightwood	57.50	3	3.71	3	Sand and Gravel	8	Loam	5	4	9	Sand/Gravel	8	913.00	6	128	147
Buffalo Creek	4.50	10	2.46	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	1000.00	8	160	181
Burnt Creek	15.00	7	3.74	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel	8	600.00	4	143	166
Butte	108.33	1	0.00	1	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	1080.00	8	82	108
Carrington	40.00	5	0.90	1	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	2470.00	10	108	132
Central Dakota	25.00	7	5.02	6	Sand and Gravel	8	Sandy Loam	6	1	10	Sand/Gravel	8	561.04	4	157	183
Charbonneau	33.00	5	2.37	3	Sand and Gravel	8	Silty Loam	4	9	5	Sand/Gravel w/Sig. Silt/Clay	6	288.00	2	110	124
Cherry Creek	12.00	9	2.44	3	Sand and Gravel	8	Silty Loam	4	12	3	Sand/Gravel w/Sig. Silt/Clay	6	240.00	2	128	138
Cherry Lake	2.00	10	3.47	3	Sand and Gravel	8	Loam	5	12	3	Sand/Gravel	8	1440.00	8	163	168
Colfax	125.00	1	0.00	1	Sand and Gravel	8	Sandy Loam	6	1	10	Confining Layer	1	700.00	6	78	109
Columbus	146.00	1	1.32	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	1600.00	8	92	116
Cottonwood Creek	12.00	9	4.65	6	Sand and Gravel	8	Sandy Loam	6	1	10	Silt/Clay	3	1496.00	8	154	181

ATTACHMENT 1: 2019 DRASTIC INPUTS AND RESULTS
Listed Alphabetically by Aquifer Name

Aquifer Name	Depth to Water (Feet)	Score	Recharge (Inches/Year)	Score	Aquifer Media	Score	Soil Media	Score	Topography (% Slope)	Score	Impact of Vadose Zone	Score	Hydraulic Conductivity (GPD/FT ²)	Score	DRASTIC	Pesticide DRASTIC
Courtenay	60.00	3	1.15	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	775.00	6	96	122
Crete	20.99	7	2.64	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	935.06	6	139	162
Crosby	286.69	1	0.00	1	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	450.00	4	70	100
Cut Bank Creek N	9.53	9	5.50	6	Sand and Gravel	8	Sandy Loam	6	1	10	Sand/Gravel	8	1544.83	8	179	201
Cut Bank Creek S	85.00	2	0.00	1	Sand and Gravel	8	Sand	9	1	10	Confining Layer	1	1800.00	8	95	133
Dead Colt	42.31	5	2.54	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	935.06	6	129	152
Deer Lake	34.49	5	1.26	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	1500.00	8	112	136
Denbigh	10.00	9	3.84	3	Sand and Gravel	8	Sandy Loam	6	1	10	Sand/Gravel w/Sig. Silt/Clay	6	2275.00	10	163	185
Des Lacs River	19.78	7	1.35	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	3740.25	10	128	150
Douglas	45.00	5	5.07	6	Sand and Gravel	8	Sandy Loam	6	7	5	Sand/Gravel w/Sig. Silt/Clay	6	800.00	6	138	154
Dry Fork Creek	65.00	3	0.00	1	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	935.00	6	86	114
Dunseith	59.04	3	2.54	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	374.02	4	113	138
East Fork Shell Creek	42.00	5	2.83	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	2000.00	10	141	160
Eastman	95.00	2	0.00	1	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	1180.00	8	87	113
Edgeley	10.00	9	3.78	3	Sand and Gravel	8	Loam	5	5	9	Sand/Gravel	8	1085.00	8	164	181
Elk Valley	10.00	9	3.85	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel	8	1882.00	8	165	184
Ellendale	73.00	3	1.27	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	748.00	6	96	122
Elliot	93.00	2	1.26	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	451.00	4	85	113
Elm Creek	75.00	2	1.43	1	Sand and Gravel	8	Silty Loam	4	15	3	Silt/Clay	3	1533.00	8	88	95
Enderlin	32.00	5	2.54	3	Sand and Gravel	8	Sandy Loam	6	1	10	Silt/Clay	3	1147.00	8	122	149
Englevale	18.21	7	2.50	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	545.00	4	133	158
Esmond	17.00	7	3.65	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel	8	538.00	4	143	166
Estevan	253.00	1	0.00	1	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	450.00	4	70	100

ATTACHMENT 1: 2019 DRASTIC INPUTS AND RESULTS

Listed Alphabetically by Aquifer Name

Aquifer Name	Depth to Water (Feet)	Score	Recharge (Inches/Year)	Score	Aquifer Media	Score	Soil Media	Score	Topography (% Slope)	Score	Impact of Vadose Zone	Score	Hydraulic Conductivity (GPD/FT ²)	Score	DRASTIC	Pesticide DRASTIC
Fairmount	95.00	2	0.00	1	Sand and Gravel	8	Clay Loam	3	1	10	Confining Layer	1	179.00	2	65	91
Fordville	16.00	7	3.95	3	Sand and Gravel	8	Clay Loam	3	1	10	Sand/Gravel	8	2709.00	10	157	168
Fort Mandan	21.00	7	2.47	3	Sand and Gravel	8	Loam	5	6	5	Sand/Gravel w/Sig. Silt/Clay	6	1343.00	8	140	151
Fox Haven	23.00	7	2.43	3	Sand and Gravel	8	Loam	5	4	9	Sand/Gravel w/Sig. Silt/Clay	6	600.00	4	132	155
Garrison	65.00	3	2.60	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	724.00	6	119	142
Glenburn	170.00	1	0.00	1	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	1200.00	8	82	108
Glencoe Channel	40.00	5	3.55	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel	8	800.00	6	139	160
Glenview	30.00	5	2.56	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	600.00	4	123	148
Goodman Creek	28.00	7	1.48	1	Sand and Gravel	8	Loam	5	13	3	Silt/Clay	3	525.00	4	103	117
Grand Forks	200.00	1	0.00	1	Sand and Gravel	8	Clay Loam	3	1	10	Confining Layer	1	2244.15	10	84	102
Grenora	60.00	3	1.24	1	Sand and Gravel	8	Loam	5	6	5	Silt/Clay	3	1600.00	8	97	111
Guelph	46.00	5	1.39	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	1029.00	8	112	136
Gwinner	104.00	1	1.22	1	Sand and Gravel	8	Clay Loam	3	1	10	Silt/Clay	3	447.00	4	76	98
Hankinson	10.00	9	5.09	6	Sand and Gravel	8	Sand	9	1	10	Sand/Gravel	8	180.00	2	167	204
Heart River	7.00	9	1.33	1	Sand and Gravel	8	Silty Loam	4	20	1	Silt/Clay	3	1533.00	8	121	124
Heimdal	4.00	10	2.26	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	1100.00	8	160	181
Hiddenwood Lake	80.00	2	1.31	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	990.00	6	91	117
Hillsboro	40.00	5	1.13	1	Sand and Gravel	8	Clay Loam	3	1	10	Silt/Clay	3	480.00	4	96	118
Hillsburg	8.00	9	2.42	3	Sand and Gravel	8	Loam	5	10	5	Sand/Gravel w/Sig. Silt/Clay	6	1230.00	8	150	161
Hofflund	62.00	3	1.35	1	Sand and Gravel	8	Loam	5	4	9	Silt/Clay	3	2200.00	10	107	127
Homer	109.00	1	1.29	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	1060.00	8	92	116
Horse Nose Butte	65.00	3	1.37	1	Sand and Gravel	8	Silty Loam	4	9	5	Silt/Clay	3	330.00	4	83	98
Horseshoe Valley	21.00	7	2.51	3	Sand and Gravel	8	Loam	5	10	5	Sand/Gravel w/Sig. Silt/Clay	6	2165.00	10	146	155

