# SHALLOW GAS FIELD SCREENING IN NORTH DAKOTA: FIELD DATA REPORT (2009 & 2010) FOR SELECTED COUNTIES

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**GEOLOGIC INVESTIGATIONS NO. 131**
**NORTH DAKOTA GEOLOGICAL SURVEY**
**Edward C. Murphy, State Geologist**
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**On the cover: Geologic field technician Brian N. Hall conducting shallow gas field screening on a shallow, ground-water observation well located in Cass County, North Dakota.**

**Acknowledgements**

The author would like to acknowledge the work of our 2009 and 2010 field season geologic technician field staff: Cassie Gudmunsen, Brian Hall, Adam Ries, Allison Christensen, and Bailey Bubach. Their thorough and consistent field work facilitated the timely and efficient completion of this geologic investigation. Their efforts have helped to create a comprehensive accounting of shallow gas occurrences found in monitoring wells across the state which will support future oil and gas related investigations.

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## BACKGROUND

### Introduction

Field screening for shallow gas occurrences in wells was first considered as an applicable field oil & gas exploration investigative activity during initial project planning discussions at the NDGS and Department of Mineral Resources, conducted in early 2005. These discussions were focused on activities and investigations supportive of an assessment of a potential shallow gas resource in central and eastern North Dakota.

It was known historically that shallow gas had been found in water wells in the north-central part of the state, in Renville and Bottineau Counties, and in the southeastern part of the state near LaMoure and Edgeley (Barry, 1908). Based on this, it was decided to investigate whether or not shallow gas may be occurring in currently existing wells, and if so, extend this work into areas where shallow gas occurrences have not previously been documented.

Since the locations of readily accessible observation wells and ground-water monitoring networks, maintained by the North Dakota State Water Commission (NDSWC), were well known; it was decided to embark on a reconnaissance style field screening investigation that could quickly deliver potentially useful shallow gas exploration information on potential shallow gas occurrence and distribution, particularly in the central and eastern portions of the state.

Field work was conducted in 18 selected counties during the 2006 – 2008 field season (Figure 1). In early 2009, it was decided to expedite the completion of this investigation and also explore the additional technical objective of expanding the work into the coal containing counties in western North Dakota. The bulk of the remaining shallow gas field screening work was completed (30 counties) in 2009 with the help of the addition of four geologic field technicians, who worked independently in the southeastern, northwestern, southwestern, and northeastern parts of the state. Field screening work in 2010 was completed by a single geologic field technician for the four remaining counties: Grand Forks, Walsh, Pembina, and Dickey. No field screening work was performed in Sioux County.

This report provides the field data collected during shallow gas field screening work completed in 2009 and 2010 and is intended as a supporting document to be used with the respective 1:150,000 scale county shallow gas field screening maps and to previously published shallow gas related investigative works (Anderson, 2009a & b, Anderson and Hall, 2009a-c, Anderson and Gudmunsen, 2009, Anderson and Ries, 2009, Anderson and others, 2009, Anderson, 2010a & b, Anderson and Bubach, 2010a-d, Anderson and Christensen, 2010a-c, Anderson and Gudmunsen, 2010a-j, Anderson and Hall, 2010a-d, Anderson and Ries, 2010a-f, Anderson and others, 2010).

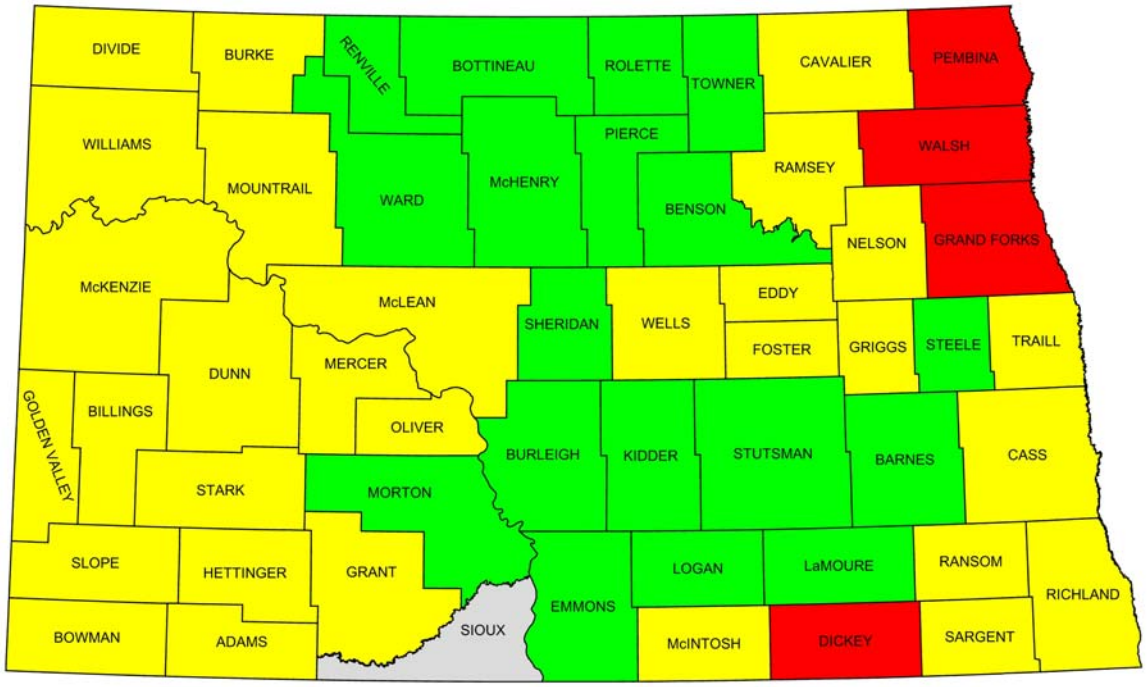


**Figure 1. Counties in North Dakota where shallow gas field screening was completed in: 2006 to 2008 (green), 2009 (yellow), and 2010 (red).**

## FIELD SCREENING METHODOLOGY

### Instrumentation

A Photovac Micro Flame-Ionization Detector (FID) was selected for use in this investigation based on durability, consistency within seasonal field screening, ease of calibration, overall reliability, and the author's previous experience with portable electronic gas monitoring instrumentation. The FID is a portable analytical instrument that analyzes total combustible organic compounds. Since this instrument is a total combustible compound meter, as such it is not compound specific. Any hydrocarbons present will be ignited and effectively "read" by the detector.

### FID Specifications

The portable FID is around two feet in length and weighs only around eight pounds. The operating temperature range is from 41°F to 105°F in a non-condensing humidity range of 0 to 100%. The FID operates in a low concentration range of 0.5 parts per million (ppm) to 2000 ppm (as methane in air) and in a high concentration range of 10 ppm to 50,000 ppm with an accurary of 0.5 ppm within plus or minus 0.5 ppm or plus or minus 10% of the actual methane concentration when operating in the low (0.5 ppm to 2000 ppm) concentration range. FID instrument precision is plus or minus 0.3 ppm or plus or minus 5% when operating within both the low and high concentration ranges (Photovac, 2007). The instrument response time is effectively immediate.

***Figure 2. Photovac portable Flame Ionization Detector (FID) used in this investigation.***

### Operation and Calibration

The FID operates by pyrolyzing an influent sample of gas and measuring the electronic conductivity of the ionic intermediates produced. The portable FID instrument used in this investigation operates on an internal hydrogen gas supplied flame source. Hydrogen was added to the FID when levels indicated that the interal hydrogen cylinder was in need of charging. Since the intent of this investigation was to detect the presence of shallow natural gas in North Dakota, the FID was intentionally calibrated by bag calibration methods to a predetermined concentration of methane (i.e. $CH_4$ or C1) in air. A gas concentration of 100 ppm (C1 in air) was used as the standard calibration for field screening. If a detected concentration was outside of the calibrated range of response, then the FID was recalibrated to a concentration of 10,000 ppm (C1 in air) as a high span calibration, and the measurement repeated in order to collect a more accurate reading at the well. The FID was calibrated in the morning prior to first use, in the afternoon around mid-day, or at major changes in atmospheric conditions (e.g., warming up during the day, cooling down in the evening), and at the end of daily use in accordance with the manufacturer's specifications.

## Field Screening Procedures at the Well

Upon arrival at each well location, the FID was monitored as each well was approached in order to potentially detect any C1 emitting from the area around the well site. The well's cap (if present) was removed and a reading collected from the top of the well casing (TOC) and recorded (Figure 3). Depending on the anticipated ground-water level within the well, an extended sample probe made of polyethylene was lowered into the well at a level just above the groundwater-atmospheric interface (GWI) (Figure 4). An appropriate amount of elapsed time was recorded in order to account for the sample to be drawn up the line to the FID based on the total amount of extended sample line lowered into the well. At the calculated time, FID instrument response as the highest reading reached (as C1 in ppm) was recorded. The sample probe was then removed from the well and a depth to water measurement was taken and recorded in the well from the TOC to the water level in the well with an electronic well tape. This information was entered immediately into a spreadsheet database in the field.

*Figure 3.*

*Figure 4.*

***Figures 3 and 4. The author conducting FID field screening at the TOC in an observation well in Stutsman County, North Dakota (Fig. 3 at left) and collection of field screening readings from the groundwater/atmospheric interface in an observation well in Burleigh County (Fig. 4 at right) with the FID fitted with an extended sample line consisting of 3/8" polyethylene tubing.***

This procedure was repeated at each well location throughout the investigation. Any positive readings on the instrument were field checked by repeating the measurement at each location and by measuring a calibration gas spike to demonstrate continued accuracy during field screening. Occasionally, a grab type ground-water sample was collected from a well if the well was under artesian conditions and a positive shallow gas field screening result was measured.

## Collection of Water-Level Measurements

Depth to water measurements (in feet) were taken at each well field screened where a positive FID instrument response was recorded. A total depth of well measurement was also consecutively collected, when required, in order to identify individual wells within well nests that were not readily identifiable in the field. All ground-water level measurements were collected with an electronic well tape during field screening.

***Figure 5. Measurement of ground-water level in an observation well in Emmons County, North Dakota with an electronic well tape.***

## Atmospheric Data Collection

After the 2006 field season, it was learned that collecting additional meteorological data during the field screening process at each well may reveal some interesting relationships between shallow gas flux within an individual well from aquifer to atmosphere. Thus, in the 2007 and 2008 field screening work, field measurements of temperature and pressure were collected at each well location where a positive FID instrument response was recorded.

***Figure 6. Field instrumentation used for the collection of atmospheric pressure and temperature.***

### Temperature

A single measurement of air temperature in the vicinity of the well in degrees Fahrenheit ($^{o}$F) was collected after the field screening procedure was completed with a Hanna Instruments thermocouple temperature probe. Individual measurements were collected and entered directly into an electronic spreadsheet database at the time of collection.

### Atmospheric Pressure

Single measurements of atmospheric pressure in millibars (mB) were also collected at the well site with a portable electronic barometer and altimeter at the completion of field screening. Measurements were collected and recorded in a similar fashion as were temperature readings.

## DESCRIPTION OF SHALLOW GAS FIELD SCREENING WORK

The concept of using portable analytical instrumentation to field screen wells for the presence of methane (C1) (i.e., shallow gas) was formulated during project discussions in the early spring of 2006 at the NDGS. Field screening ground-water observation wells throughout eighteen selected counties in North Dakota was completed during the latter parts of the 2006, 2007, and the 2008 field seasons and is summarized in Anderson (2009a). This "second phase" of the field screening project encompassed the field screening of the remaining 34 counties not visited during the first phase of the project.

Four geosciences students from the N.D. University System were hired as field geologic technicians for the 2009 field season, where 30 counties were completed, and one was hired for remaining field screening work (four counties) during the 2010 field season (Figure 7). Each technician was trained on field methods and instrumentation on repeated surveys of ground-water wells in Burleigh County and counties within each field technician's area of responsibility. Subsequently, each technician was deployed to their respective field areas.

This facilitated shallow gas field investigative program objectives, by (1) providing a consistent temporal set of shallow gas field screening data to evaluate for a single area, in this case southern Burleigh County, and (2) allowed field staff to begin field screening data collection contemporaneously with field training.

A total of over 6,500 individual observation well locations were investigated during this second phase of ground-water well field screening work. Monitoring and stock supply well locations were collected and compiled from an office review of the well location and construction information available from existing databases, well records, and publications. This information was plotted on field maps at a scale of 1:100,000 that were overlain onto a digital photographic base map. These maps were used, along with electronic database files, for well location and identification in the field and during the field screening process for data collection and compilation.

### Shallow Gas Field Screening Conducted in 2009

This second phase of shallow gas field-screening program was initiated in May, 2009 in southeastern North Dakota in Cass County. As field staff became trained and available, field screening was initiated in northwestern, southwestern and north-central North Dakota (Figures 8, 9, & 10, respectively). During the 2009 field season, a total of 5,148 wells were investigated which resulted in 2,048 wells being visited in the field and field screened for shallow gas. The difference between the amount of wells investigated and the amount of wells visited in the field is that many of the wells on record do not exist in their respective field locations as many have most likely been abandoned through non-use or simply destroyed by agricultural practices (e.g., tractors and haying). FID instrument responses consistent with a shallow gas occurrence were found at 511 of the wells field screened. The balance, 1,537 wells, showed no response. A brief discussion of the results of field screening for each county investigated in 2009, follows.

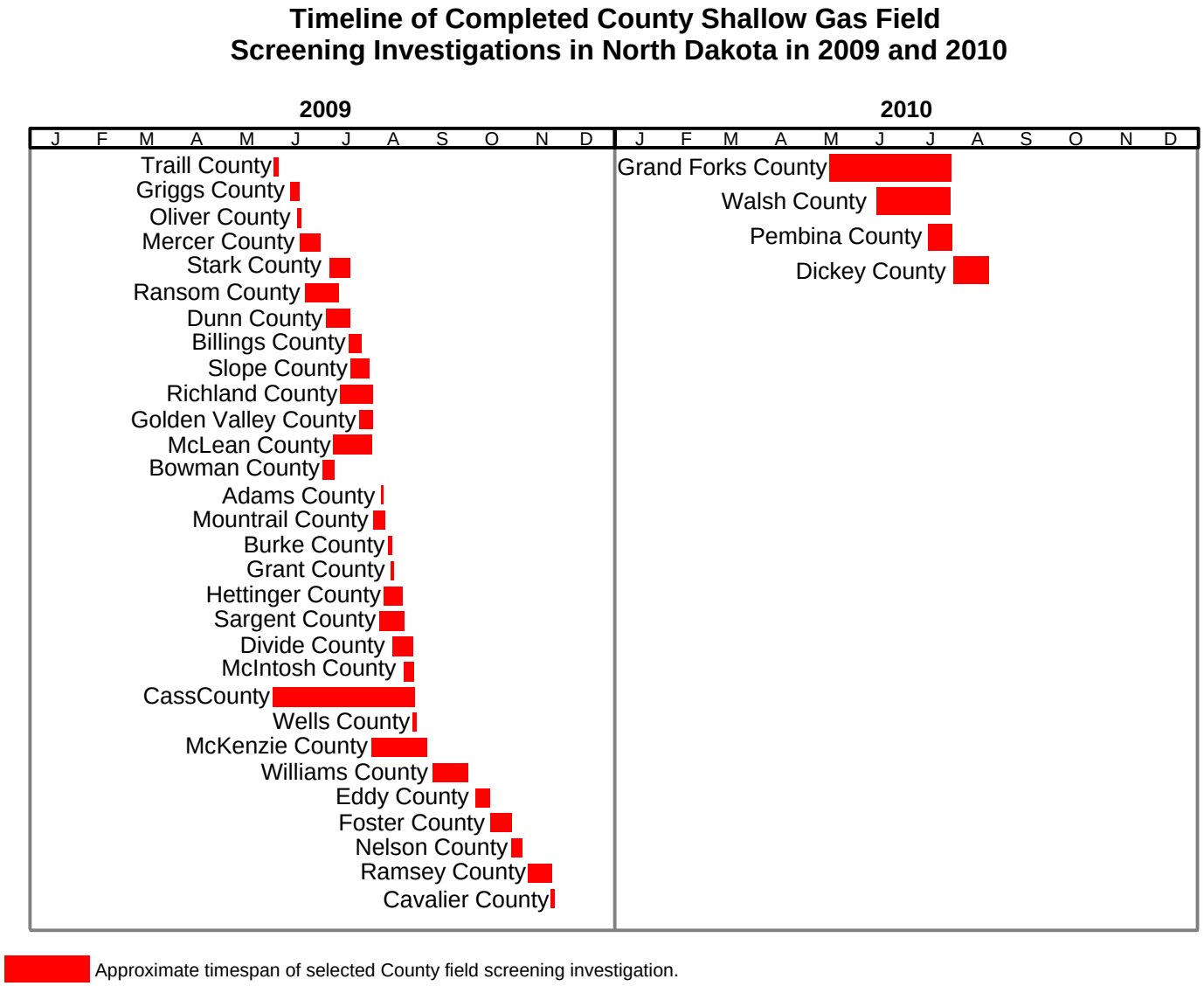


**Figure 7. Generalized timeline of occurrence for shallow gas field screening investigations completed on selected counties in North Dakota in 2009 and 2010.**