ATTACHMENT 1: 2019 DRASTIC INPUTS AND RESULTS

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Icelandic	12.00	9	5.14	6	Sand and Gravel	8	Sand	9	1	10	Sand/Gravel	8	10.00	1	164	202
Inkster	28.00	7	5.60	6	Sand and Gravel	8	Sandy Loam	6	1	10	Sand/Gravel	8	1500.00	8	169	191
James River	4.00	10	2.43	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	1000.00	8	160	181
Jamestown	15.00	7	3.87	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel	8	1400.00	8	155	174
Juanita Lake	3.00	10	3.49	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel	8	1230.00	8	170	189
Karlsruhe	16.00	7	3.68	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel	8	800.00	6	149	170
Keene	117.71	1	0.00	1	Sand and Gravel	8	Sandy Loam	6	4	9	Confining Layer	1	1122.08	8	83	110
Kenmare	77.46	2	1.32	1	Sand and Gravel	8	Loam	5	2	9	Silt/Clay	3	538.00	4	84	110
Kilgore	10.00	9	3.66	3	Sand and Gravel	8	Sand	9	1	10	Sand/Gravel w/Sig. Silt/Clay	6	681.00	4	151	188
Killdeer	20.00	7	1.38	1	Sand and Gravel	8	Silty Loam	4	9	5	Silt/Clay	3	935.00	6	109	122
Knife River	18.00	7	1.40	1	Sand and Gravel	8	Silty Loam	4	1	10	Sand/Gravel w/Sig. Silt/Clay	6	2060.00	10	141	157
Koble	28.00	7	3.71	3	Sand and Gravel	8	Sandy Loam	6	1	10	Sand/Gravel w/Sig. Silt/Clay	6	374.02	4	135	163
Lake Ilo	33.00	5	2.55	3	Sand and Gravel	8	Sandy Loam	6	1	10	Silt/Clay	3	411.43	4	110	141
Lake Nettie	11.00	9	3.57	3	Sand and Gravel	8	Loam	5	12	3	Sand/Gravel	8	1287.00	8	158	163
Lake Souris	8.00	9	5.06	6	Sand and Gravel	8	Sandy Loam	6	1	10	Sand/Gravel	8	2275.00	10	185	205
LaMoure	22.00	7	3.93	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel	8	650.00	4	143	166
LaMoure North	32.86	5	5.25	6	Sand and Gravel	8	Sand	9	4	9	Sand/Gravel	8	650.00	4	152	185
Landa	17.19	7	1.35	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	1008.38	8	122	146
Leeds	75.00	2	1.27	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	130.00	2	79	109
Lignite City	28.00	7	1.35	1	Sand and Gravel	8	Silty Loam	4	1	10	Silt/Clay	3	1500.00	8	120	141
Little Heart	42.00	5	1.33	1	Sand and Gravel	8	Silty Loam	4	12	3	Silt/Clay	3	1907.00	8	103	110
Little Knife River Valley	10.00	9	2.81	3	Sand and Gravel	8	Silty Loam	4	7	5	Sand/Gravel w/Sig. Silt/Clay	6	1400.00	8	148	156
Little Missouri River	22.00	7	1.18	1	Sand and Gravel	8	Silty Loam	4	3	9	Silt/Clay	3	1080.00	8	119	138

ATTACHMENT 1: 2019 DRASTIC INPUTS AND RESULTS
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Little Muddy	58.00	3	2.56	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	1122.00	8	125	146
Long Lake	120.00	1	1.26	1	Sand and Gravel	8	Silty Loam	4	8	5	Silt/Clay	3	800.00	6	79	92
Lost Lake	52.00	3	1.16	1	Sand and Gravel	8	Loam	5	4	9	Silt/Clay	3	1830.00	8	101	123
Maddock	21.00	7	2.35	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	1406.00	8	145	166
Manfred	6.00	9	2.22	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	650.00	4	143	168
Martin	55.00	3	3.43	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel	8	1080.00	8	135	154
McIntosh	50.00	3	2.44	3	Sand and Gravel	8	Thin or Absent	10	9	5	Silt/Clay	3	1085.00	8	115	144
McKenzie	90.00	2	1.23	1	Sand and Gravel	8	Silty Loam	4	1	10	Silt/Clay	3	800.00	6	89	112
McVile	60.00	3	2.26	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	236.00	2	107	134
Medford	10.00	9	5.42	6	Sand and Gravel	8	Sandy Loam	6	1	10	Sand/Gravel	8	660.00	4	167	193
Medina North	7.00	9	3.72	3	Sand and Gravel	8	Loam	5	2	9	Sand/Gravel	8	2056.00	10	170	185
Medina South	7.00	9	3.73	3	Sand and Gravel	8	Loam	5	2	9	Sand/Gravel	8	2056.00	10	170	185
Middle James	13.00	9	1.36	1	Sand and Gravel	8	Silty Loam	4	1	10	Silt/Clay	5	561.04	4	128	151
Midway	24.00	7	2.52	1	Sand and Gravel	8	Loam	4	1	10	Sand/Gravel w/Sig. Silt/Clay	6	655.00	4	123	145
Milnor Channel	18.00	7	3.69	1	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel	8	333.00	4	135	158
Missouri River	22.00	7	2.50	3	Sand and Gravel	8	Sand	9	4	9	Silt/Clay	3	2218.00	10	143	175
Missouri River - Lake Sakakawea	15.56	7	1.32	1	Sand and Gravel	8	Silty Loam	4	1	10	Silt/Clay	3	1028.57	8	120	141
Missouri River-Oahe	12.21	9	1.27	1	Sand and Gravel	8	Silty Loam	4	1	10	Silt/Clay	3	746.95	6	124	147
Montpelier	167.63	1	0.00	1	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	2992.20	10	88	112
Munich	38.00	5	1.26	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	785.00	6	106	132
Napoleon	48.00	5	3.73	3	Sand and Gravel	8	Loam	5	3	9	Sand/Gravel	8	1015.00	8	144	161
New Rockford	90.00	2	1.17	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	2465.00	10	103	125
New Town	130.00	1	1.41	3	Sand and Gravel	8	Clay Loam	4	4	9	Silt/Clay	3	2200.00	10	103	120

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North Burleigh	49.00	5	3.49	3	Sand and Gravel	8	Loam	5	9	5	Sand/Gravel	8	740.00	6	134	145
Northwest Buried Channel	184.42	1	0.00	3	Sand and Gravel	8	Loam	5	3	9	Confining Layer	1	2618.18	10	95	117
Oakes	12.00	9	5.44	1	Sand and Gravel	8	Sandy Loam	5	1	10	Sand/Gravel	8	800.00	6	151	172
Otter Creek	43.59	5	1.32	1	Sand and Gravel	8	Silty Loam	3	4	9	Silt/Clay	3	935.00	6	101	119
Page	15.00	7	2.39	1	Sand and Gravel	8	Loam	4	1	10	Sand/Gravel w/Sig. Silt/Clay	6	1100.00	8	135	153
Painted Woods Creek	10.00	9	3.55	3	Sand and Gravel	8	Loam	5	5	9	Sand/Gravel	8	1040.00	8	164	181
Painted Woods Lake	21.00	7	1.27	3	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	778.00	6	124	150
Pembina Delta	80.00	2	2.50	1	Sand and Gravel	8	Clay Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	360.00	4	100	125
Pembina River	20.00	7	1.23	3	Sand and Gravel	8	Silty Loam	3	1	10	Silt/Clay	3	935.00	6	120	140
Pipestem Creek	9.00	9	2.52	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	1543.00	8	155	176
Pleasant Lake	40.00	5	1.30	3	Sand and Gravel	8	Loam	5	10	5	Silt/Clay	3	778.00	6	109	125
Pony Gulch	40.00	5	0.00	1	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	3740.25	10	108	132
Random Creek	10.00	9	2.62	3	Sand and Gravel	8	Clay Loam	3	5	9	Sand/Gravel w/Sig. Silt/Clay	6	1300.00	8	150	163
Ray	127.00	1	1.34	1	Sand and Gravel	8	Silty Loam	4	1	10	Silt/Clay	3	2000.00	10	96	115
Renner	247.60	1	0.00	1	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	1832.50	8	82	108
Riverdale	6.00	9	4.00	1	Sand and Gravel	8	Loam	5	11	5	Sand/Gravel	8	1120.00	8	152	161
Rocky Run	3.00	10	4.80	3	Sand and Gravel	8	Sandy Loam	5	1	10	Sand/Gravel	8	900.00	6	164	185
Rolla	17.00	7	1.29	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	650.00	4	110	138
Rosefield	79.38	2	0.00	1	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	432.00	4	75	105
Rugby Aquifer	42.00	5	1.28	1	Sand and Gravel	8	Clay Loam	3	4	9	Silt/Clay	3	1120.43	8	107	123
Rusland	5.00	9	2.20	3	Sand and Gravel	8	Loam	6	1	10	Sand/Gravel w/Sig. Silt/Clay	6	730.00	6	151	177
Russell Lake	23.00	7	3.86	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel	8	1000.00	8	155	174
Ryder	17.00	7	1.32	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	700.00	6	116	142

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Ryder Ridge	75.00	2	1.34	3	Sand and Gravel	8	Loam	4	1	10	Silt/Clay	3	850.00	6	97	120
Sand Prairie	12.00	9	3.60	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel	8	485.00	4	153	176
Sanish	41.00	5	0.00	1	Sand and Gravel	8	Loam	5	4	9	Confining Layer	1	2393.76	10	107	129
Seven Mile Coulee	20.00	7	3.79	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel	8	980.00	6	149	170
Sheldon	17.45	7	3.77	3	Sand and Gravel	8	Sandy Loam	6	1	10	Sand/Gravel	8	748.05	6	151	175
Shell Creek-Central	78.20	2	2.75	3	Sand and Gravel	8	Loam	5	4	9	Sand/Gravel w/Sig. Silt/Clay	6	950.00	6	113	134
Shell Creek-East Branch	73.23	3	2.68	1	Sand and Gravel	8	Loam	5	5	9	Sand/Gravel w/Sig. Silt/Clay	6	1000.00	8	116	135
Shell Creek-White Lake	24.00	7	2.75	3	Sand and Gravel	8	Silty Loam	4	4	9	Sand/Gravel w/Sig. Silt/Clay	6	2300.00	10	148	162
Shell Valley	18.00	7	3.77	1	Sand and Gravel	8	Sandy Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	1502.00	8	137	158
Sheyenne Delta	10.00	9	4.97	1	Sand and Gravel	8	Sandy Loam	5	1	10	Sand/Gravel	8	750.00	6	151	172
Shields	50.00	3	1.39	1	Sand and Gravel	8	Silty Loam	4	12	3	Silt/Clay	3	524.00	4	81	92
Skjermo Lake	30.00	5	2.30	1	Sand and Gravel	8	Loam	10	10	5	Sand/Gravel w/Sig. Silt/Clay	6	2100.00	10	138	162
Smoky Butte	99.82	2	0.00	1	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	2244.00	10	93	117
Snake Creek	58.00	3	1.36	1	Sand and Gravel	8	Loam	5	4	9	Silt/Clay	3	1080.00	8	101	123
Soo Channel	37.00	5	2.41	3	Sand and Gravel	8	Loam	5	2	9	Sand/Gravel w/Sig. Silt/Clay	6	600.00	4	122	145
Souris River	15.00	7	1.30	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	500.00	4	110	138
South Branch Beaver Creek	42.36	5	2.72	3	Sand and Gravel	8	Silty Loam	4	1	10	Sand/Gravel w/Sig. Silt/Clay	6	600.00	4	121	143
South Fessenden	11.00	9	2.31	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	800.00	6	149	172
Spiritwood N	150.00	1	1.00	1	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	950.00	6	76	104
Spiritwood S	147.00	1	1.00	1	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	950.00	6	76	104
Spiritwood-Berlin	215.00	1	1.00	1	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	748.00	6	76	104
Spiritwood-Devils Lake	129.50	1	1.00	1	Sand and Gravel	8	Silty Loam	4	6	5	Confining Layer	1	950.00	6	69	84