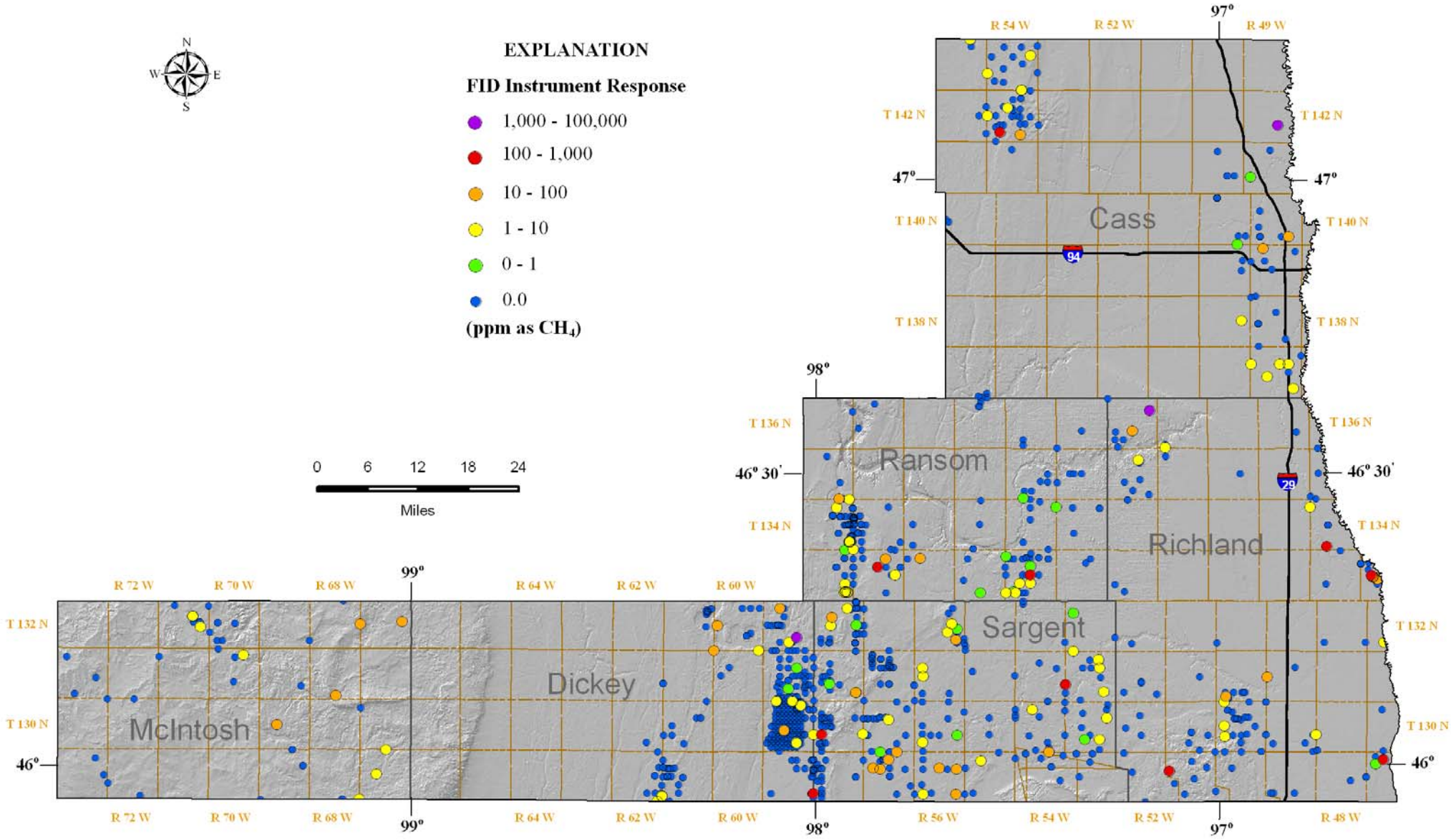


**Figure 8. Locations of FID shallow gas occurrences in southeastern North Dakota.**

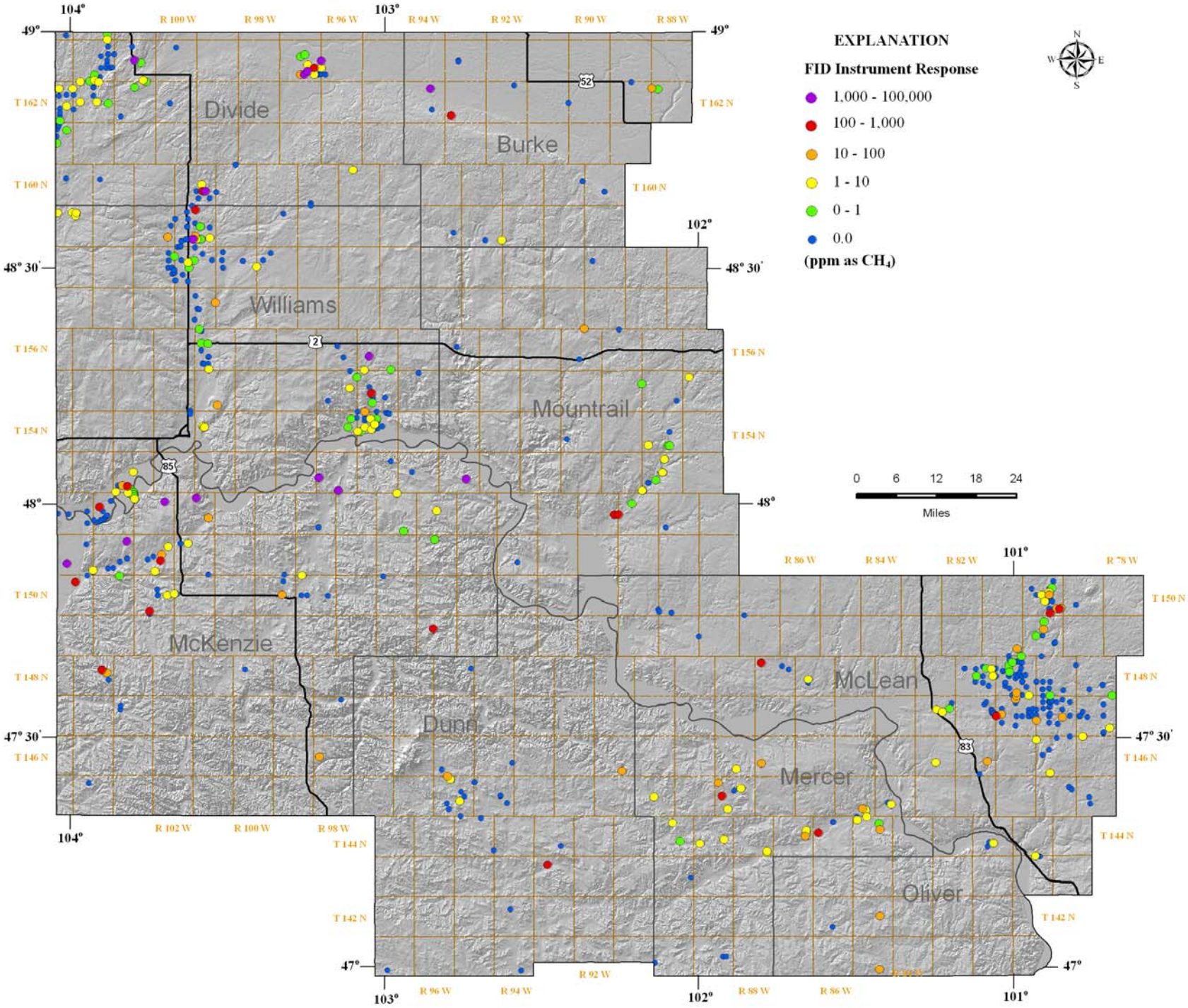


**Figure 9. Locations of FID shallow gas occurrences in northwestern North Dakota.**

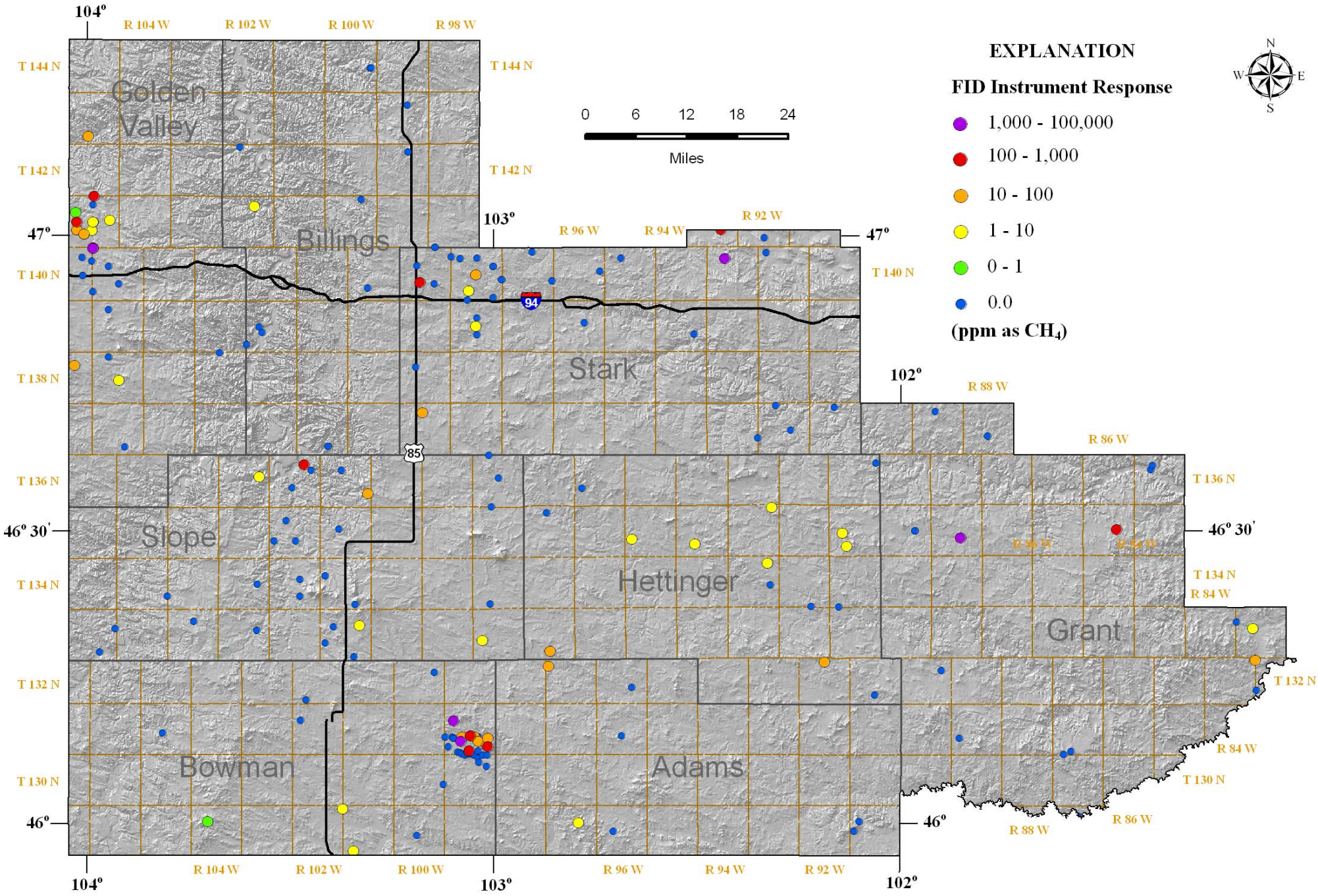


**Figure 10. Locations of FID shallow gas occurrences in southwestern North Dakota.**

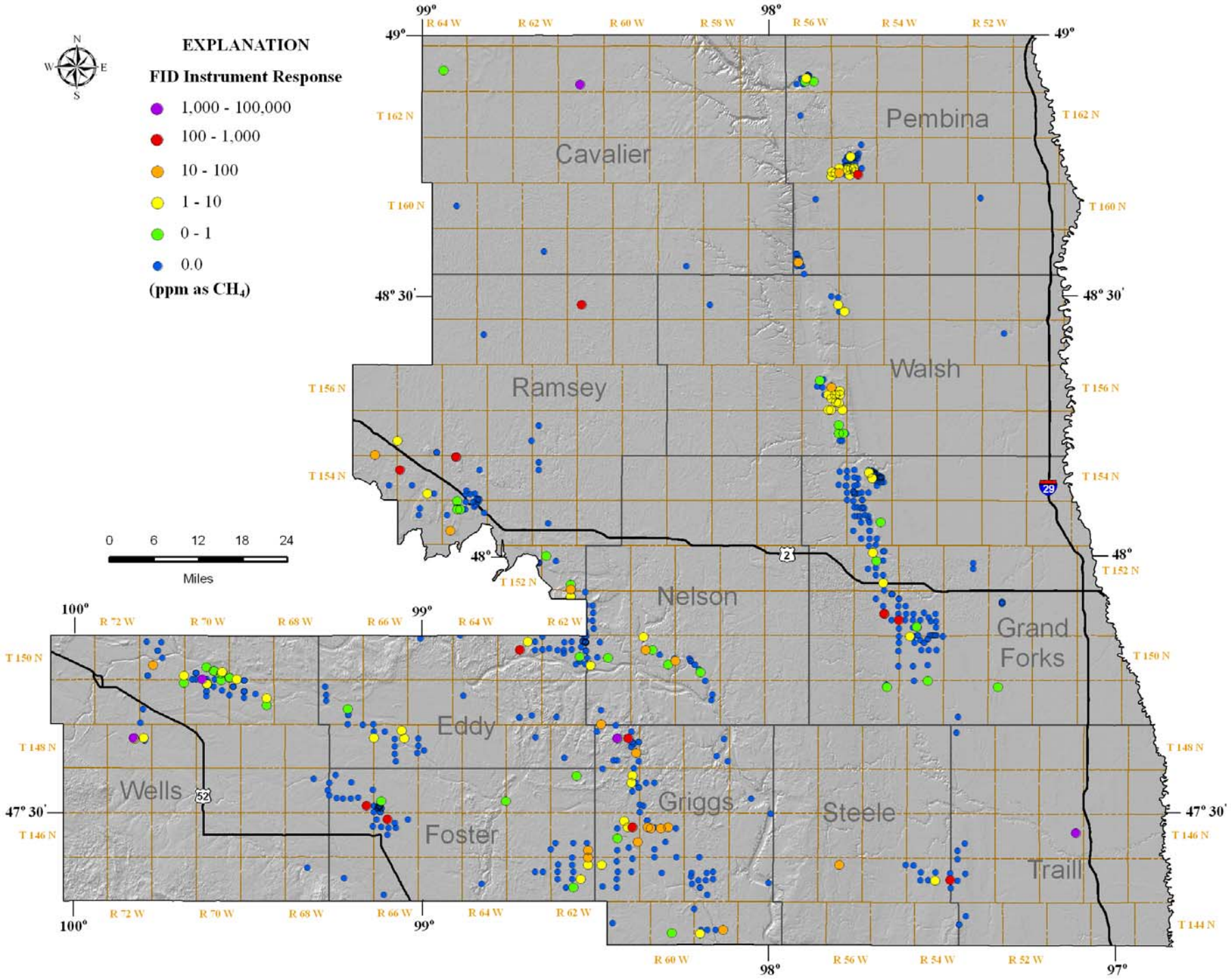


**Figure 11. Locations of FID shallow gas occurrences in northeastern North Dakota.**

**Traill County**

Field screening in Traill County was conducted over a three-day period on May 19, 20, & 22, 2009. Site information for 39 wells was reviewed prior to field investigation, which resulted in 11 wells being field screened. Of these, one stock well (146-51-13CBB1), located approximately four miles northwest of Hillsboro, returned an FID response of 1,075 ppm as C1 (Figure 12) at the GWI (Table 1). This well is most likely completed within the Hillsboro Aquifer (Appendix I) which traverses the center of the county, along a generally north to south trend. 17 wells were not found suggesting that these wells have either been abandoned or destroyed.

**Griggs County**

Field screening in Griggs County was conducted from May 28 through June 3, 2009. Site information for 128 well sites was reviewed prior to field investigation which resulted in 90 wells being field screened. Of these, 20 returned positive FID responses (Table 2), ranging from 0.2 to 2,063 ppm as C1 (Figure 13). The remaining 70 wells showed no response (i.e., 0.0 ppm). Wells with positive FID responses are distributed primarily in the northwestern portion of the county in the Spirtwood Aquifer (Appendix I). 14 wells were not found.

**Oliver County**

Field screening was conducted in Oliver County from June 3-5, 2009. Site information for 68 wells was reviewed prior to field investigation, which resulted in 35 wells being visited in the field. Of these, seven were field screened (Table 3). Two of the four stock well locations visited in the field were found to have wells present but were not tested due to well non-use and access constraints. Of the remaining testable wells field screened, three observation wells returned positive FID responses of 28 ppm (142-85-14CCC) measured at the TOC, 21.2 ppm (142-85-27DDD), and 1.8 ppm (144-82-27BBB1) measured at the GWI (Figure 14). 28 wells were not found.

**Mercer County**

Field screening in Mercer County, was conducted over a ten day period from June 5-18, 2009. Site information for 117 wells was reviewed prior to field investigation, which resulted in 38 wells being field screened. Of these, 24 returned positive FID responses (Table 4), ranging from 0.3 to 311.7 ppm as C1 (Figure 15). Three wells were found to have detectable concentrations of C1 at both the TOC and GWI. Well 144-87-14DDC recorded a concentration of 0.1 ppm at the TOC. Well 144-87-14ADD recorded a concentration of 0.4 ppm at the TOC. Well 145-88-10DDA recorded a concentration of 1.0 ppm at the TOC. Wells with positive FID responses are variably distributed throughout the northern portion of the county in the Knife River and Goodman Creek Aquifers (Appendix I).

**Table 1. Field screening information collected from ground-water observation wells in Traill County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **S-14605113CBB1** | 5/22/09 | 13:00 | 0.0 | 1,075 | 11.00 | 81.4 | 1,054 |

S- = Stock Well
TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

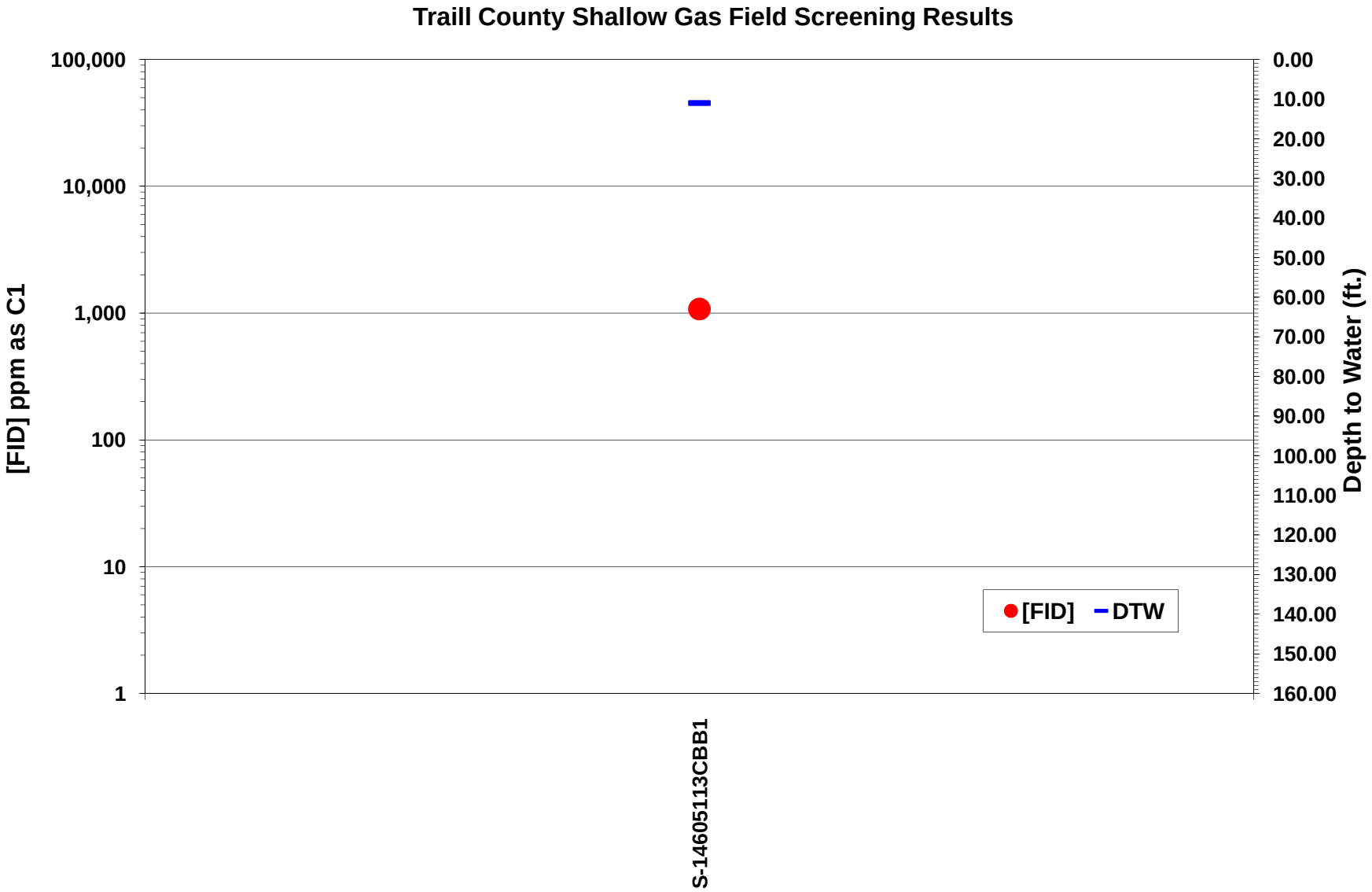


**Figure 12. Shallow gas field screening results in Traill County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.**

**Table 2. Field screening information collected from ground-water observation wells in Griggs County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **14806111DCC2** | 05/26/09 | 14:31 | 0 | 230 | NM | 61.00 | 1,030 |
| **14806110CCC2** | 05/26/09 | 16:58 | 0 | 2,063 | NM | 62.50 | 1,028 |
| **14806110CCC3** | 05/26/09 | 16:58 | 0 | 27.9 | NM | 62.50 | 1,028 |
| **14806124DCC** | 05/26/09 | 17:50 | 0 | 16.1 | NM | 64.00 | 1,029 |
| **14706101CCC** | 05/27/09 | 16:20 | 0 | 8.3 | 26.77 | 72.50 | 1,026 |
| **14706111DDD** | 05/27/09 | 16:48 | 0 | 3.3 | 14.64 | 71.40 | 1,026 |
| **14606110AAA2** | 05/28/09 | 14:33 | 0 | 8.2 | 28.58 | 76.20 | 1,029 |
| **14606111CDD** | 05/28/09 | 15:25 | 0 | 8.8 | 24.68 | 76.60 | 1,029 |
| **14606112CCC2** | 05/28/09 | 15:44 | 0 | 756 | 13.00 | 75.30 | 1,031 |
| **14606112CCC1** | 05/28/09 | 15:44 | 0 | 9.6 | 16.60 | 75.30 | 1,031 |
| **14606008CCD** | 05/28/09 | 16:36 | 0 | 25.4 | 31.98 | 69.20 | 1,031 |
| **14606017ABB** | 05/28/09 | 16:51 | 0 | 19.2 | 30.18 | 68.80 | 1,030 |
| **14606016AAA** | 05/28/09 | 17:18 | 0 | 13.8 | 28.38 | 66.50 | 1,030 |
| **14606010DDD** | 05/28/09 | 17:27 | 0 | 52.9 | 11.60 | 65.40 | 1,031 |
| **14606124DDC** | 05/29/09 | 8:30 | 0 | 31.7 | 24.46 | 56.00 | 1,033 |
| **14606122BCC** | 05/29/09 | 8:51 | 0.2 | 0.2 | 24.82 | 58.00 | 1,032 |
| **14506107AAA** | 05/29/09 | 10:38 | 0 | 6.5 | 18:32 | 66.00 | 1,030 |
| **14405923CCC** | 06/02/09 | 19:10 | 0 | 22 | 87.34 | 57.00 | 1,022 |
| **14406027BCB1** | 06/03/09 | 14:05 | 0 | 0.3 | 13.64 | 68.00 | 1,024 |
| **14405930ADD** | 06/03/09 | 14:36 | 0 | 5.3 | 46.42 | 71.00 | 1,022 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
NM = Not Measured
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

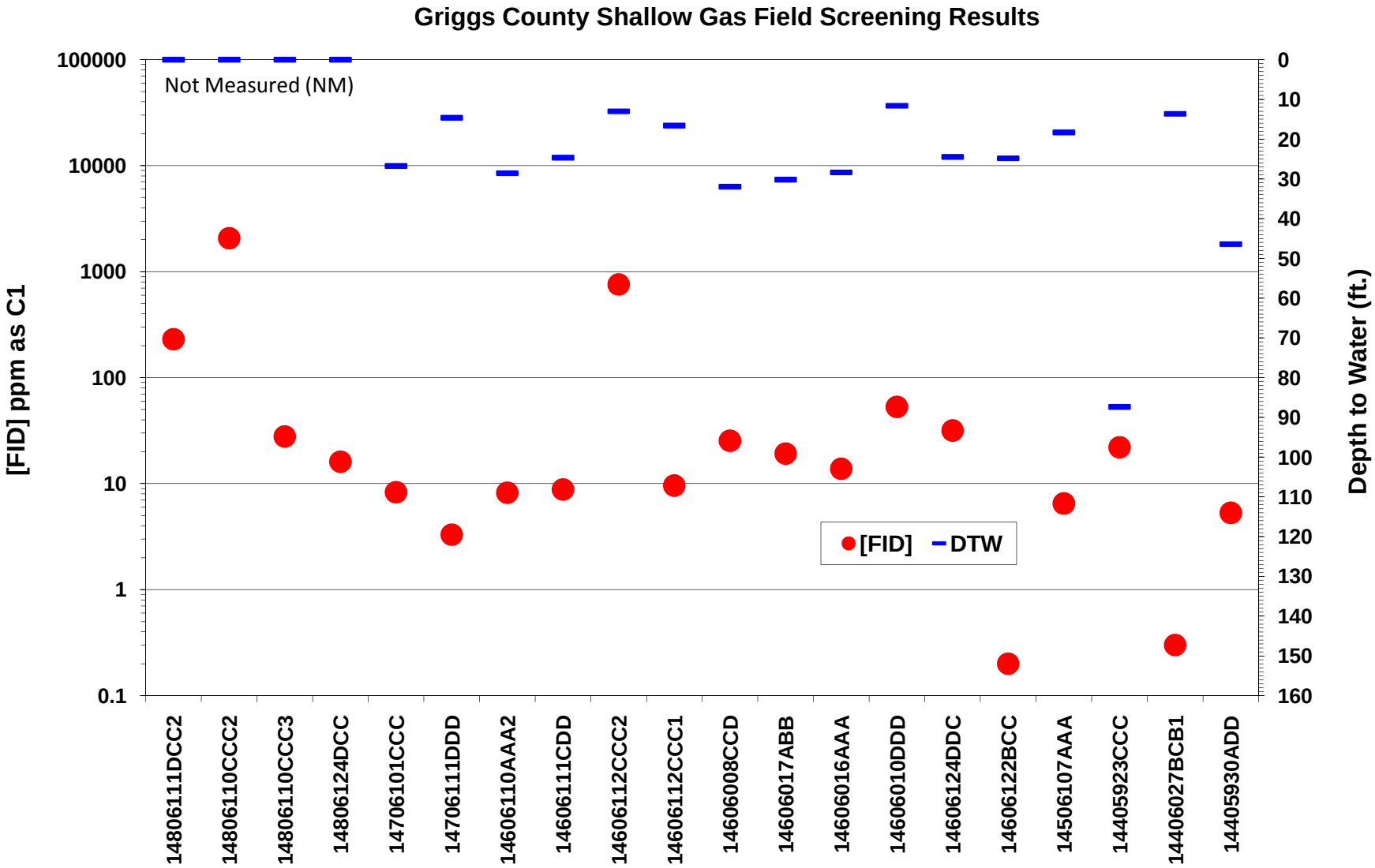


**Figure 13. Shallow gas field screening results in Griggs County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.**

**Table 3. Field screening information collected from ground-water observation wells in Oliver County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **14108527DDD** | 06/03/09 | 9:26 | 0.0 | 21.2 | 34.98 | 78.9 | 1,011 |
| **14208514CCC** | 06/03/09 | 10:10 | 28 | NM | NM | 69.1 | 1,015 |
| **14408227BBB1** | 06/03/09 | 13:21 | 0.0 | 1.8 | 15.31 | 80.3 | 1,025 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
NM = Not Measured
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

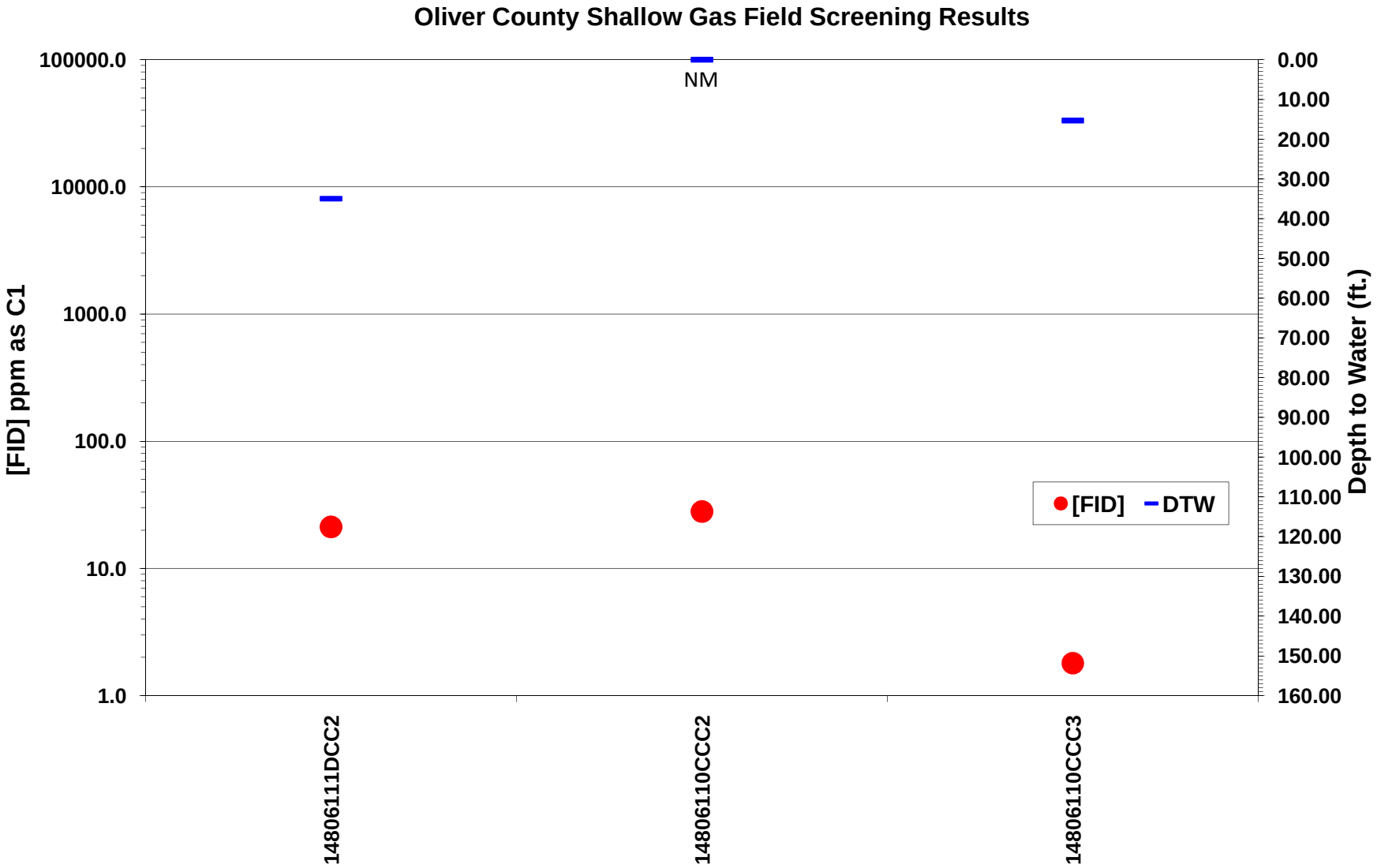


**Figure 14. Shallow gas field screening results in Oliver County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. NM = Not Measured.**