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Spiritwood-Grand Rapids	166.00	1	1.00	1	Sand and Gravel	8	Loam	5	7	5	Confining Layer	1	1000.00	8	77	93
Spiritwood-Griggs	179.00	1	1.00	1	Sand and Gravel	8	Silty Loam	4	1	10	Confining Layer	1	1000.00	8	80	103
Spiritwood-LaMoure SE	203.00	1	1.00	3	Sand and Gravel	8	Silty Loam	5	4	9	Confining Layer	1	950.00	6	83	109
Spiritwood-Oakes	162.00	1	1.00	3	Sand and Gravel	8	Sandy Loam	4	1	10	Confining Layer	1	800.00	6	82	107
Spiritwood-Rogers	159.00	1	1.00	1	Sand and Gravel	8	Silty Loam	5	1	10	Confining Layer	1	600.00	4	70	100
Spiritwood-Sheyenne River	181.00	1	1.00	3	Sand and Gravel	8	Sandy Loam	5	1	10	Confining Layer	1	800.00	6	84	112
Spiritwood-Stutsman	179.00	1	1.00	1	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	800.00	6	76	104
Spiritwood-Warwick	193.00	1	1.00	1	Sand and Gravel	8	Silty Loam	4	1	10	Confining Layer	1	700.00	6	74	99
Spring Creek	61.00	3	2.58	3	Sand and Gravel	8	Thin or Absent	10	1	10	Silt/Clay	3	1084.00	8	120	159
Square Butte Creek	30.00	5	2.58	3	Sand and Gravel	8	Silty Loam	4	10	5	Sand/Gravel w/Sig. Silt/Clay	6	1080.00	8	128	136
Squaw Creek	128.00	1	0.00	1	Sand and Gravel	8	Loam	5	4	9	Confining Layer	1	748.05	6	75	101
St. James	54.00	3	1.25	1	Sand and Gravel	8	Silty Loam	3	4	9	Silt/Clay	3	1907.00	8	97	113
Starkweather	118.00	1	1.29	3	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	610.00	4	88	116
Stoney Creek	10.00	9	3.31	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel	8	800.00	6	159	180
Strasburg	6.00	9	3.96	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel	8	1800.00	8	165	184
Strawberry Lake	38.00	5	1.28	1	Sand and Gravel	8	Loam	5	12	3	Silt/Clay	3	1080.00	8	105	115
Streeter	57.00	3	1.19	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	1295.00	8	102	126
Sundre	90.00	2	2.76	3	Sand and Gravel	8	Loam	5	4	9	Sand/Gravel w/Sig. Silt/Clay	6	1700.00	8	119	138
Sydney	196.00	1	0.00	3	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	1000.00	8	90	116
Thompson	117.00	1	0.00	1	Sand and Gravel	8	Clay Loam	3	1	10	Confining Layer	1	640.00	4	66	90
Tobacco Garden	44.00	5	1.19	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	3740.00	10	118	140
Tokio	24.00	7	3.20	3	Sand and Gravel	8	Loam	5	11	5	Sand/Gravel	8	1130.00	8	150	159
Tolgen	6.00	9	2.62	3	Sand and Gravel	8	Loam	5	10	5	Sand/Gravel w/Sig. Silt/Clay	6	650.00	4	138	153

ATTACHMENT 1: 2019 DRASTIC INPUTS AND RESULTS
Listed Alphabetically by Aquifer Name

Aquifer Name	Depth to Water (Feet)	Score	Recharge (Inches/Year)	Score	Aquifer Media	Score	Soil Media	Score	Topography (% Slope)	Score	Impact of Vadose Zone	Score	Hydraulic Conductivity (GPD/FT ²)	Score	DRASTIC	Pesticide DRASTIC
Tower City	11.00	9	3.47	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel	8	856.00	6	159	180
Trappers Coulee	11.00	9	2.43	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	2244.15	10	161	180
Trenton	54.00	3	1.18	1	Sand and Gravel	8	Silty Loam	4	1	10	Silt/Clay	3	1700.00	8	100	121
Turtle Lake	29.00	7	2.55	1	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	267.00	2	119	146
Upper Apple Creek	12.50	9	3.94	3	Sand and Gravel	8	Loam	5	7	5	Sand/Gravel	8	960.00	6	154	165
Upper Buffalo Creek	12.67	9	1.19	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	500.00	4	120	148
Vang	13.00	9	5.26	3	Sand and Gravel	8	Sandy Loam	5	10	5	Sand/Gravel	8	1500.00	8	160	169
Voltaire	14.00	9	2.49	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	1533.00	8	155	176
Wagonsport	8.00	9	3.73	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel	8	900.00	6	159	180
Wahpeton Buried Valley	125.00	1	0.00	3	Sand and Gravel	8	Sandy Loam	5	1	10	Confining Layer	1	561.04	4	78	108
Warwick Aquifer	17.00	7	4.50	6	Sand and Gravel	8	Sand	9	1	10	Sand/Gravel	8	881.00	6	169	202
Weller Slough	142.00	1	0.00	1	Sand and Gravel	8	Loam	5	1	10	Confining Layer	1	1200.00	8	82	108
West Fargo	125.00	1	0.00	1	Sand and Gravel	8	Clay Loam	3	1	10	Confining Layer	1	1454.00	8	78	98
West Wildrose	107.00	1	1.31	1	Sand and Gravel	8	Loam	5	9	5	Silt/Clay	3	1700.00	8	87	101
White Earth	14.00	9	4.10	1	Sand and Gravel	8	Loam	5	18	1	Sand/Gravel	8	2200.00	10	154	153
White Shield	100.00	1	0.00	3	Sand and Gravel	8	Loam	9	1	10	Confining Layer	1	830.00	6	92	132
Wildrose	34.00	5	2.45	1	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	1000.00	8	127	148
Wimbledon	35.00	5	2.34	3	Sand and Gravel	8	Loam	5	1	10	Sand/Gravel w/Sig. Silt/Clay	6	1000.00	8	135	156
Windsor	250.00	1	1.22	1	Sand and Gravel	8	Loam	5	6	5	Silt/Clay	3	1000.00	8	87	101
Wing Channel	108.00	1	1.35	1	Sand and Gravel	8	Loam	5	7	5	Silt/Clay	3	640.00	4	75	93
Winona	134.00	1	1.35	1	Sand and Gravel	8	Silty Loam	4	13	3	Silt/Clay	3	860.00	6	77	86
Wishek	14.00	9	2.50	3	Sand and Gravel	8	Loam	5	5	9	Sand/Gravel w/Sig. Silt/Clay	6	1300.00	8	154	173
Wolf Creek	21.00	7	1.32	1	Sand and Gravel	8	Loam	5	1	10	Silt/Clay	3	880.00	6	116	142

ATTACHMENT 1: 2019 DRASTIC INPUTS AND RESULTS

Listed Alphabetically by Aquifer Name

Aquifer Name	Depth to Water (Feet)	Score	Recharge (Inches/Year)	Score	Aquifer Media	Score	Soil Media	Score	Topography (% Slope)	Score	Impact of Vadose Zone	Score	Hydraulic Conductivity (GPD/FT ²)	Score	DRASTIC	Pesticide DRASTIC
Yellowstone	20.00	7	2.35	3	Sand and Gravel	8	Sand	9	1	10	Silt/Clay	3	1496.00	8	138	174
Yellowstone River Channel	120.00	1	1.19	1	Sand and Gravel	8	Loam	5	5	9	Silt/Clay	3	1200.00	8	91	113
Ypsilanti	10.93	9	3.73	3	Sand and Gravel	8	Loam	5	4	9	Sand/Gravel	8	1496.10	8	164	181
Zap	27.00	7	1.55	1	Sand and Gravel	8	Loam	5	4	9	Silt/Clay	3	486.00	4	109	135
Zeeland	77.00	2	1.32	1	Sand and Gravel	8	Clay Loam	3	1	10	Silt/Clay	3	1100.00	8	93	111