**Table 4. Field screening information collected from ground-water observation wells in Mercer County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **14408714AAA** | 06/05/09 | 14:13 | 0.0 | 4.5 | 18.67 | 67.7 | 950 |
| **14408714ADD** | 06/05/09 | 14:41 | 0.4 | 1.8 | 26.07 | 83.1 | 952 |
| **14408511CCC** | 06/05/09 | 15:17 | 0.0 | 17.7 | 38.40 | 68.6 | 951 |
| **14408510AAA** | 06/05/09 | 15:43 | 0.0 | 0.6 | 56.24 | 71.6 | 952 |
| **14408836BBC2** | 06/08/09 | 9:58 | 0.0 | 3.3 | 18.85 | 55.5 | 937 |
| **14408836BCC** | 06/08/09 | 9:58 | 0.0 | 3.3 | 18.85 | 55.5 | 937 |
| **14509021AAA1** | 06/08/09 | 12:32 | 0.0 | 2.8 | 4.85 | 60.4 | 938 |
| **14409004DDC** | 06/08/09 | 13:12 | 0.0 | 1.3 | 10.20 | 56.4 | 938 |
| **14409022DAD** | 06/08/09 | 13:36 | 0.0 | 0.3 | 35.02 | 61.2 | 940 |
| **14408930AAA** | 06/08/09 | 13:59 | 0.0 | 5.6 | 82.86 | 60.0 | 939 |
| **14608827CCD** | 06/09/09 | 9:39 | 0.0 | 6.8 | 11.04 | 57.2 | 946 |
| **14508810DDA** | 06/09/09 | 10:16 | 1.0 | 0.7 | 32.63 | 58.1 | 942 |
| **14608730AAA** | 06/10/09 | 8:36 | 0.0 | 56.2 | 129.80 | 51.4 | 945 |
| **14508817CCC** | 06/10/09 | 9:20 | 0.0 | 311.7 | 188.96 | 70.7 | 936 |
| **14508806DCC** | 06/10/09 | 9:55 | 0.0 | 41 | 224.50 | 70.0 | 933 |
| **14508829DDD** | 06/10/09 | 11:10 | 0.0 | 5.5 | 139.71 | 74.1 | 937 |
| **14408618ADC2** | 06/10/09 | 13:00 | 0.0 | 109.3 | 20.47 | 78.0 | 950 |
| **14408506DBA1** | 06/10/09 | 14:54 | 0.0 | 6.9 | 43.75 | 82.7 | 950 |
| **14508526CCB** | 06/10/09 | 16:06 | 0.0 | 32.8 | 2.34 | 71.4 | 950 |
| **14508535ABB** | 06/10/09 | 16:23 | 0.0 | 2.4 | 3.54 | 71.3 | 950 |
| **14408504BBB** | 06/10/09 | 17:28 | 0.0 | 2.2 | 15.15 | 69.5 | 950 |
| **14508428BAD** | 06/11/09 | 9:28 | 0.0 | 7.3 | 25.49 | 68.2 | 952 |
| **14408714DDC** | 06/15/09 | 12:00 | 0.1 | 11 | 44.10 | 76.4 | 941 |
| **14408923ACC1** | 06/17/09 | 13:47 | 0.0 | 1.6 | 32.49 | 82.3 | 938 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

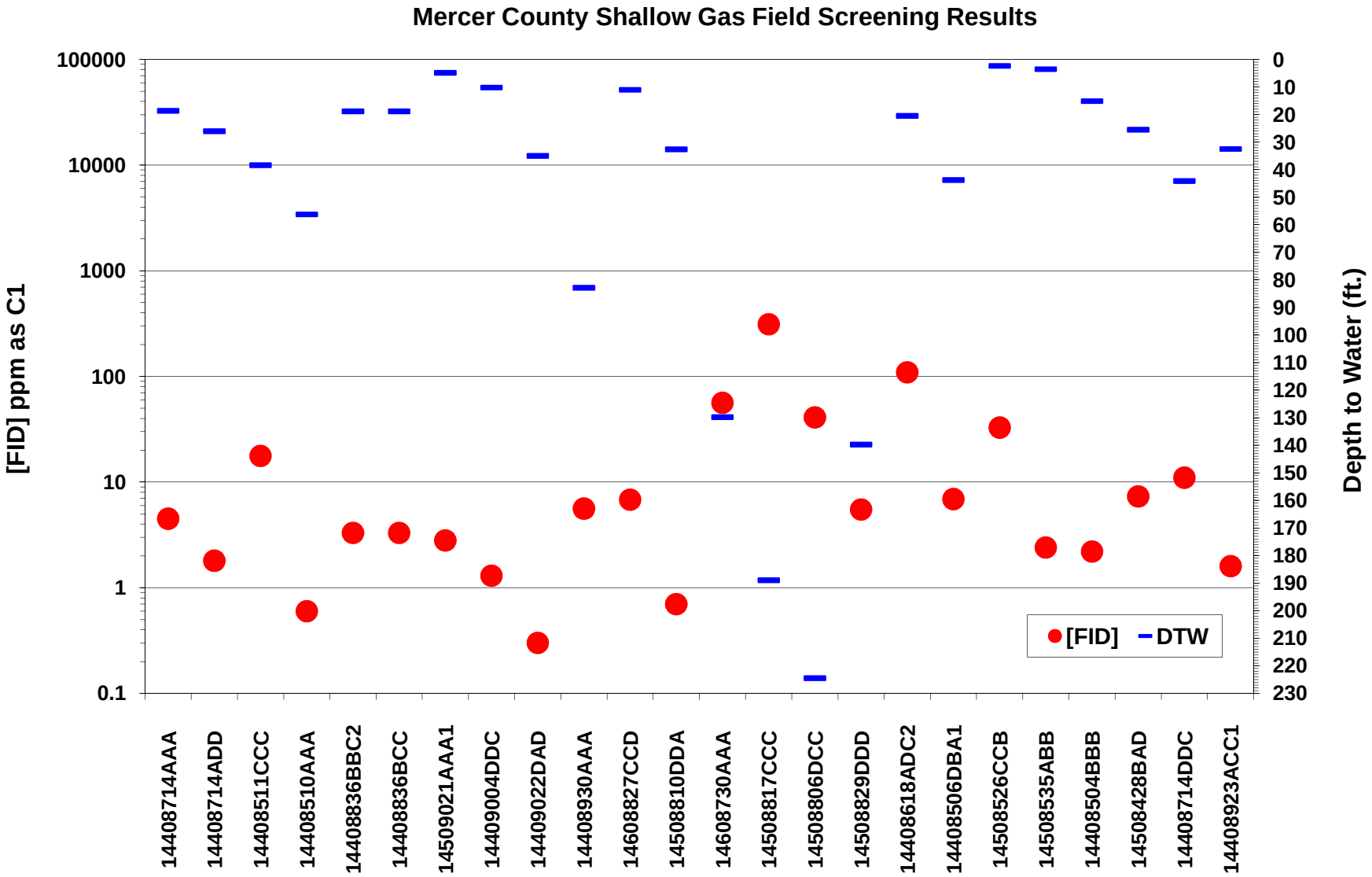


**Figure 15. Shallow gas field screening results in Mercer County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.**

**Bowman County**

Field screening in Bowman County, North Dakota was conducted over a five non-consecutive day period from June 20 to 27, 2009. Well site information for 100 well sites was reviewed prior to field investigation, which resulted in 170 wells being visited in the field. Of these, 47 observation wells were field screened (Table 5) which returned 13 positive FID responses, ranging from 0.7 to 24,250 ppm as C1 (Figure 16), which were clustered in the east-central part of the county, directly northwest of Gascoyne. Wells with positive FID responses are completed in Cretaceous and Tertiary Aquifers (Appendix I). 34 wells were not found.

**Ransom County**

Field screening in Ransom County was conducted over a 12 non-consecutive day period from June 8 to June 30, 2009. Site information for 363 wells was reviewed prior to field investigation, which resulted in 191 wells (183 observation wells and 8 stock wells) being visited in the field. Of these, 34 returned positive FID responses (Table 6), ranging from 0.2 to 186.5 ppm as C1 (Figure 17). Five wells were found to have detectable concentrations of C1 at the TOC ranging from 0.8 to 2.8 ppm as C1. Wells with positive FID responses are variably distributed throughout the monitoring network in the southeastern part of the county in the Englevale Aquifer, and in the southern and western part of the county in the Sheyenne Delta Aquifer (Appendix I). 62 wells were not found.

**Dunn County**

Field screening in Dunn County was conducted over a 9 non-consecutive day period from June 22 to July 7, 2009. Site information for 272 wells was reviewed prior to field investigation, which resulted in 27 observation wells being field screened (Table 7). Of these, five returned positive FID responses, ranging from 0.4 to 124.6 ppm as C1 (Figure 18). Two wells (145-95-22DDBA and 145-95-5AAAAA2) were found to have detectable concentrations of C1 at the TOC. Wells with positive FID responses are variably distributed throughout the monitoring network in the central part of the county in the Killdeer Aquifer and the underlying Sentinel Butte - Tongue River Aquifer (Appendix I). 72 well sites were not found.

**Stark County**

Field screening in Stark County, North Dakota was conducted over an eight non-consecutive day period from June 24 to July 7, 2009. Site information for a total of 170 well sites was reviewed prior to field investigation which resulted in 35 well sites being field screened. Of these, seven returned positive FID responses (Table 7), ranging from 3.7 to 5,596 ppm as C1 (Figure 18). Two wells were found to have detectable concentrations of C1 at the TOC. Well 140-93-9BBC recorded a concentration of 22.7 ppm and well 137-99-9ABA, an artesian stock well, recorded a concentration of 34.1 ppm at the TOC. Wells with positive FID responses are located dominantly in the western portion of the county in the Sentinel Butte- Tongue River Aquifer (Appendix I).

**Table 5. Field screening information collected from ground-water observation wells in Bowman County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **S-12910408DDD** | 07/21/09 | 11:50 | 0.7 | NM | NM | 80.8 | 994 |
| **12910132BCD** | 07/21/09 | 14:10 | 5.0 | NM | NM | 82.8 | 1,006 |
| **13109921CCC2** | 07/21/09 | 16:05 | 0.0 | 10.7 | 56.41 | 85.3 | 1,005 |
| **13109936BBB2** | 07/22/09 | 15:00 | 0.0 | 290.9 | 61.64 | 91.7 | 1,005 |
| **13109926DDD** | 07/22/09 | 15:55 | 0.0 | 10.2 | 4.39 | 86.2 | 1,005 |
| **13109929ADD4** | 07/23/09 | 9:35 | 0.0 | 1,953 | 44.47 | 77.7 | 1,003 |
| **13109922CCB** | 07/23/09 | 10:55 | 0.0 | 189.2 | 39.26 | 88.7 | 1,003 |
| **13109922DCC1** | 07/23/09 | 11:10 | 0.0 | 42.0 | 41.21 | 87.6 | 1,002 |
| **13109925BBB2** | 07/23/09 | 11:40 | 0.0 | 20.1 | 106.81 | 91.6 | 1,000 |
| **13109933DAA** | 07/23/09 | 13:00 | 0.0 | 820.8 | 9.11 | 91.6 | 1,003 |
| **13109927ADD** | 07/23/09 | 13:35 | 0.0 | 13.5 | 46.33 | 94.8 | 1,001 |
| **13109917BBB** | 07/23/09 | 14:35 | 0.0 | 24,250 | 56.55 | 97.7 | 1,013 |
| **S-12910201ADD** | 07/27/09 | 15:05 | 1.1 | NM | NM | 1,048 | 78.4 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
NM = Not Measured
S = Stock Well
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

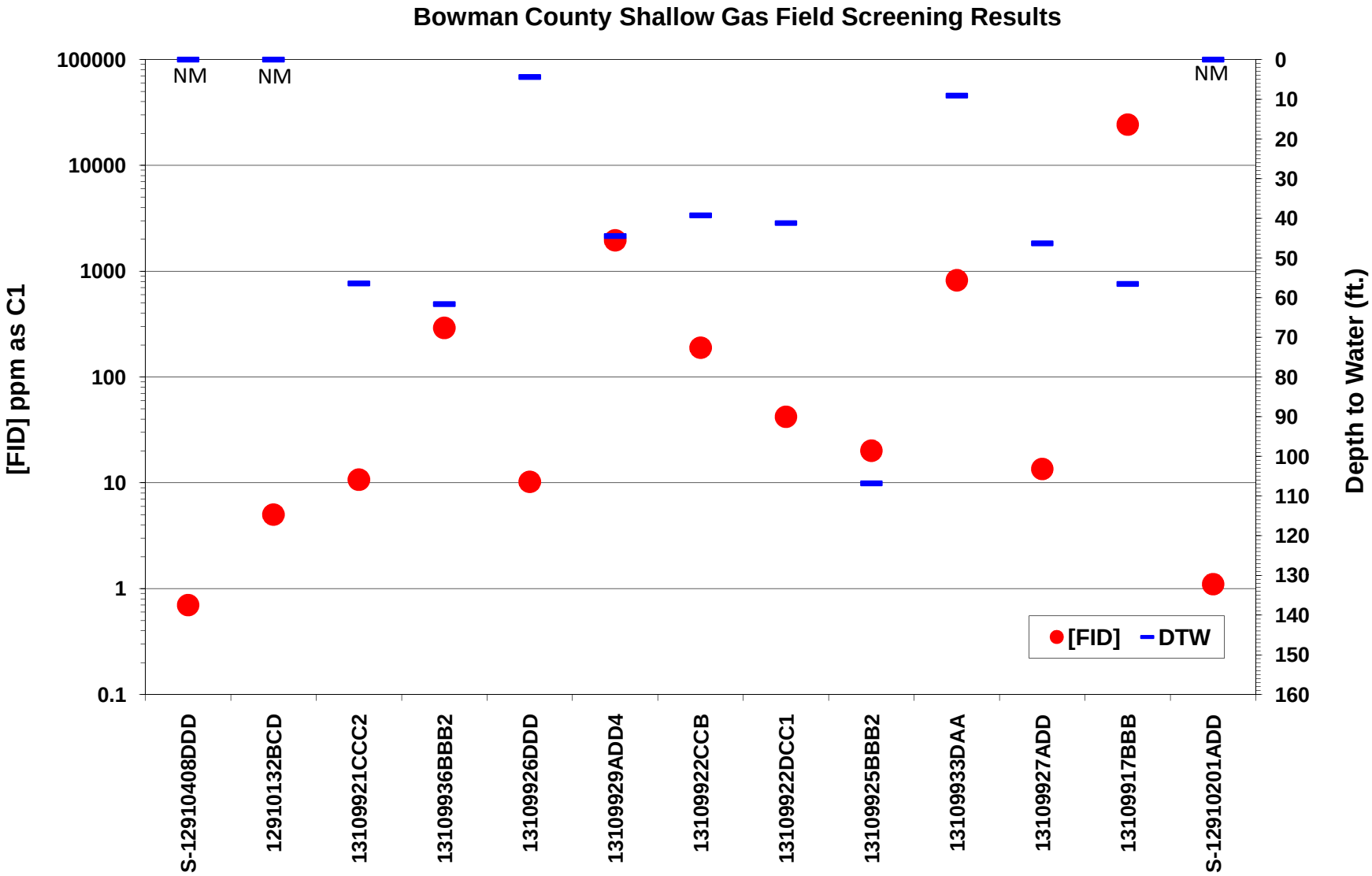


**Figure 16. Shallow gas field screening results in Bowman County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. NM = Not Measured. S = Stock Well.**

**Table 6. Field screening information collected from ground-water observation wells in Ransom County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **13505836CDD** | 06/09/09 | 11:42 | 0.0 | 1.4 | 48.96 | 60.2 | 1,005 |
| **13505835CDC** | 06/09/09 | 12:34 | 0.0 | 61.5 | 7.38 | 59.3 | 1,006 |
| **13405811BBB** | 06/09/09 | 12:59 | 0.0 | 4.7 | 14.28 | 64.7 | 1,007 |
| **13305825BBB** | 06/15/09 | 10:40 | 1.1 | 1.2 | 7.94 | 68.0 | 1,005 |
| **13305534BBB** | 06/15/09 | 12:02 | 0.8 | NM | NM | 80.7 | 1,005 |
| **13305431BBB** | 06/15/09 | 12:33 | 1.0 | 0.0 | 9.44 | 76.4 | 1,007 |
| **13305430DDD** | 06/15/09 | 12:57 | 0.0 | 0.6 | 21.86 | 80.2 | 1,006 |
| **13305432BBA** | 06/15/09 | 13:12 | 2.4 | NM | NM | 78.8 | 1,005 |
| **13305421DDD2** | 06/15/09 | 14:09 | 2.8 | 0.9 | 5.28 | 76.2 | 1,007 |
| **13305420DCD2** | 06/15/09 | 15:05 | 1.5 | 0.0 | 7.76 | 77.1 | 1,006 |
| **13305416DDD** | 06/15/09 | 16:30 | 0.0 | 186.5 | 8.56 | 77.2 | 1,006 |
| **13305409DDD2** | 06/15/09 | 16:56 | 0.0 | 0.4 | 16.02 | 76.9 | 1,006 |
| **13305406CCB2** | 06/15/09 | 17:26 | 0.0 | 0.6 | 15.42 | 74.3 | 1,006 |
| **13405825DCCCD2** | 06/17/09 | 15:15 | 0.0 | 2.4 | 18 | 84.3 | 995 |
| **13405825DCCCD1** | 06/17/09 | 15:15 | 0.0 | 2.2 | 18.72 | 84.3 | 995 |
| **13405825DCCCC2** | 06/17/09 | 15:41 | 0.0 | 1.4 | 19.66 | 82.4 | 995 |
| **13405825DCCCC1** | 06/17/09 | 15:41 | 0.0 | 1.2 | 19.98 | 82.4 | 995 |
| **13405825DCCCC3** | 06/17/09 | 15:41 | 0.0 | 0.6 | 19.88 | 82.4 | 995 |
| **13405731CCC1** | 06/17/09 | 17:49 | 1.0 | 1.1 | 11.18 | 80.6 | 993 |
| **13405836CCC** | 06/17/09 | 18:09 | 0.0 | 0.2 | 21.16 | 80.2 | 993 |
| **13305825CCC3** | 06/18/09 | 10:28 | 0.0 | 1.9 | 20.14 | 75.2 | 993 |
| **13305825CCC5** | 06/18/09 | 10:28 | 0.0 | 1.7 | 21.08 | 75.2 | 993 |
| **13305825CCC1** | 06/18/09 | 10:28 | 0.0 | 1.5 | 20.18 | 75.2 | 993 |
| **13305825CCC4** | 06/18/09 | 10:28 | 0.0 | 1.4 | 21.18 | 75.2 | 993 |
| **13305825CCC2** | 06/18/09 | 10:28 | 0.0 | 0.2 | 20.48 | 75.2 | 993 |
| **13305825CDCC4** | 06/18/09 | 11:40 | 2.6 | 1.4 | 5.88 | 84.2 | 990 |
| **13305825CDCC2** | 06/18/09 | 11:40 | 0.0 | 0.4 | 5.02 | 84.2 | 990 |
| **13305825CDCC1** | 06/18/09 | 11:40 | 0.0 | 0.2 | 5.58 | 84.2 | 990 |
| **13305716AAA** | 06/22/09 | 15:26 | 0.0 | 144.3 | 59.6 | 80.4 | 993 |
| **13305714DDD** | 06/22/09 | 17:14 | 0.0 | 3.4 | 22.88 | 83.3 | 994 |
| **13305710AAB** | 06/22/09 | 18:05 | 0.0 | 18.2 | 35.68 | 82.8 | 994 |
| **13305605DDD** | 06/22/09 | 18:29 | 0.0 | 57.4 | 33.54 | 82.1 | 994 |
| **13505433CCC2** | 06/24/09 | 10:55 | 0.0 | 0.6 | 15.44 | 83.8 | 1,000 |
| **13405401DDD2** | 06/25/09 | 13:47 | 0.6 | 0.7 | 2.47 | 83.4 | 1,000 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
NM = Not Measured
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

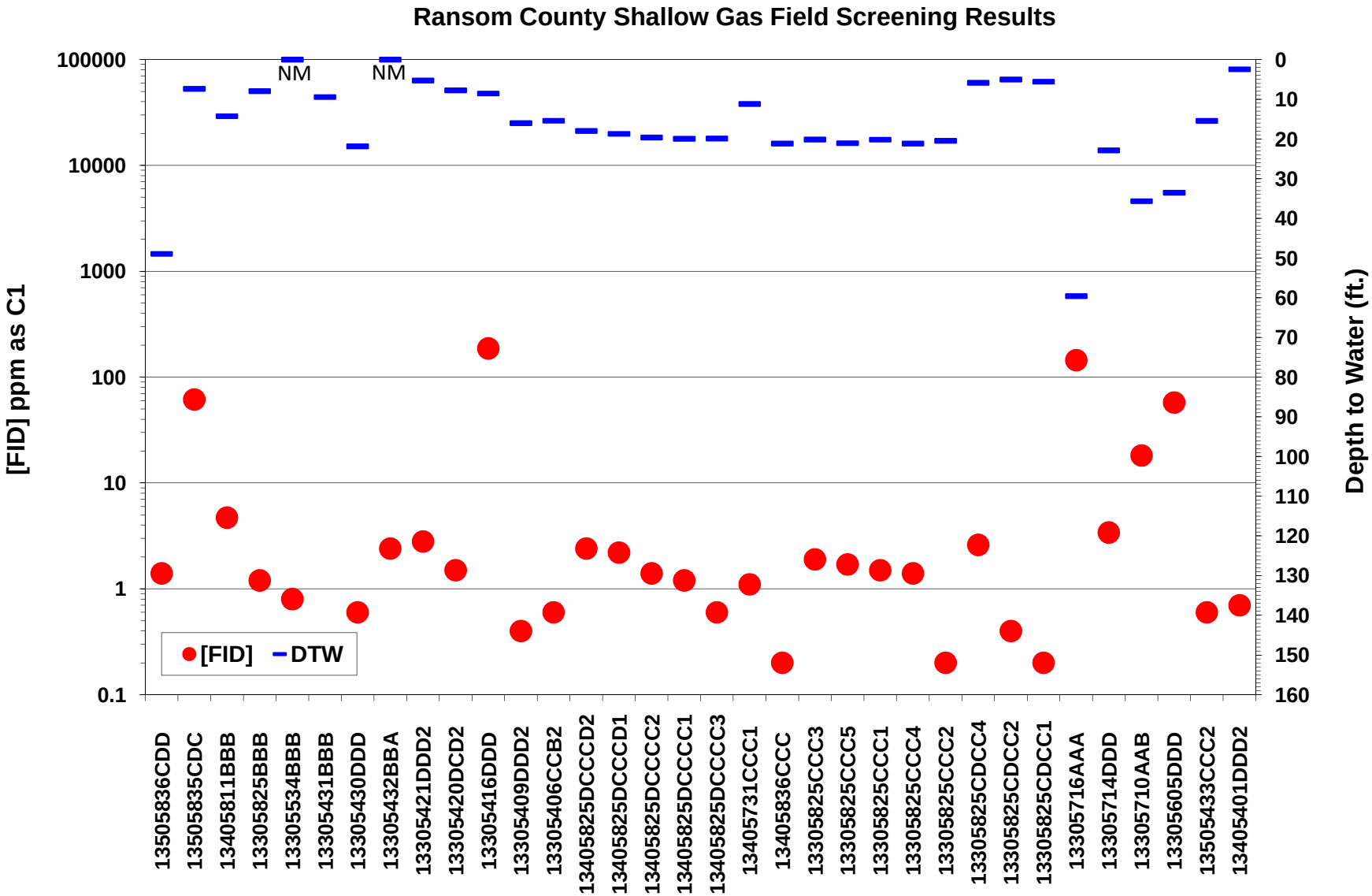


**Figure 17. Shallow gas field screening results in Ransom County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. NM = Not Measured.**

**Table 7. Field screening information collected from ground-water observation wells in Dunn County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **14509522DDBA** | 06/22/09 | 12:49 | 0.4 | 2.5 | 14.88 | 88.6 | 925 |
| **14509504CAABA1** | 06/29/09 | 13:07 | 0.0 | 1.9 | 6.83 | 88.2 | 929 |
| **14509505AAAAA2** | 06/29/09 | 13:35 | 3.3 | 10.7 | 17.57 | 88.5 | 929 |
| **14609135BBC** | 07/01/09 | 13:12 | 0.0 | 80 | 34.83 | 89.3 | 939 |
| **14309309BCB** | 07/06/09 | 15:30 | 0.0 | 124.6 | 96.71 | 88.5 | 934 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

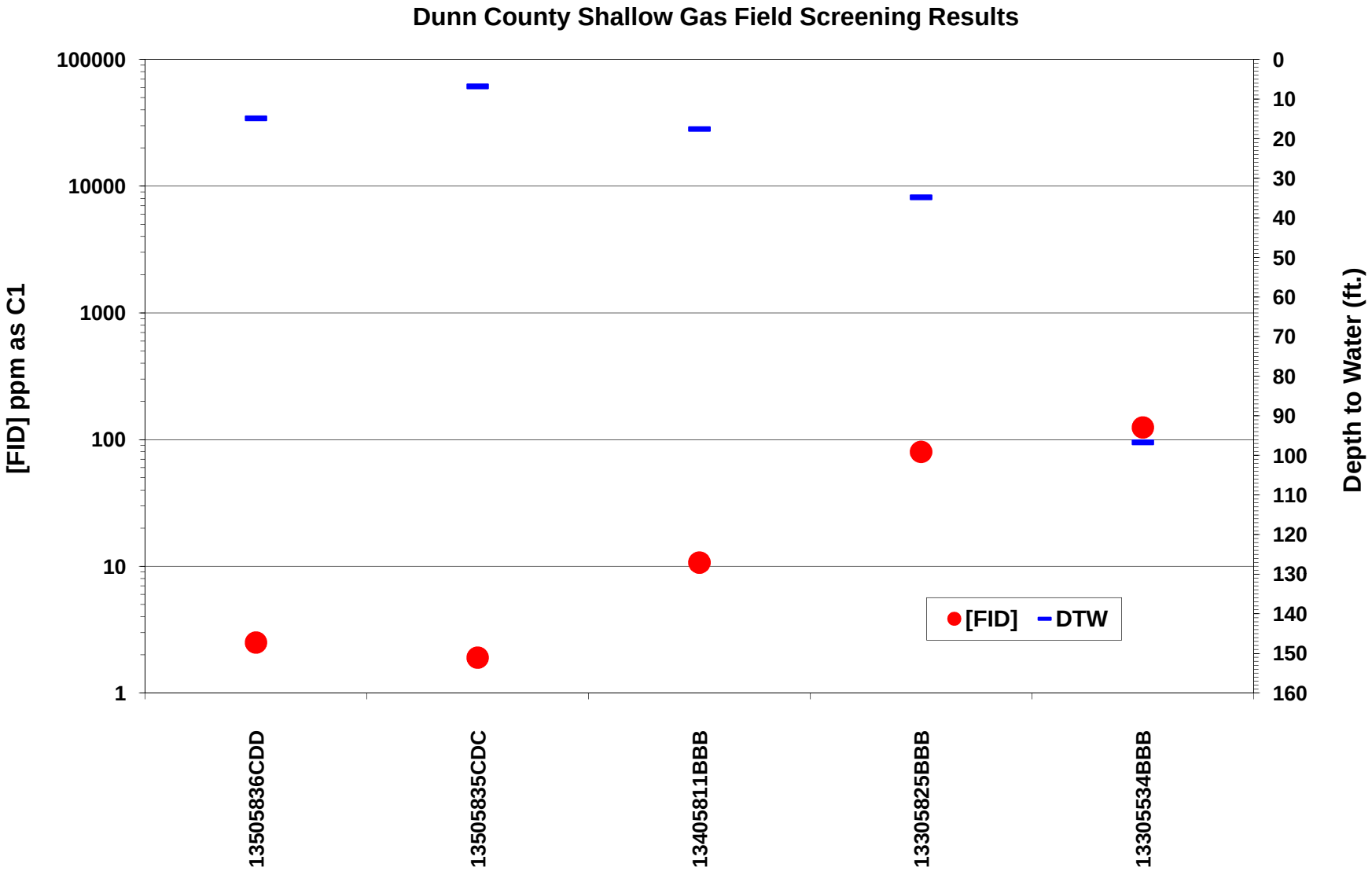


**Figure 18. Shallow gas field screening results in Dunn County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.**

**Table 8. Field screening information collected from ground-water observation wells in Stark County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **14009921CDD1** | 06/25/09 | 9:15 | 0.0 | 114.1 | 78.78 | 73.0 | 1012 |
| **14009828CCC2** | 06/25/09 | 12:35 | 0.0 | 3.7 | 17.23 | 82.2 | 1015 |
| **14009821AAA** | 06/29/09 | 13:35 | 0.0 | 42.2 | 19.50 | 87.2 | 1013 |
| **13909821AAA** | 06/29/09 | 14:35 | 0.0 | 5.2 | 60.38 | 85.9 | 1014 |
| **S-13709909ABA** | 07/01/09 | 9:45 | 34.1 | NMa | Flowing | NM | NM |
| **14009309BBC** | 07/02/09 | 10:45 | 22.7 | 5,596 | 37.40 | 76.3 | 1029 |
| **14109326BBB2** | 07/02/09 | 11:25 | 0.0 | 437 | 11.23 | 78.4 | 1035 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
S = Stock Well
NM = Not Measured
a = artesian (flowing well)
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

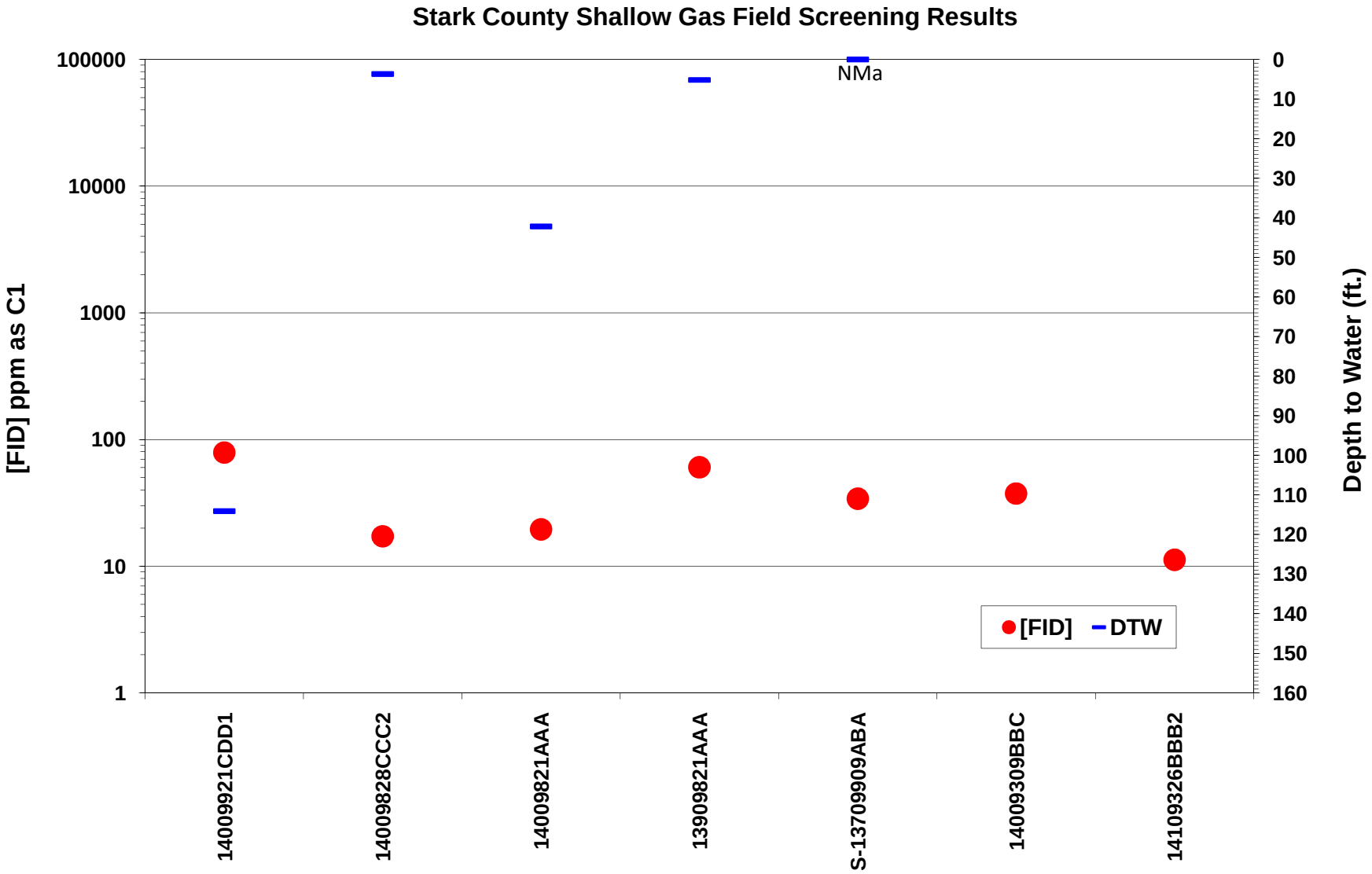


**Figure 19. Shallow gas field screening results in Stark County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. NM = Not Measured. S = Stock Well. a = artesian well.**

**Billings County**

Field screening in Billings County, was conducted over a four non-consecutive day period from July 7, to July 15, 2009. Site information for a total of 121 wells was reviewed prior to field investigation, which resulted in 65 wells being investigated in the field. Of these, 13 were field screened with one well (141-102-10ABD) (Table 9) returning a low-level positive FID response, of 2.0 ppm as C1 (Figure 20). This well is an artesian well completed in the Fox Hills Aquifer (Appendix I). 37 well sites were not found.

**Slope County**

Field screening in Slope County, was conducted over a 6 non-consecutive day period from July 8 to July 20, 2009. Site information for 117 well sites, was reviewed prior to field investigation, which resulted in 62 wells being visited in the field. Of these, 29 wells (7 observation wells and 22 stock wells) were field screened, which returned five positive FID responses (Table 10), ranging from 3.4 to 172.6 ppm as C1 (Figure 20). Wells with positive FID responses are variably distributed throughout the monitoring network in the north-central and southeastern part of the county coincident with the Tongue River – Ludlow and Fox Hills Aquifer (Appendix I). 12 wells were not found.

**McLean County**

Field screening in McLean County, was conducted over a twenty, non-consecutive day period from June 27 to July 22, 2009. Site information for over 1,500 wells was reviewed prior to field investigation. which resulted in 433 wells being visited in the field. Of these, 204 observation wells were field screened where 44 wells (Table 11) returned positive FID responses ranging from 0.1 to 839.1 ppm as C1 (Figure 21). Wells with positive FID responses are located mostly in the northeastern part of the county coincident with the Lake Nettie and Strawberry Lake Aquifers (Appendix I). 201 wells were not found.