ATTACHMENT 2: 2019 GEOGRAPHIC TARGETING SYSTEM RESULTS

ATTACHMENT 2

2019 GEOGRAPHIC TARGETING SYSTEM RESULTS

Listed by Total Monitoring Score

ATTACHMENT 2: 2019 GEOGRAPHIC TARGETING SYSTEM RESULTS

Aquifer	Vulnerability Value (Pesticide DRASTIC)	Vulnerability Score	Vulnerability Rating	Sensitivity Value (dollars/farmed acre)	Sensitivity Score	Sensitivity Rating	Risk Value (acre-feet/mi ²)	Risk Score	Risk Rating	Total Monitoring Score	Total Monitoring Priority Rating
Edgeley	181	3	HIGH	403.19	3	HIGH	319.41	3	HIGH	9	HIGH
Elk Valley	184	3	HIGH	525.42	3	HIGH	159.91	3	HIGH	9	HIGH
Fordville	168	3	HIGH	528.80	3	HIGH	122.65	3	HIGH	9	HIGH
Hankinson	204	3	HIGH	616.56	3	HIGH	181.52	3	HIGH	9	HIGH
Inkster	191	3	HIGH	525.43	3	HIGH	189.43	3	HIGH	9	HIGH
Juanita Lake	189	3	HIGH	453.36	3	HIGH	247.17	3	HIGH	9	HIGH
Koble	163	3	HIGH	356.92	3	HIGH	37.15	3	HIGH	9	HIGH
LaMoure	166	3	HIGH	409.71	3	HIGH	227.16	3	HIGH	9	HIGH
LaMoure North	185	3	HIGH	403.17	3	HIGH	235.03	3	HIGH	9	HIGH
Medina North	185	3	HIGH	356.92	3	HIGH	591.13	3	HIGH	9	HIGH
Medina South	185	3	HIGH	356.92	3	HIGH	531.56	3	HIGH	9	HIGH
Oakes	172	3	HIGH	395.90	3	HIGH	199.14	3	HIGH	9	HIGH
Rusland	177	3	HIGH	368.71	3	HIGH	316.18	3	HIGH	9	HIGH
Sand Prairie	176	3	HIGH	367.87	3	HIGH	53.09	3	HIGH	9	HIGH
Sheyenne Delta	172	3	HIGH	497.31	3	HIGH	49.75	3	HIGH	9	HIGH
Carrington	132	2	MODERATE	439.49	3	HIGH	192.13	3	HIGH	8	HIGH
Central Dakota	183	3	HIGH	213.21	2	MODERATE	112.81	3	HIGH	8	HIGH
Englevale	158	2	MODERATE	423.74	3	HIGH	328.90	3	HIGH	8	HIGH
Esmond	166	3	HIGH	300.23	2	MODERATE	167.52	3	HIGH	8	HIGH
Icelandic	202	3	HIGH	586.90	3	HIGH	21.04	2	MODERATE	8	HIGH
Jamestown	174	3	HIGH	356.92	2	MODERATE	1715.06	3	HIGH	8	HIGH
Maddock	166	3	HIGH	300.24	2	MODERATE	42.91	3	HIGH	8	HIGH
Manfred	168	3	HIGH	368.72	3	HIGH	21.63	2	MODERATE	8	HIGH
Middle James	151	2	MODERATE	382.57	3	HIGH	579.41	3	HIGH	8	HIGH
Milnor Channel	158	2	MODERATE	535.57	3	HIGH	161.14	3	HIGH	8	HIGH
Napolean	161	3	HIGH	301.29	2	MODERATE	42.75	3	HIGH	8	HIGH
Page	153	2	MODERATE	514.08	3	HIGH	82.40	3	HIGH	8	HIGH
Pembina River	140	2	MODERATE	586.92	3	HIGH	105.12	3	HIGH	8	HIGH
Pipstem Creek	176	3	HIGH	390.95	3	HIGH	28.27	2	MODERATE	8	HIGH
Seven Mile Coulee	170	3	HIGH	356.92	2	MODERATE	104.26	3	HIGH	8	HIGH
Tower City	180	3	HIGH	443.11	3	HIGH	11.73	2	MODERATE	8	HIGH
Trappers Coulee	180	3	HIGH	299.79	2	MODERATE	292.61	3	HIGH	8	HIGH
Warwick Aquifer	202	3	HIGH	286.06	2	MODERATE	130.06	3	HIGH	8	HIGH

ATTACHMENT 2: 2019 GEOGRAPHIC TARGETING SYSTEM RESULTS

Aquifer	Vulnerability Value (Pesticide DRASTIC)	Vulnerability Score	Vulnerability Rating	Sensitivity Value (dollars/farmed acre)	Sensitivity Score	Sensitivity Rating	Risk Value (acre-feet/m ²)	Risk Score	Risk Rating	Total Monitoring Score	Total Monitoring Priority Rating
Wishek	173	3	HIGH	244.55	2	MODERATE	45.35	3	HIGH	8	HIGH
Big Bend	166	3	HIGH	357.54	3	HIGH	0.00	1	LOW	7	MODERATE
Burnt Creek	166	3	HIGH	188.92	1	LOW	168.95	3	HIGH	7	MODERATE
Crete	162	3	HIGH	474.98	3	HIGH	0.00	1	LOW	7	MODERATE
Denbigh	185	3	HIGH	186.86	1	LOW	84.09	3	HIGH	7	MODERATE
Elliot	113	1	LOW	357.58	3	HIGH	237.68	3	HIGH	7	MODERATE
Garrison	142	2	MODERATE	263.70	2	MODERATE	258.24	3	HIGH	7	MODERATE
Grand Forks	102	1	LOW	525.29	3	HIGH	41.06	3	HIGH	7	MODERATE
Guelph	136	2	MODERATE	298.96	2	MODERATE	111.57	3	HIGH	7	MODERATE
Gwinner	98	1	LOW	475.43	3	HIGH	50.85	3	HIGH	7	MODERATE
Heimdal	181	3	HIGH	368.74	3	HIGH	0.00	1	LOW	7	MODERATE
Horseshoe Valley	155	2	MODERATE	263.77	2	MODERATE	187.97	3	HIGH	7	MODERATE
James River	181	3	HIGH	407.29	3	HIGH	1.24	1	LOW	7	MODERATE
Karlsruhe	170	3	HIGH	186.86	1	LOW	86.28	3	HIGH	7	MODERATE
Lake Nettie	163	3	HIGH	233.86	2	MODERATE	32.44	2	MODERATE	7	MODERATE
McVile	134	2	MODERATE	319.70	2	MODERATE	53.82	3	HIGH	7	MODERATE
Medford	193	3	HIGH	526.40	3	HIGH	0.00	1	LOW	7	MODERATE
Midway	145	2	MODERATE	356.92	3	HIGH	5.24	2	MODERATE	7	MODERATE
Painted Woods Lake	150	2	MODERATE	263.21	2	MODERATE	136.42	3	HIGH	7	MODERATE
Rocky Run	185	3	HIGH	368.73	3	HIGH	0.00	1	LOW	7	MODERATE
Russell Lake	174	3	HIGH	440.35	3	HIGH	0.00	1	LOW	7	MODERATE
Sheldon	175	3	HIGH	357.54	3	HIGH	0.00	1	LOW	7	MODERATE
Skjermo Lake	162	3	HIGH	165.60	1	LOW	109.21	3	HIGH	7	MODERATE
South Fessenden	172	3	HIGH	368.73	3	HIGH	0.00	1	LOW	7	MODERATE
Square Butte Creek	136	2	MODERATE	208.41	2	MODERATE	39.07	3	HIGH	7	MODERATE
Stoney Creek	180	3	HIGH	402.03	3	HIGH	0.00	1	LOW	7	MODERATE
Strasburg	184	3	HIGH	265.70	2	MODERATE	20.30	2	MODERATE	7	MODERATE
Sundre	138	2	MODERATE	253.29	2	MODERATE	273.36	3	HIGH	7	MODERATE
Vang	169	3	HIGH	255.56	2	MODERATE	7.39	2	MODERATE	7	MODERATE
Voltaire	176	3	HIGH	186.85	1	LOW	52.64	3	HIGH	7	MODERATE
Wahpeton Buried Valley	108	1	LOW	616.48	3	HIGH	374.17	3	HIGH	7	MODERATE
White Shield	132	2	MODERATE	263.61	2	MODERATE	89.95	3	HIGH	7	MODERATE
Ypsilanti	181	3	HIGH	357.05	3	HIGH	0.00	1	LOW	7	MODERATE