Ri**chland County**

Field screening in Richland County was conducted over a twelve, non-consecutive day period from July 1 to 22, 2009. Site information for over 1,000 well sites was reviewed prior to field investigation which resulted in 318 well sites being visited in the field. Of these, 147 wells were field screened, which returned 28 wells (Table 12) with positive FID responses ranging from 0.5 to 28,123 ppm as C1 (Figure 22). Ten wells were found to have detectable concentrations of C1 at the TOC (Table 12). Wells with positive FID responses are located in the northwestern and northeastern parts of the county in the Sheyenne Delta and Colfax Aquifers, respectively, and in the southern parts of the county, in wells completed in the Milnor Channel, Brightwood, Hankinson, and Fairmont Aquifers (Appendix I). 64 wells were not found.

**Table 9. Field screening information collected from ground-water observation wells in Billings County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **S-14110210ABD** | 07/14/09 | 15:17 | 2.0 | NMa | Flowing | 75.3 | 922 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
S = Stock Well, NM = Not Measured, a = artesian (flowing well)
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

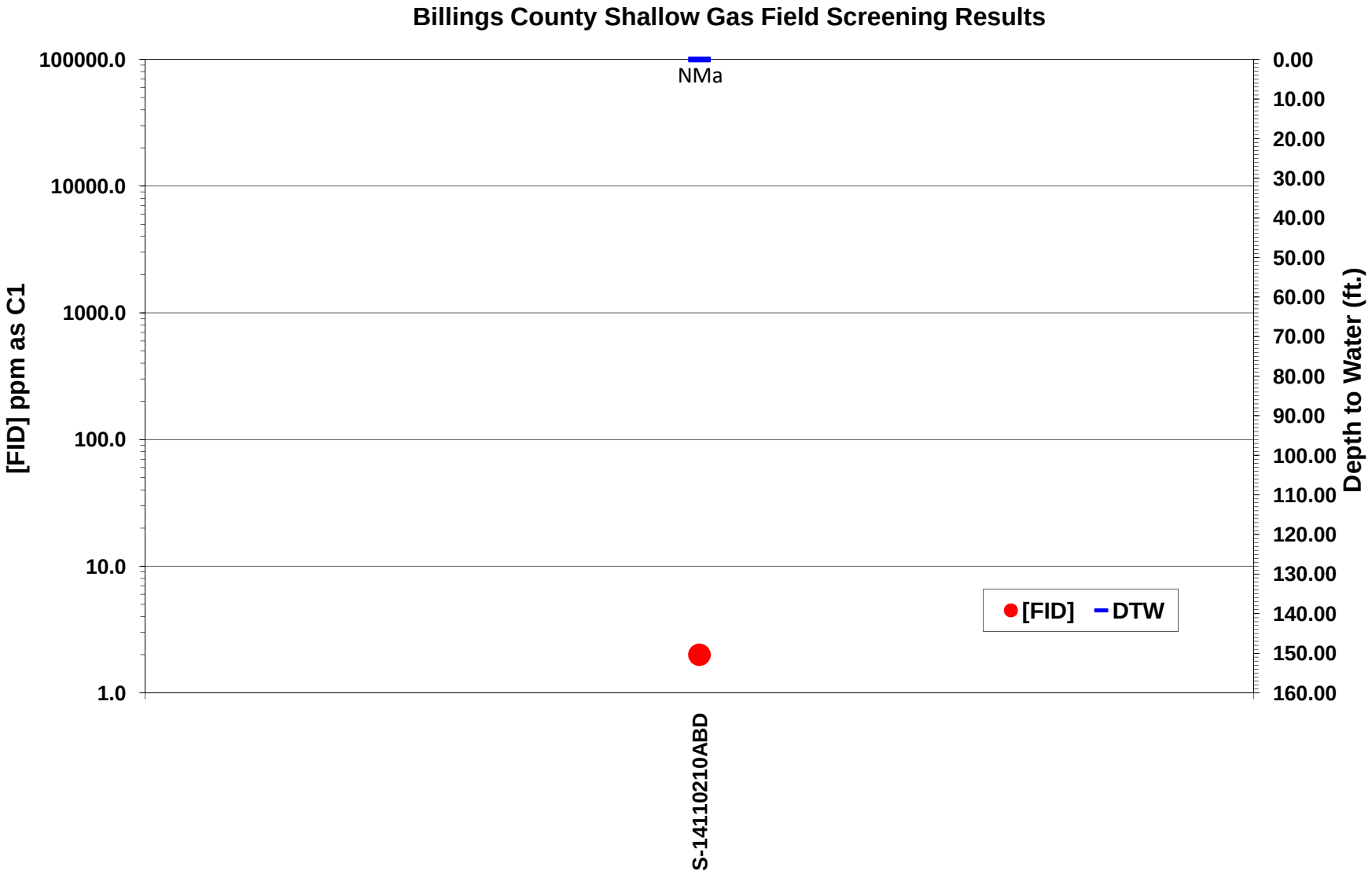


**Figure 20. Shallow gas field screening results in Billings County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. NM = Not Measured. S = Stock Well. a = artesian well.**

**Table 10. Field screening information collected from ground-water observation wells in Slope County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **13310111DCC** | 7/9/09 | 10:10 | 0.0 | 3.9 | 100.21 | 73.8 | 1,000 |
| **S-13610125ACC** | 7/14/09 | 16:00 | 23.7 | NM | NM | 73.8 | 991 |
| **S-13610211BBB** | 7/15/09 | 13:05 | 172.6 | NM | NM | 80.8 | 1,015 |
| **S-13610314ADC** | 7/15/09 | 14:15 | 3.4 | NM | NM | 86.4 | 1,011 |
| **S-13309820CBC** | 7/16/09 | 14:50 | 7.0 | NM | NM | 83.6 | 1,010 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
S = Stock Well
NM = Not Measured
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

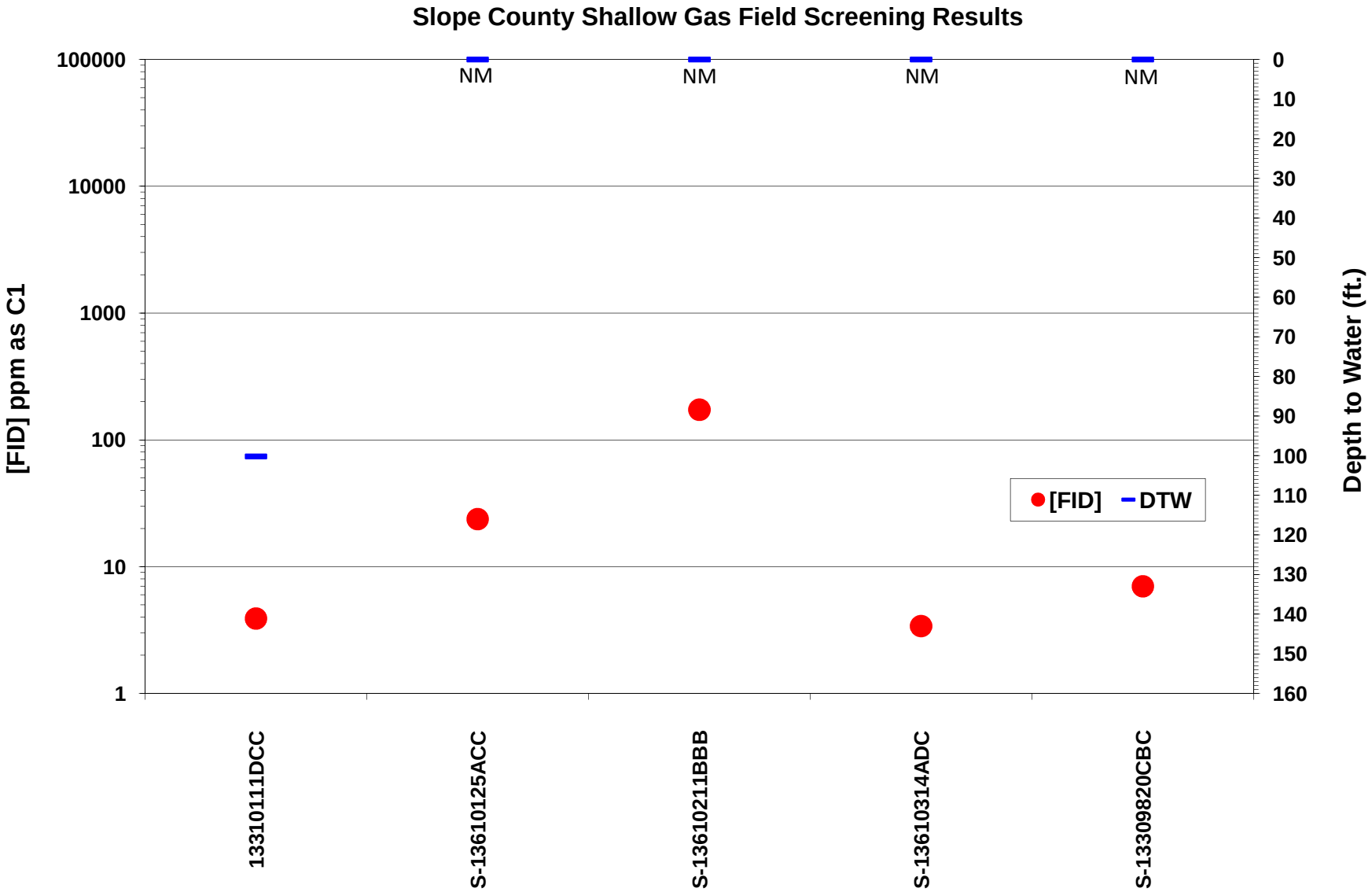


**Figure 21. Shallow gas field screening results in Slope County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. NM = Not Measured. S = Stock Well.**

**Table 11. Field screening information collected from ground-water observation wells in McLean County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **14908015BBB** | 06/24/09 | 12:30 | 0.0 | 30.5 | 8.29 | 85.6 | 629 |
| **15008035CBC** | 06/24/09 | 13:11 | 0.0 | 150.2 | 37.70 | 82.8 | 637 |
| **14708022AAD** | 06/25/09 | 13:32 | 0.0 | 10.3 | 7.63 | 92.5 | 1,008 |
| **14708118DDB** | 06/29/09 | 16:08 | 0.0 | 82.3 | 12.90 | 77.2 | 1,009 |
| **14708019CBC** | 06/30/09 | 14:15 | 0.0 | 15.6 | 16.35 | 91.0 | 1,011 |
| **14708119BBB1** | 07/01/09 | 13:32 | 0.0 | 839.1 | NM | 88.9 | 1,009 |
| **14607906AAA2** | 07/06/09 | 10:45 | 0.0 | 3.3 | 58.00 | 80.1 | 1,008 |
| **14607906AAA1** | 07/06/09 | 10:45 | 0.0 | 0.5 | 58.49 | 80.1 | 1,008 |
| **14707926DDA** | 07/06/09 | 13:14 | 0.0 | 2.3 | 85.81 | 113.5 | 1,006 |
| **14608223DCA** | 07/07/09 | 10:52 | 0.0 | 17.3 | 31.42 | 64.4 | 1,000 |
| **14608322CCC** | 07/07/09 | 13:30 | 0.0 | 3.8 | 99.30 | 76.3 | 1,003 |
| **14608006CBB2** | 07/07/09 | 16:30 | 0.0 | 1.3 | 21.40 | 78.8 | 1,007 |
| **14807936CDC** | 07/08/09 | 10:15 | 0.0 | 0.5 | 12.15 | 80.2 | 1,004 |
| **14808033CCC** | 07/08/09 | 14:14 | 0.0 | 0.9 | 22.43 | 77.7 | 1,003 |
| **14808135DDD** | 07/08/09 | 15:00 | 0.0 | 1.7 | 6.39 | 78.4 | 1,004 |
| **14808134CBB** | 07/08/09 | 15:34 | 0.0 | 65.5 | 6.39 | 83.8 | 1,004 |
| **14708103BBB** | 07/08/09 | 16:00 | 0.0 | 17 | 9.00 | 83.1 | 1,004 |
| **14708104DAA** | 07/08/09 | 16:14 | 0.0 | 54.7 | 8.99 | 86.9 | 1,003 |
| **14808109BAA** | 07/09/09 | 16:24 | 0.0 | 0.6 | 23.13 | 81.0 | 1,003 |
| **14808103AAB** | 07/09/09 | 17:25 | 0.0 | 0.4 | 9.90 | 82.4 | 1,002 |
| **14908125CCD** | 07/09/09 | 17:44 | 0.0 | 11.1 | 19.00 | 87.3 | 1,001 |
| **14808222BBB** | 07/13/09 | 14:44 | 0.0 | 0.2 | 34.72 | 64.6 | 1,011 |
| **14808707AAA2** | 07/13/09 | 15:05 | 0.0 | 238.8 | 13.85 | 68.3 | 1,026 |
| **14808224ABB2** | 07/13/09 | 15:19 | 0.0 | 3.3 | 6.13 | 74.1 | 1,009 |
| **14808116BCC** | 07/13/09 | 15:55 | 0.0 | 0.1 | 17.34 | 69.8 | 1,009 |
| **14808108DAA** | 07/13/09 | 16:10 | 0.0 | 0.1 | 12.12 | 70.0 | 1,009 |
| **14308103BAA** | 07/14/09 | 13:45 | 0.0 | 5.5 | 38.40 | 81.0 | 1,006 |
| **14808213BAB** | 07/15/09 | 11:16 | 0.0 | 5.4 | 20.57 | 62.8 | 1,011 |
| **14808211DCC1** | 07/15/09 | 12:55 | 0.0 | 0.6 | 22.73 | 68.7 | 1,011 |
| **14908020AAA2** | 07/15/09 | 15:34 | 0.0 | 0.7 | 9.00 | 72.5 | 1,008 |
| **14908003CCD** | 07/15/09 | 16:30 | 0.0 | 0.9 | 14.65 | 73.9 | 1,008 |
| **14608033BCC** | 07/16/09 | 13:18 | 0.0 | 1 | 38.15 | 78.6 | 1,013 |
| **15008025CCC** | 07/20/09 | 9:36 | 0.0 | 18.9 | 36.69 | 68.9 | 1,003 |
| **15008036BAA** | 07/20/09 | 9:48 | 0.0 | 120.5 | 56.50 | 67.5 | 1,003 |
| **15008022CDC** | 07/20/09 | 10:32 | 0.0 | 1.3 | 19.82 | 69.8 | 1,002 |
| **15008025DCD** | 07/20/09 | 11:41 | 0.0 | 67 | 18.79 | 75.6 | 1,004 |
| **15008015DDD** | 07/20/09 | 14:22 | 0.0 | 42.6 | 55.20 | 98.1 | 1,002 |
| **15008015DAA** | 07/20/09 | 14:55 | 0.0 | 1.5 | 10.83 | 92.8 | 1,002 |
| **15008011CDC** | 07/20/09 | 15:25 | 0.0 | 0.5 | 50.42 | 86.9 | 1,001 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **15008016DDC** | 07/20/09 | 16:43 | 0.0 | 1.2 | 19.42 | 82.9 | 1,001 |
| **14708314BCC** | 07/21/09 | 14:46 | 0.0 | 1.8 | 6.45 | 80.8 | 1,008 |
| **14708315BBA** | 07/21/09 | 15:02 | 0.0 | 1 | 12.42 | 84.0 | 1,009 |
| **14708312CCC** | 07/21/09 | 15:23 | 0.0 | 0.9 | 5.50 | 83.8 | 1,009 |
| **14808620DAA** | 07/22/09 | 13:46 | 0.0 | 2.9 | 67.20 | 86.7 | 1,007 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
NM = Not Measured
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