ATTACHMENT 2: 2019 GEOGRAPHIC TARGETING SYSTEM RESULTS

Aquifer	Vulnerability Value (Pesticide DRASTIC)	Vulnerability Score	Vulnerability Rating	Sensitivity Value (dollars/farmed acre)	Sensitivity Score	Sensitivity Rating	Risk Value (acre-feet/m ²)	Risk Score	Risk Rating	Total Monitoring Score	Total Monitoring Priority Rating
Bantel	139	2	MODERATE	413.95	3	HIGH	0.00	1	LOW	6	MODERATE
Belmont	103	1	LOW	563.96	3	HIGH	1.97	2	MODERATE	6	MODERATE
Bismarck	145	2	MODERATE	188.92	1	LOW	43.84	3	HIGH	6	MODERATE
Brightwood	147	2	MODERATE	616.58	3	HIGH	0.00	1	LOW	6	MODERATE
Buffalo Creek	181	3	HIGH	263.65	2	MODERATE	0.00	1	LOW	6	MODERATE
Cherry Creek	138	2	MODERATE	107.37	1	LOW	87.52	3	HIGH	6	MODERATE
Cherry Lake	168	3	HIGH	265.75	2	MODERATE	0.08	1	LOW	6	MODERATE
Colfax	109	1	LOW	616.54	3	HIGH	2.07	2	MODERATE	6	MODERATE
Cut Bank Creek N	201	3	HIGH	296.40	2	MODERATE	1.06	1	LOW	6	MODERATE
Dead Colt	152	2	MODERATE	357.55	3	HIGH	0.00	1	LOW	6	MODERATE
Deer Lake	136	2	MODERATE	356.92	3	HIGH	0.00	1	LOW	6	MODERATE
Douglas	154	2	MODERATE	256.99	2	MODERATE	24.47	2	MODERATE	6	MODERATE
East Fork Shell Creek	160	2	MODERATE	160.62	1	LOW	33.79	3	HIGH	6	MODERATE
Eastman	113	1	LOW	444.84	3	HIGH	4.55	2	MODERATE	6	MODERATE
Ellendale	122	1	LOW	409.16	3	HIGH	1.57	2	MODERATE	6	MODERATE
Enderlin	149	2	MODERATE	416.06	3	HIGH	0.00	1	LOW	6	MODERATE
Fairmount	91	1	LOW	616.46	3	HIGH	7.99	2	MODERATE	6	MODERATE
Glencoe Channel	160	2	MODERATE	195.48	1	LOW	92.07	3	HIGH	6	MODERATE
Glenview	148	2	MODERATE	188.99	1	LOW	43.47	3	HIGH	6	MODERATE
Hillsboro	118	1	LOW	560.68	3	HIGH	25.48	2	MODERATE	6	MODERATE
Hillsburg	161	3	HIGH	301.32	2	MODERATE	0.00	1	LOW	6	MODERATE
Kilgore	188	3	HIGH	226.17	2	MODERATE	0.00	1	LOW	6	MODERATE
Knife River	157	2	MODERATE	148.54	1	LOW	139.37	3	HIGH	6	MODERATE
Lake Ilo	141	2	MODERATE	120.86	1	LOW	575.36	3	HIGH	6	MODERATE
Lake Souris	205	3	HIGH	187.07	1	LOW	28.78	2	MODERATE	6	MODERATE
Lignite City	141	2	MODERATE	176.52	1	LOW	47.66	3	HIGH	6	MODERATE
Little Muddy	146	2	MODERATE	167.75	1	LOW	173.43	3	HIGH	6	MODERATE
Martin	154	2	MODERATE	216.48	2	MODERATE	2.20	2	MODERATE	6	MODERATE
Missouri River	175	3	HIGH	190.69	1	LOW	21.61	2	MODERATE	6	MODERATE
Painted Woods Creek	181	3	HIGH	203.83	2	MODERATE	0.00	1	LOW	6	MODERATE
Pleasant Lake	125	1	LOW	251.51	2	MODERATE	89.82	3	HIGH	6	MODERATE
Pony Gulch	132	2	MODERATE	368.71	3	HIGH	0.00	1	LOW	6	MODERATE
Riverdale	161	3	HIGH	253.37	2	MODERATE	0.00	1	LOW	6	MODERATE

ATTACHMENT 2: 2019 GEOGRAPHIC TARGETING SYSTEM RESULTS

Aquifer	Vulnerability Value (Pesticide DRASTIC)	Vulnerability Score	Vulnerability Rating	Sensitivity Value (dollars/farmed acre)	Sensitivity Score	Sensitivity Rating	Risk Value (acre-feet/m ²)	Risk Score	Risk Rating	Total Monitoring Score	Total Monitoring Priority Rating
Rolla	138	2	MODERATE	221.53	2	MODERATE	10.83	2	MODERATE	6	MODERATE
Rugby Aquifer	123	1	LOW	237.62	2	MODERATE	100.28	3	HIGH	6	MODERATE
Ryder	142	2	MODERATE	255.68	2	MODERATE	6.12	2	MODERATE	6	MODERATE
Shell Creek-East Branch	135	2	MODERATE	208.51	2	MODERATE	7.12	2	MODERATE	6	MODERATE
Shell Creek-White Lake	162	3	HIGH	164.66	1	LOW	7.11	2	MODERATE	6	MODERATE
Shell Valley	158	2	MODERATE	202.14	1	LOW	154.65	3	HIGH	6	MODERATE
Soo Channel	145	2	MODERATE	188.94	1	LOW	216.29	3	HIGH	6	MODERATE
Spiritwood N	104	1	LOW	403.18	3	HIGH	33.50	2	MODERATE	6	MODERATE
Spiritwood-Berlin	104	1	LOW	402.93	3	HIGH	33.50	2	MODERATE	6	MODERATE
Spiritwood-Grand Rapids	93	1	LOW	408.98	3	HIGH	33.49	2	MODERATE	6	MODERATE
Spiritwood-Griggs	103	1	LOW	453.39	3	HIGH	33.50	2	MODERATE	6	MODERATE
Spiritwood-LaMoure SE	109	1	LOW	402.05	3	HIGH	33.50	2	MODERATE	6	MODERATE
Spiritwood-Rogers	100	1	LOW	374.79	3	HIGH	33.47	2	MODERATE	6	MODERATE
Spiritwood-Warwick	99	1	LOW	479.98	3	HIGH	33.51	2	MODERATE	6	MODERATE
Spring Creek	159	2	MODERATE	237.26	2	MODERATE	6.38	2	MODERATE	6	MODERATE
Streeter	126	1	LOW	283.63	2	MODERATE	122.47	3	HIGH	6	MODERATE
Tobacco Garden	140	2	MODERATE	107.36	1	LOW	56.31	3	HIGH	6	MODERATE
Tokio	159	2	MODERATE	299.57	2	MODERATE	15.85	2	MODERATE	6	MODERATE
Upper Apple Creek	165	3	HIGH	188.96	1	LOW	1.56	2	MODERATE	6	MODERATE
Upper Buffalo Creek	148	2	MODERATE	356.92	3	HIGH	0.00	1	LOW	6	MODERATE
Wagonsport	180	3	HIGH	189.65	1	LOW	10.75	2	MODERATE	6	MODERATE
West Fargo	98	1	LOW	519.67	3	HIGH	18.49	2	MODERATE	6	MODERATE
Wimbledon	156	2	MODERATE	398.54	3	HIGH	0.00	1	LOW	6	MODERATE
Windsor	101	1	LOW	356.92	3	HIGH	15.04	2	MODERATE	6	MODERATE
Winona	86	1	LOW	265.66	2	MODERATE	229.46	3	HIGH	6	MODERATE
Yellowstone	174	3	HIGH	107.24	1	LOW	9.55	2	MODERATE	6	MODERATE
Adrian	112	1	LOW	395.89	3	HIGH	0.00	1	LOW	5	MODERATE
Antelope Creek	103	1	LOW	152.40	1	LOW	40.79	3	HIGH	5	MODERATE
Beaver Creek S	140	2	MODERATE	265.67	2	MODERATE	0.00	1	LOW	5	MODERATE
Beaver Lake	143	2	MODERATE	301.31	2	MODERATE	0.00	1	LOW	5	MODERATE
Braddock	149	2	MODERATE	265.71	2	MODERATE	0.00	1	LOW	5	MODERATE
Charbonneau	124	1	LOW	107.30	1	LOW	757.72	3	HIGH	5	MODERATE
Cottonwood Creek	181	3	HIGH	167.67	1	LOW	0.00	1	LOW	5	MODERATE

ATTACHMENT 2: 2019 GEOGRAPHIC TARGETING SYSTEM RESULTS

Aquifer	Vulnerability Value (Pesticide DRASTIC)	Vulnerability Score	Vulnerability Rating	Sensitivity Value (dollars/farmed acre)	Sensitivity Score	Sensitivity Rating	Risk Value (acre-feet/m ²)	Risk Score	Risk Rating	Total Monitoring Score	Total Monitoring Priority Rating
Des Lacs River	150	2	MODERATE	262.87	2	MODERATE	0.00	1	LOW	5	MODERATE
Fort Mandan	151	2	MODERATE	262.32	2	MODERATE	0.00	1	LOW	5	MODERATE
Glenburn	108	1	LOW	293.76	2	MODERATE	2.15	2	MODERATE	5	MODERATE
Grenora	111	1	LOW	166.38	1	LOW	52.18	3	HIGH	5	MODERATE
Hofflund	127	1	LOW	167.85	1	LOW	1303.09	3	HIGH	5	MODERATE
Homer	116	1	LOW	356.92	3	HIGH	0.00	1	LOW	5	MODERATE
Landa	146	2	MODERATE	282.52	2	MODERATE	0.00	1	LOW	5	MODERATE
Little Knife River Valley	156	2	MODERATE	160.59	1	LOW	9.31	2	MODERATE	5	MODERATE
Little Missouri River	138	2	MODERATE	114.52	1	LOW	6.76	2	MODERATE	5	MODERATE
Lost Lake	123	1	LOW	263.79	2	MODERATE	5.19	2	MODERATE	5	MODERATE
McIntosh	144	2	MODERATE	252.70	2	MODERATE	0.00	1	LOW	5	MODERATE
McKenzie	112	1	LOW	188.97	1	LOW	41.03	3	HIGH	5	MODERATE
Missouri River - Lake Sakakawea	141	2	MODERATE	201.79	1	LOW	21.73	2	MODERATE	5	MODERATE
Missouri River-Oahe	147	2	MODERATE	179.01	1	LOW	21.75	2	MODERATE	5	MODERATE
Montpelier	112	1	LOW	367.62	3	HIGH	0.00	1	LOW	5	MODERATE
Munich	132	2	MODERATE	356.04	2	MODERATE	0.00	1	LOW	5	MODERATE
New Rockford	125	1	LOW	303.13	2	MODERATE	27.68	2	MODERATE	5	MODERATE
New Town	120	1	LOW	163.71	1	LOW	58.35	3	HIGH	5	MODERATE
North Burleigh	145	2	MODERATE	200.02	1	LOW	12.64	2	MODERATE	5	MODERATE
Northwest Buried Channel	117	1	LOW	255.74	2	MODERATE	14.66	2	MODERATE	5	MODERATE
Pembina Delta	125	1	LOW	517.64	3	HIGH	0.00	1	LOW	5	MODERATE
Random Creek	163	3	HIGH	188.97	1	LOW	0.00	1	LOW	5	MODERATE
Rosefield	105	1	LOW	368.74	3	HIGH	0.00	1	LOW	5	MODERATE
Shell Creek-Central	134	2	MODERATE	160.63	1	LOW	7.12	2	MODERATE	5	MODERATE
Smoky Butte	117	1	LOW	166.16	1	LOW	103.16	3	HIGH	5	MODERATE
Souris River	138	2	MODERATE	235.15	2	MODERATE	0.96	1	LOW	5	MODERATE
South Branch Beaver Creek	143	2	MODERATE	237.18	2	MODERATE	0.00	1	LOW	5	MODERATE
Spiritwood S	104	1	LOW	319.89	2	MODERATE	33.50	2	MODERATE	5	MODERATE
Spiritwood-Devils Lake	84	1	LOW	313.35	2	MODERATE	33.50	2	MODERATE	5	MODERATE
Spiritwood-Oakes	107	1	LOW	260.80	2	MODERATE	33.49	2	MODERATE	5	MODERATE
Spiritwood-Sheyenne River	112	1	LOW	300.18	2	MODERATE	33.48	2	MODERATE	5	MODERATE
Spiritwood-Stutsman	104	1	LOW	305.17	2	MODERATE	33.50	2	MODERATE	5	MODERATE

ATTACHMENT 2: 2019 GEOGRAPHIC TARGETING SYSTEM RESULTS

Aquifer	Vulnerability Value (Pesticide DRASTIC)	Vulnerability Score	Vulnerability Rating	Sensitivity Value (dollars/farmed acre)	Sensitivity Score	Sensitivity Rating	Risk Value (acre-feet/m ²)	Risk Score	Risk Rating	Total Monitoring Score	Total Monitoring Priority Rating
Strawberry Lake	115	1	LOW	259.43	2	MODERATE	19.31	2	MODERATE	5	MODERATE
Sydney	116	1	LOW	356.92	3	HIGH	0.00	1	LOW	5	MODERATE
Thompson	90	1	LOW	525.30	3	HIGH	0.00	1	LOW	5	MODERATE
Tolgen	153	2	MODERATE	255.65	2	MODERATE	0.00	1	LOW	5	MODERATE
Trenton	121	1	LOW	148.42	1	LOW	41.39	3	HIGH	5	MODERATE
Turtle Lake	146	2	MODERATE	263.76	2	MODERATE	0.00	1	LOW	5	MODERATE
Wildrose	148	2	MODERATE	165.86	1	LOW	2.70	2	MODERATE	5	MODERATE
Wolf Creek	142	2	MODERATE	263.73	2	MODERATE	0.00	1	LOW	5	MODERATE
Zeeland	111	1	LOW	237.19	2	MODERATE	3.10	2	MODERATE	5	MODERATE
Apple Creek	125	1	LOW	188.94	1	LOW	19.12	2	MODERATE	4	LOW
Butte	108	1	LOW	203.89	2	MODERATE	0.00	1	LOW	4	LOW
Columbus	116	1	LOW	192.62	1	LOW	20.62	2	MODERATE	4	LOW
Courtenay	122	1	LOW	356.91	2	MODERATE	0.00	1	LOW	4	LOW
Crosby	100	1	LOW	165.74	1	LOW	5.25	2	MODERATE	4	LOW
Cut Bank Creek S	133	2	MODERATE	186.85	1	LOW	1.06	1	LOW	4	LOW
Dunseith	138	2	MODERATE	202.13	1	LOW	0.00	1	LOW	4	LOW
Elm Creek	95	1	LOW	176.54	1	LOW	7.73	2	MODERATE	4	LOW
Fox Haven	155	2	MODERATE	188.93	1	LOW	0.00	1	LOW	4	LOW
Goodman Creek	117	1	LOW	142.52	1	LOW	22.96	2	MODERATE	4	LOW
Heart River	124	1	LOW	184.66	1	LOW	6.32	2	MODERATE	4	LOW
Hiddenwood Lake	117	1	LOW	257.47	2	MODERATE	0.00	1	LOW	4	LOW
Horse Nose Butte	98	1	LOW	120.89	1	LOW	7.68	2	MODERATE	4	LOW
Keene	110	1	LOW	107.40	1	LOW	17.10	2	MODERATE	4	LOW
Killdeer	122	1	LOW	150.68	1	LOW	20.35	2	MODERATE	4	LOW
Leeds	109	1	LOW	300.24	2	MODERATE	0.00	1	LOW	4	LOW
Little Heart	110	1	LOW	183.39	1	LOW	11.35	2	MODERATE	4	LOW
Long Lake	92	1	LOW	202.05	1	LOW	13.39	2	MODERATE	4	LOW
Otter Creek	119	1	LOW	216.10	2	MODERATE	0.00	1	LOW	4	LOW
Ray	115	1	LOW	167.81	1	LOW	24.30	2	MODERATE	4	LOW
Renner	108	1	LOW	152.40	1	LOW	10.72	2	MODERATE	4	LOW
Ryder Ridge	120	1	LOW	255.66	2	MODERATE	0.00	1	LOW	4	LOW
Shields	92	1	LOW	134.26	1	LOW	3.59	2	MODERATE	4	LOW
Snake Creek	123	1	LOW	262.94	2	MODERATE	0.00	1	LOW	4	LOW