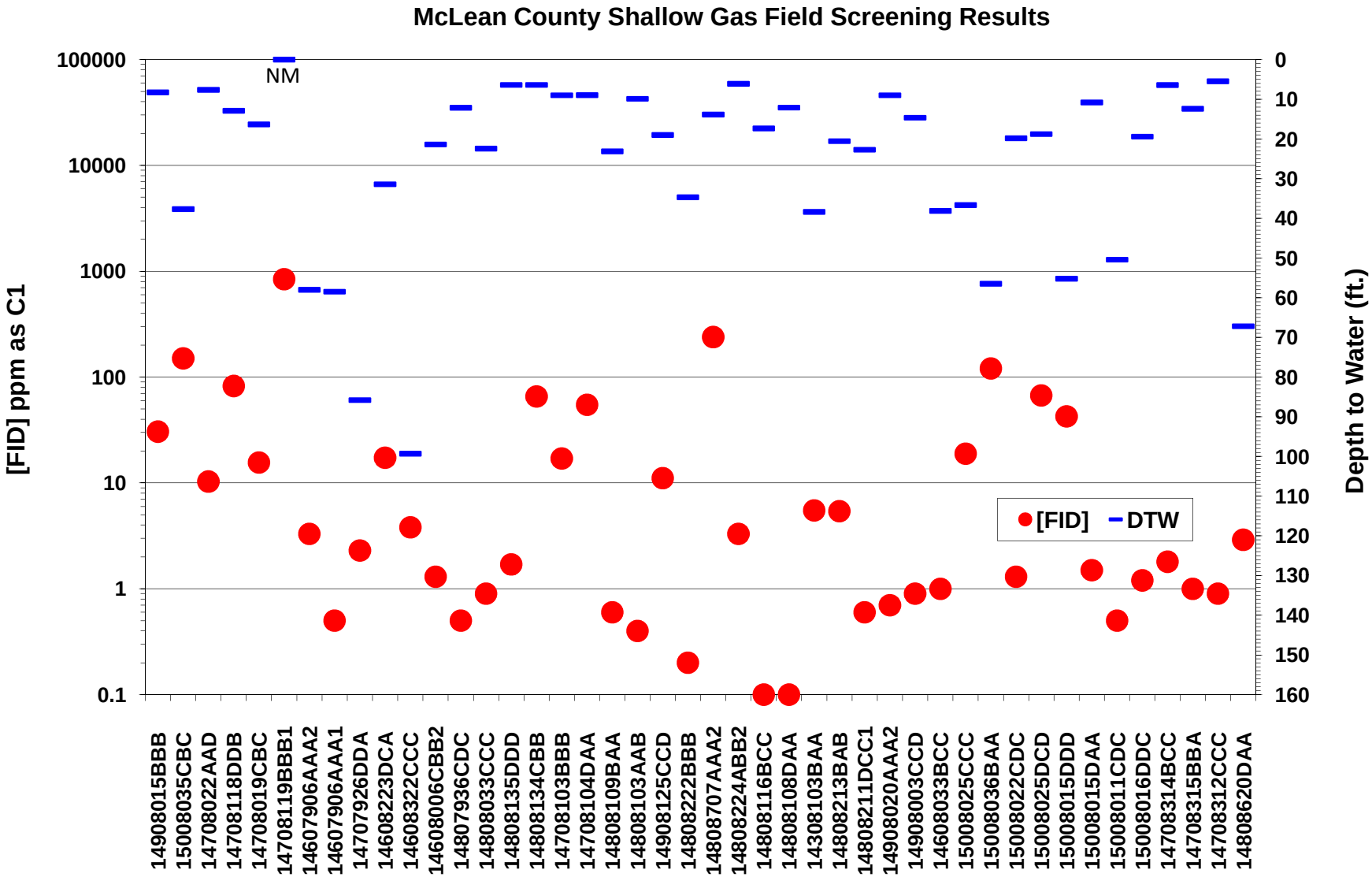


**Figure 22. Shallow gas field screening results in McLean County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. NM = Not Measured.**

**Table 12. Field screening information collected from ground-water observation wells in Richland County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **13605212CBB** | 07/01/09 | 17:34 | 3,851 | 28,123 | 7.58 | 85.4 | 1,004 |
| **13605222CCC** | 07/02/09 | 13:55 | 35.1 | 75.2 | 4.58 | 80.6 | 1,008 |
| **13505210ACA1** | 07/02/09 | 14:40 | 0.0 | 6.8 | 13.18 | 80.5 | 1,009 |
| **13605131DDD** | 07/02/09 | 16:08 | 0.0 | 3.4 | 21.38 | 82.6 | 1,010 |
| **12904705DDD** | 07/07/09 | 14:36 | 0.0 | 106.8 | 1.66 | 76.3 | 1,004 |
| **12904708BCC** | 07/07/09 | 15:04 | 0.0 | 0.9 | 3.62 | 76.4 | 1,003 |
| **13004924DDD** | 07/09/09 | 11:26 | 0.0 | 4.2 | 6.70 | 74.6 | 1,003 |
| **12905214AAA** | 07/15/09 | 12:20 | 23.9 | 636.2 | 22.76 | 70.8 | 997 |
| **13005018DDD** | 07/16/09 | 10:20 | 1.7 | 2.6 | 3.08 | 64.8 | 1,005 |
| **13005029BBC** | 07/16/09 | 10:39 | 1.1 | 9.1 | 37.64 | 70.1 | 1,005 |
| **13105032BCD2** | 07/16/09 | 16:17 | 0.0 | 98.2 | 18.86 | 71.8 | 1,003 |
| **13005006AAA2** | 07/16/09 | 16:50 | 0.0 | 4 | 5.36 | 72.4 | 1,003 |
| **13204728CCC2** | 07/17/09 | 18:50 | 0.0 | 2 | 13.88 | 73.6 | 1,008 |
| **13304720AAD2** | 07/20/09 | 13:42 | 0.0 | 5 | 59.98 | 74.8 | 1,005 |
| **13304720AAD1** | 07/20/09 | 13:42 | 0.0 | 5 | 59.78 | 74.8 | 1,005 |
| **13304720AAD3** | 07/20/09 | 13:42 | 0.0 | 0.5 | 33.22 | 74.8 | 1,005 |
| **13304720ADD6** | 07/21/09 | 9:34 | 3.8 | 16.3 | 61.00 | 75.2 | 1,005 |
| **13304720ADD5** | 07/21/09 | 9:34 | 4.1 | 2.4 | 5.62 | 75.2 | 1,005 |
| **13304720ADB4** | 07/21/09 | 10:16 | 3.6 | 9.9 | 63.98 | 75.3 | 1,004 |
| **13304720ADB3** | 07/21/09 | 10:16 | 6.0 | 3.4 | 64.18 | 75.3 | 1,004 |
| **13304720BABB** | 07/21/09 | 12:33 | 0.0 | 116.8 | 31.00 | 76.1 | 1,005 |
| **13304720BAD3** | 07/21/09 | 13:30 | 0.0 | 38.9 | 42.52 | 75.8 | 1,004 |
| **13304720BAD1** | 07/21/09 | 13:30 | 0.0 | 37.2 | 67.02 | 75.8 | 1,004 |
| **13304720BAD2** | 07/21/09 | 13:30 | 0.0 | 34 | 69.18 | 75.8 | 1,004 |
| **13304720ABDC1** | 07/21/09 | 14:06 | 0.0 | 6.6 | 76.48 | 76.4 | 1,004 |
| **13404832DAA** | 07/21/09 | 19:24 | 0.0 | 423.2 | 18.32 | 73.5 | 1,003 |
| **13404901DDD2** | 07/22/09 | 14:59 | 0.0 | 1.2 | 10.14 | 82.1 | 1,007 |
| **13104919BBB3** | 07/22/09 | 19:10 | 14.1 | 64.2 | 4.58 | 74.8 | 1,002 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

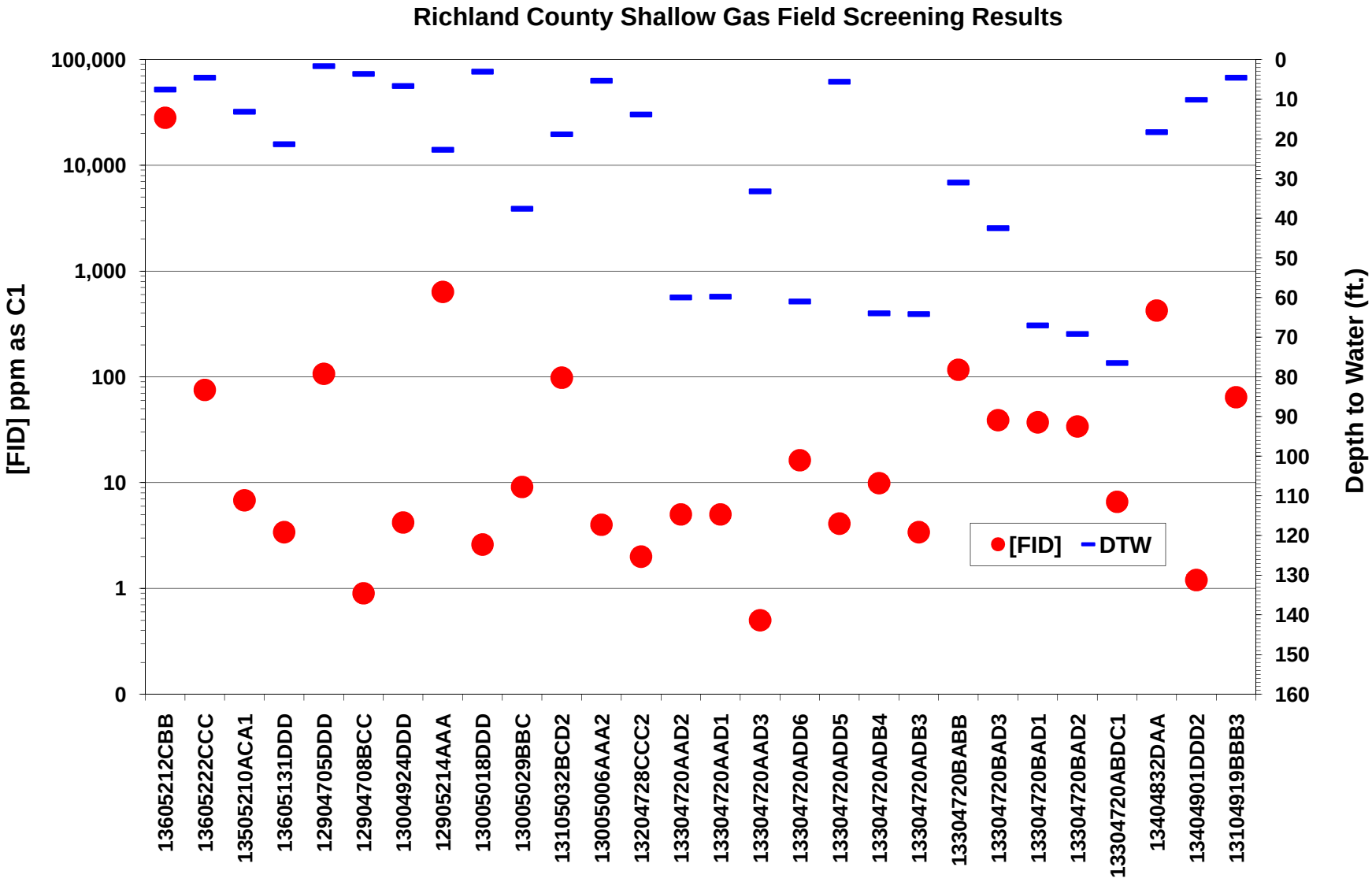


**Figure 23. Shallow gas field screening results in Richland County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.**

**Golden Valley County**

Field screening in Golden Valley County, North Dakota was conducted over a seven day period from July 14 to 22, 2009. Site information for over 160 wells was reviewed prior to field investigation, which resulted in 76 wells being visited in the field. Of these, 29 wells (27 observation wells and 2 stock wells) were field screened, which returned 16 wells (Table 13) with positive FID responses, ranging from 0.6 to 4,291 ppm as C1 (Figure 23). Two wells (140-150-6BBB2 & 141-152-9ADD3) were found to have detectable concentrations of C1 emanating from the TOC (Table 13). 29 wells were not found.

**Adams County**

Field screening in Adams County, North Dakota was conducted over a two day period on July 28 & 29, 2009. Site information for 144 wells was reviewed prior to field investigation of which 40 wells were selected to be visited in the field. Of these, eight wells were field screened (Table 14) which returned two wells (132-97-7CAB4 & 129-97-15AAB) with positive FID responses of 68 (at the GWI) and 5.6 ppm (at the TOC) as C1, respectively (Figure 24). These wells are completed in the Tongue River – Ludlow Aquifer (Appendix I). The two wells with positive FID responses are located in the western part of the county. 18 wells were not found.

**Mountrail County**

Field screening in Mountrail County was conducted over a five, non-consecutive day period from June 23 to July 30, 2009. Site information for 258 wells was reviewed prior to field investigation, which resulted in 112 wells being visited in the field. Of these, 36 observation wells were field screened, which returned 19 wells (Table 15) with positive FID responses ranging from 0.1 to 515.5 ppm as C1 (Figure 25). Wells with positive FID responses are located mostly in the east-central part of the county, in the Shell Creek Aquifer (Appendix I). 67 wells were not found.

**Burke County**

Field screening in Burke County, North Dakota was conducted over a three day period from August 2 - 4, 2009. 94 wells were visited in the field. Of these, 19 wells were field screened (Table 16), with five wells returning positive FID responses ranging from 0.4 to 31,347 ppm as C1 (Figure 26). One well (162-94-10AAA1) was found to have detectable concentrations of C1 (8.1 ppm) emanating from the TOC. Wells with positive FID responses were completed in the Columbus and Sentinel Butte-Tongue River Aquifers (Appendix I). 46 wells were not found.

**Table 13. Field screening information collected from ground-water observation wells in Golden Valley County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **14110507DDD3** | 07/21/09 | 16:47 | 0.0 | 0.6 | 14.68 | 94.3 | 920 |
| **14110521AAA1** | 07/21/09 | 15:23 | 0.0 | 4.7 | 122.44 | 96.8 | 918 |
| **14110521AAA2** | 07/21/09 | 15:23 | 0.0 | 0.8 | 36.07 | 96.8 | 918 |
| **14110514DDA** | 07/21/09 | 14:49 | 0.0 | 2.2 | 166.52 | 87.4 | 915 |
| **14110520BBB** | 07/21/09 | 13:52 | 0.0 | 172.6 | 54.36 | 88.4 | 919 |
| **14110520CCC2** | 07/21/09 | 12:46 | 0.0 | 16.7 | 51.36 | 103.8 | 919 |
| **14110520CCC1** | 07/21/09 | 12:46 | 0.0 | 1.5 | 148.60 | 103.8 | 919 |
| **14110528AAB** | 07/21/09 | 11:30 | 0.0 | 6.6 | 20.34 | 94.7 | 920 |
| **14110529ADD3** | 07/21/09 | 11:05 | 0.2 | 3.7 | 24.70 | 88.2 | 920 |
| **14110529ADD1** | 07/21/09 | 10:51 | 0.0 | 21.8 | 22.90 | 88.2 | 920 |
| **14010506BBB2** | 07/21/09 | 9:37 | 0.9 | 4,291 | 38.28 | 86.2 | 920 |
| **14010506BBB1** | 07/21/09 | 9:37 | 0.0 | 110.4 | 44.32 | 86.2 | 920 |
| **14110503BBB** | 07/17/09 | 9:45 | 0.0 | 207.9 | 151.15 | 88.6 | 918 |
| **13810522BCB** | 07/17/09 | 9:37 | 0.0 | 2.8 | 29.33 | 78.7 | 922 |
| **13810610DAA** | 07/16/09 | 16:16 | 0.0 | 53.7 | 70.88 | 80.8 | 916 |
| **14310533BAB** | 07/15/09 | 13:52 | 0.0 | 14.1 | 81.34 | 81.0 | 931 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

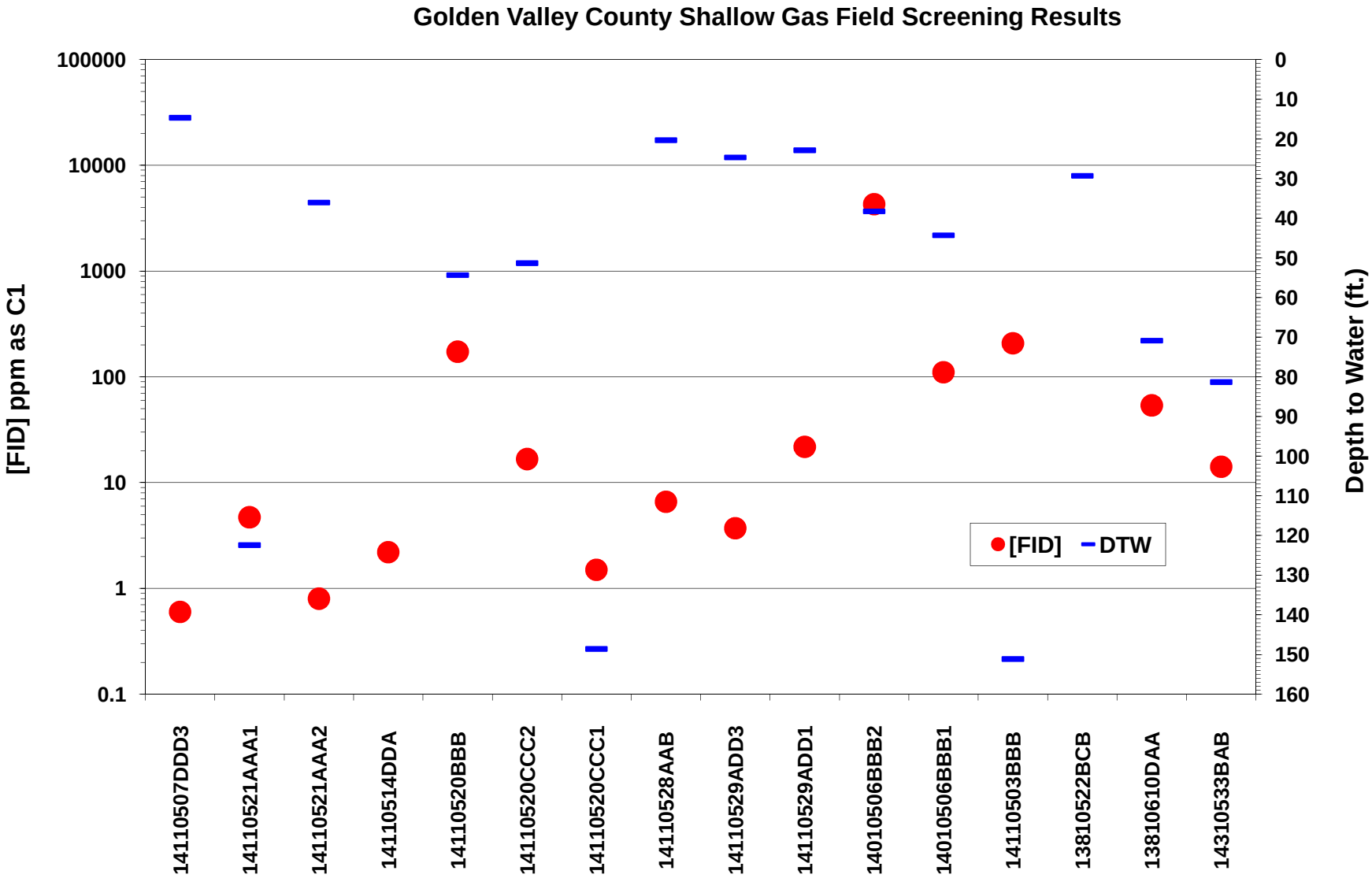


**Figure 24. Shallow gas field screening results in Golden Valley County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.**