ATTACHMENT 2: 2019 GEOGRAPHIC TARGETING SYSTEM RESULTS

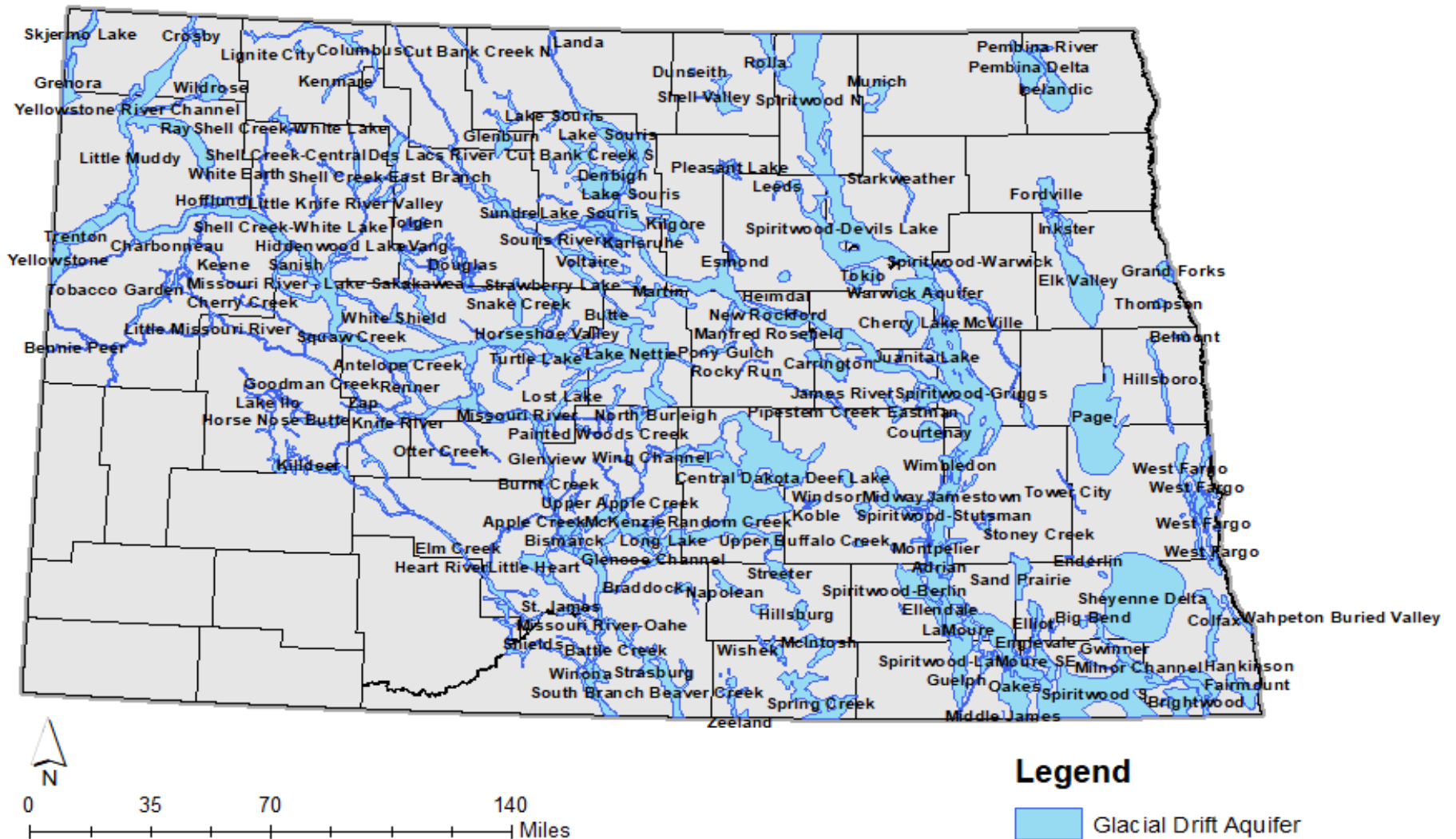
Aquifer	Vulnerability Value (Pesticide DRASTIC)	Vulnerability Score	Vulnerability Rating	Sensitivity Value (dollars/farmed acre)	Sensitivity Score	Sensitivity Rating	Risk Value (acre-feet/m ²)	Risk Score	Risk Rating	Total Monitoring Score	Total Monitoring Priority Rating
Starkweather	116	1	LOW	338.29	2	MODERATE	0.00	1	LOW	4	LOW
Weller Slough	108	1	LOW	263.73	2	MODERATE	0.00	1	LOW	4	LOW
West Wildrose	101	1	LOW	167.43	1	LOW	16.34	2	MODERATE	4	LOW
White Earth	153	2	MODERATE	160.54	1	LOW	0.00	1	LOW	4	LOW
Wing Channel	93	1	LOW	188.97	1	LOW	3.11	2	MODERATE	4	LOW
Yellowstone River Channel	113	1	LOW	166.85	1	LOW	26.77	2	MODERATE	4	LOW
Zap	135	2	MODERATE	152.38	1	LOW	0.00	1	LOW	4	LOW
Battle Creek	109	1	LOW	109.50	1	LOW	0.00	1	LOW	3	LOW
Beaver Creek N	122	1	LOW	110.04	1	LOW	0.00	1	LOW	3	LOW
Bennie Peer	108	1	LOW	107.28	1	LOW	0.00	1	LOW	3	LOW
Dry Fork Creek	114	1	LOW	167.85	1	LOW	0.00	1	LOW	3	LOW
Estevan	100	1	LOW	165.75	1	LOW	0.00	1	LOW	3	LOW
Kenmare	110	1	LOW	176.56	1	LOW	0.00	1	LOW	3	LOW
Sanish	129	1	LOW	162.79	1	LOW	0.00	1	LOW	3	LOW
Squaw Creek	101	1	LOW	115.32	1	LOW	0.00	1	LOW	3	LOW
St. James	113	1	LOW	154.84	1	LOW	0.00	1	LOW	3	LOW

ATTACHMENT 3: 2019 GEOGRAPHIC TARGETING SYSTEM MAP FIGURES

ATTACHMENT 3

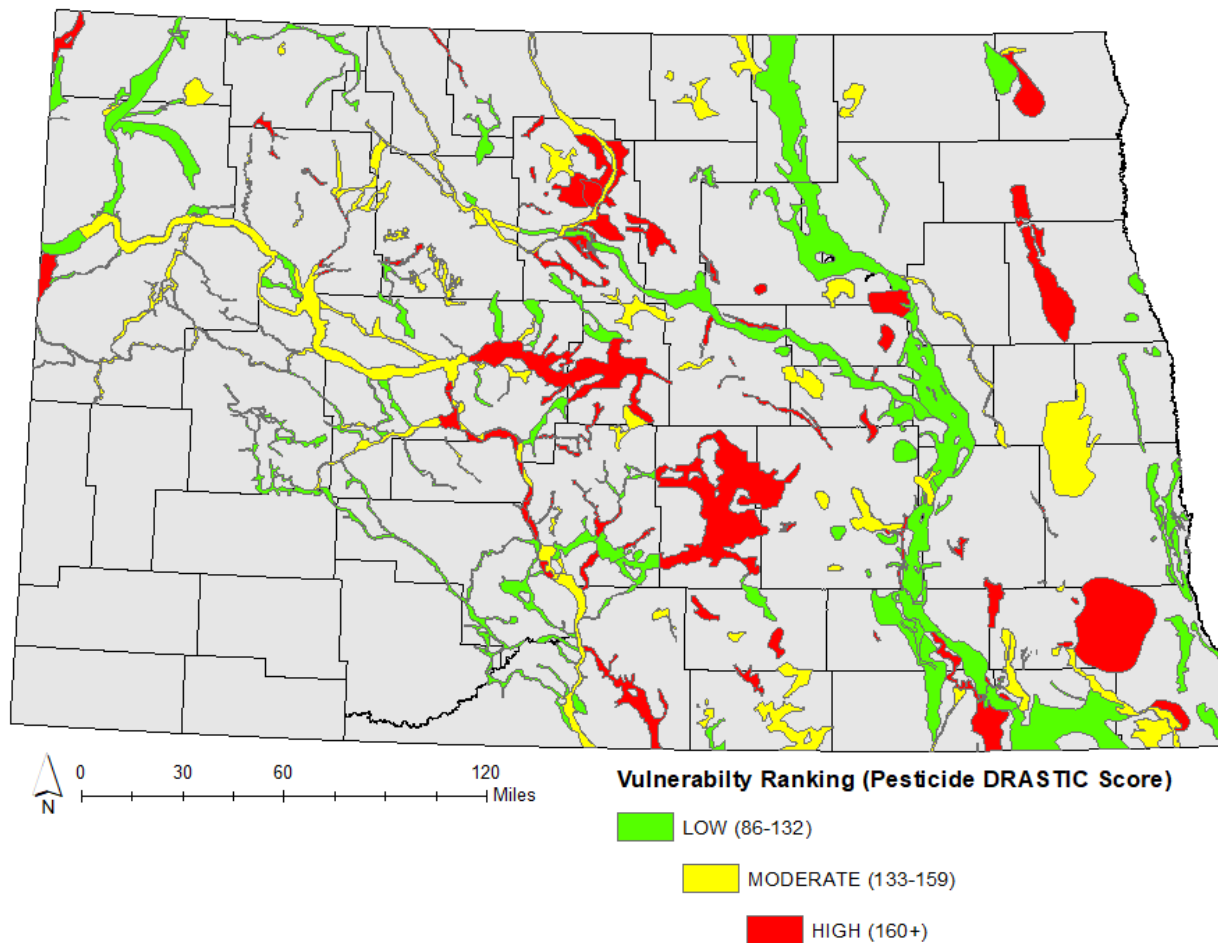
2019 GEOGRAPHIC TARGETING SYSTEM MAP FIGURES

Glacial Drift Aquifers of North Dakota



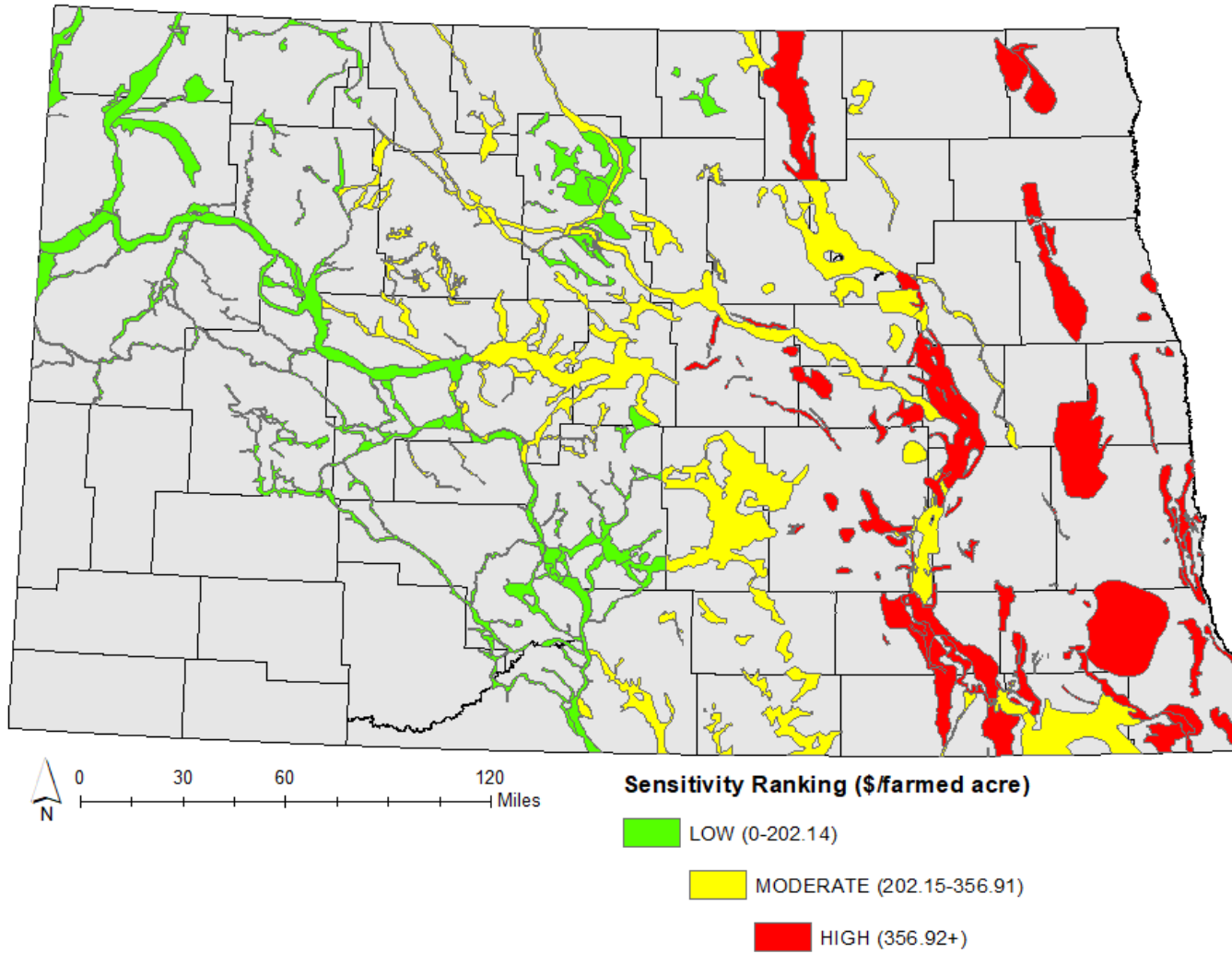
Vulnerability Results

Pesticide DRASTIC Model



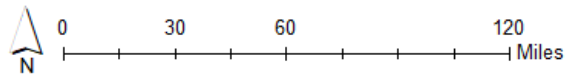
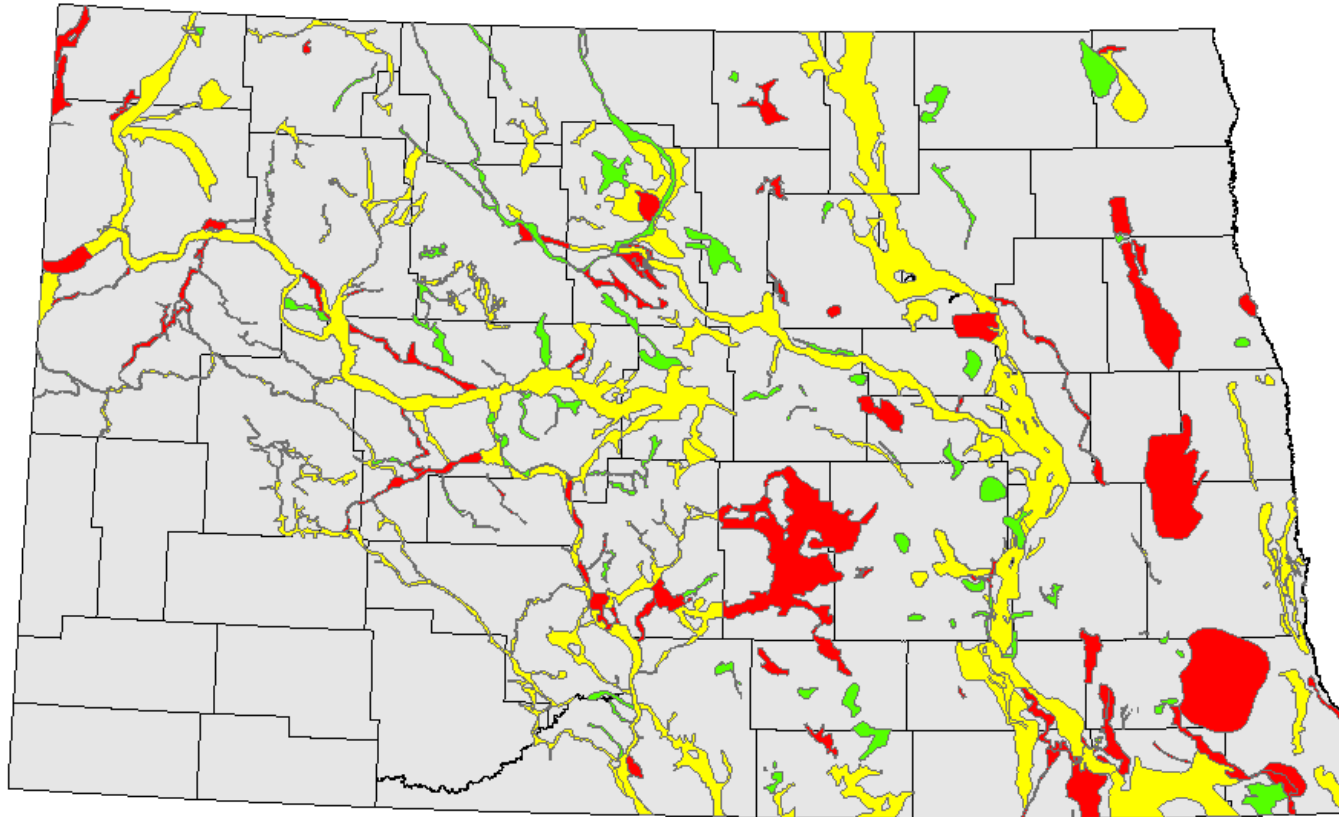
Sensitivity Results

Agricultural Sales per Farmed Acre



Risk Results

2016 Aquifer Appropriations per Square Mile

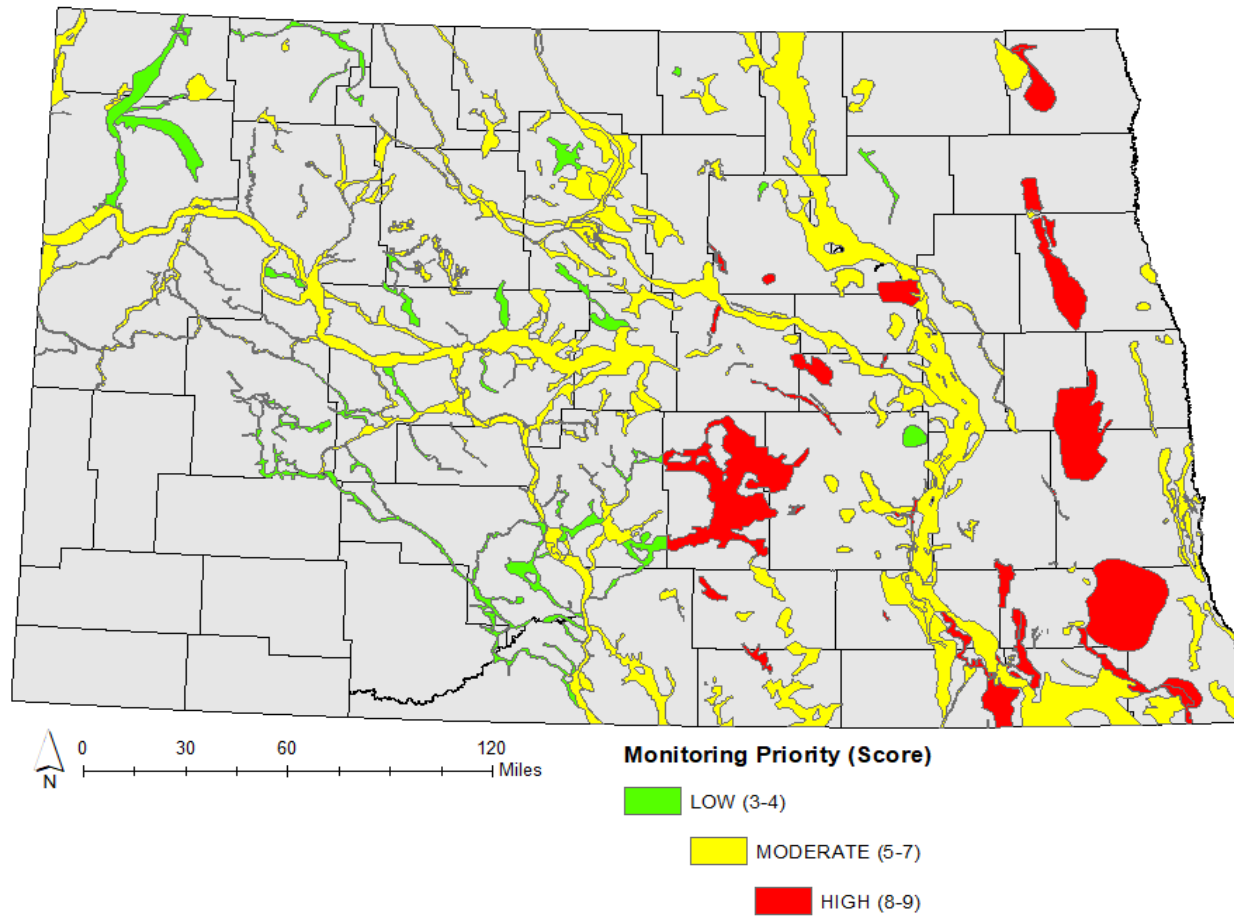


Risk Ranking (acre-feet/sq. mile)

- LOW (0-1.24)
- MODERATE (1.244-33.51)
- HIGH (33.52+)

ATTACHMENT 3: 2019 GEOGRAPHIC TARGETING SYSTEM MAP FIGURES

Total Monitoring Score



Change in Aquifer Monitoring Priority

(1997-2018)