**Table 14. Field screening information collected from ground-water observation wells in Adams County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **13209707CAB4** | 07/28/09 | 9:20 | 0.0 | 68 | 90.72 | 70.0 | 1,058 |
| **S-12909715AAB** | 07/28/09 | 14:25 | 5.6 | NM | NM | 79.4 | 1,052 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
S = Stock Well
NM = Not Measured
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

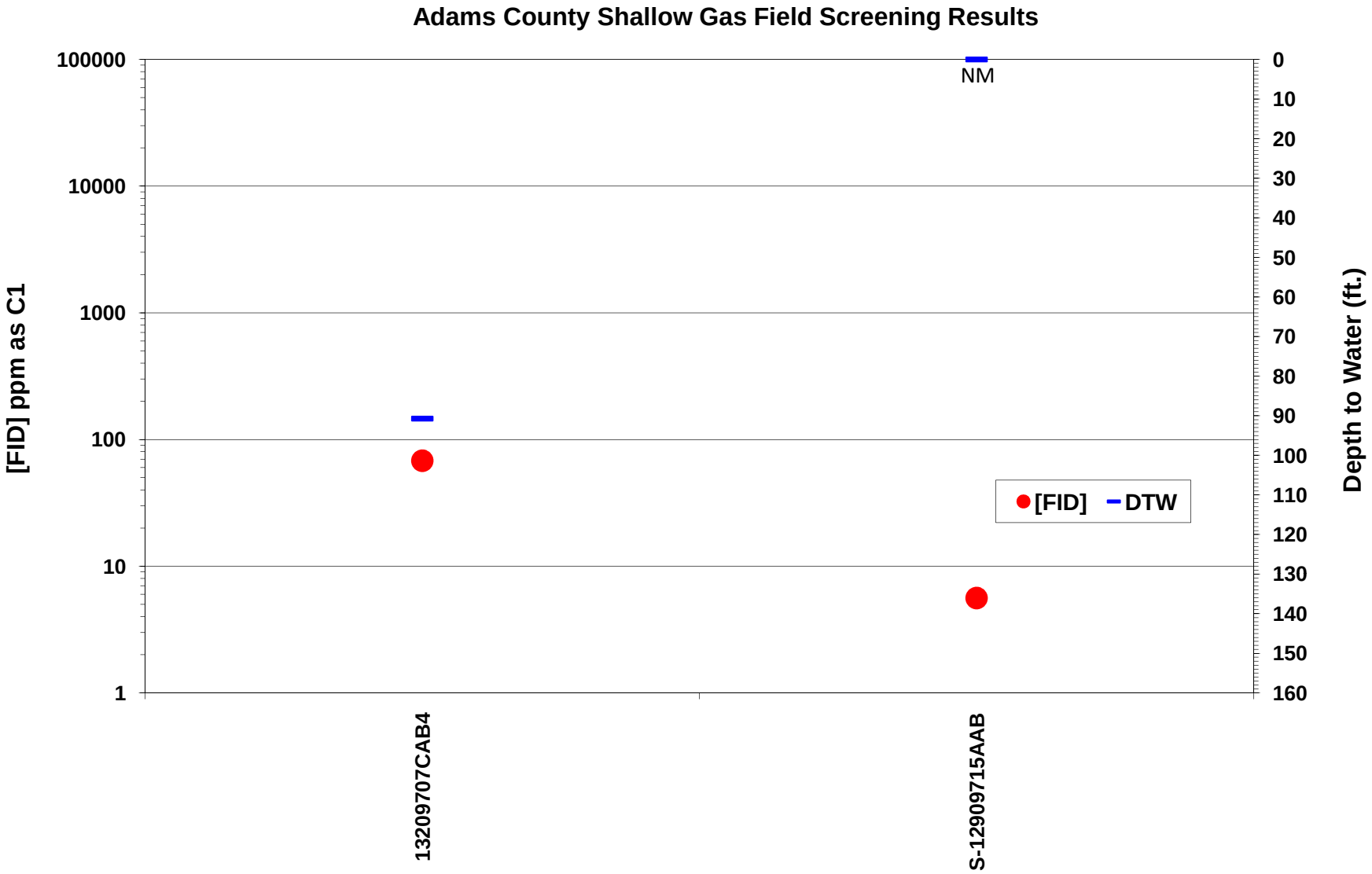


**Figure 25. Shallow gas field screening results in Adams County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. NM = Not Measured. S = Stock Well.**

**Table 15. Field screening information collected from ground-water observation wells in Mountrail County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| 15209019BBB | 7/23/09 | 12:22 | 0.0 | 515.5 | 13.10 | 90.5 | 1,002 |
| 15209124BAB1 | 7/23/09 | 13:49 | 0.0 | 202 | 7.90 | 91.9 | 1,004 |
| 15209124BAB2 | 7/23/09 | 13:49 | 0.0 | 150.8 | 9.29 | 91.9 | 1,004 |
| 15209009BCC1 | 7/27/09 | 9:28 | 0.0 | 0.1 | 13.60 | 75.6 | 1,012 |
| 15309036DAA2 | 7/27/09 | 10:19 | 0.0 | 2.8 | 4.79 | 82.2 | 1,007 |
| 15309036DAA3 | 7/27/09 | 10:19 | 0.0 | 0.2 | 4.60 | 82.2 | 1,007 |
| 15309036DAA1 | 7/27/09 | 10:19 | 0.0 | 0.1 | 7.42 | 82.2 | 1,007 |
| 15308929AAA | 7/27/09 | 12:13 | 0.0 | 0.9 | 6.79 | 84 | 1,010 |
| 15308916DDD1 | 7/27/09 | 12:43 | 0.0 | 2.9 | 8.78 | 85.3 | 1,010 |
| 15308916DDD2 | 7/27/09 | 12:43 | 0.0 | 2.3 | 9.48 | 85.3 | 1,010 |
| 15308916DDD3 | 7/27/09 | 12:43 | 0.0 | 1.4 | 10.01 | 85.3 | 1,010 |
| 15308910BBA2 | 7/27/09 | 14:10 | 0.0 | 2.2 | 14.12 | 84.6 | 1,009 |
| 15308910BBA1 | 7/27/09 | 14:10 | 0.0 | 0.6 | 10.71 | 84.6 | 1,009 |
| S-15408930DDD | 7/27/09 | 15:04 | 0.0 | 8.8 | NM | NM | NM |
| 15408934AAB1 | 7/27/09 | 15:22 | 0.0 | 0.5 | 15.21 | 89.1 | 1,007 |
| 15408935BBB | 7/27/09 | 15:47 | 0.0 | 0.2 | 10.27 | 95.5 | 1,007 |
| 15509012DDD | 7/28/09 | 11:03 | 0.0 | 0.9 | 24.95 | 76.1 | 1,005 |
| 15508806DDD | 7/28/09 | 15:22 | 0.0 | 8.2 | 129.65 | 83.7 | 999 |
| 15709136DDD | 7/29/09 | 14:00 | 0.0 | 32.4 | 40.80 | 77.4 | 996 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
S = Stock Well
NM = Not Measured
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

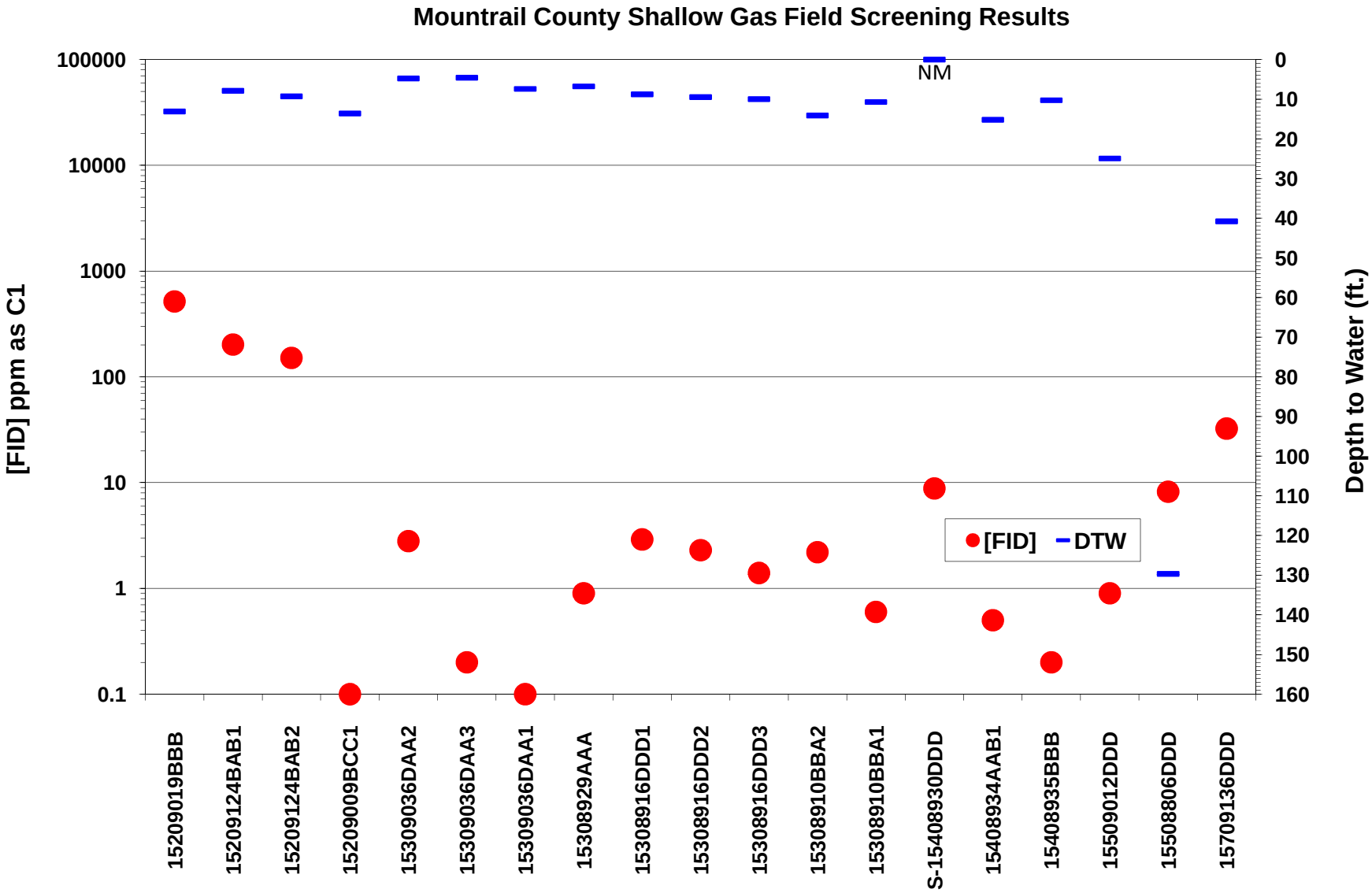


**Figure 26. Shallow gas field screening results in Mountrail County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. NM = Not Measured. S = Stock Well.**

**Table 16. Field screening information collected from ground-water observation wells in Burke County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **15909336AAA** | 8/3/2009 | 10:48 | 0.0 | 5.8 | 49.96 | 82.9 | 991 |
| **16209330DDD1** | 8/3/2009 | 14:31 | 0.0 | 352.7 | 46.50 | 71.8 | 988 |
| **16209410AAA1** | 08/03/09 | 15:54 | 8.1 | 31,347 | 15.65 | 72.5 | 1,007 |
| **16208806CCC** | 08/04/09 | 15:42 | 0.0 | 12.6 | 46.67 | 83.5 | 1,012 |
| **16208807AAA2** | 08/04/09 | 15:58 | 0.0 | 0.4 | 9.40 | 82.8 | 1,013 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

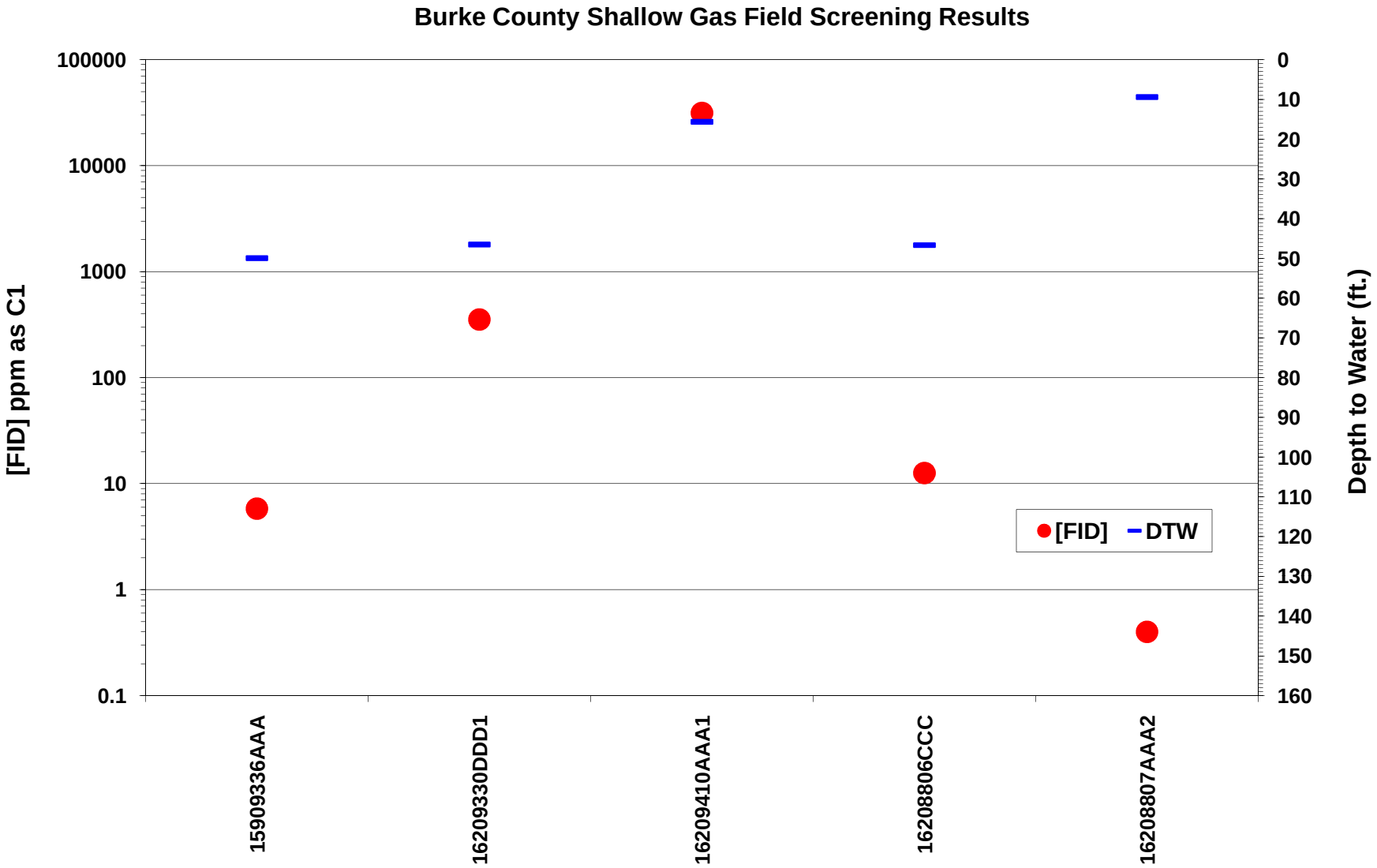


**Figure 27. Shallow gas field screening results in Burke County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.**

## Grant County

Field screening in Grant County, North Dakota was conducted over a three day period from August 3 to 5, 2009. Site information for 86 wells was reviewed prior to field investigation which resulted in 58 wells being visited in the field. 18 wells (16 observation and two stock wells) were field screened. Of these, four (Table 17) returned positive FID responses ranging from 8.1 to 4,238 ppm as C1 (Figure 27). 16 wells were not visited due to access and\or time constraints. Wells with positive FID responses were completed in the Tongue River, Cannonball, and Shields Aquifers. 24 wells were not found.

## Hettinger County

Field screening in Hettinger County was conducted over a four day period from July 30 to August 11, 2009. Site information for 116 wells was reviewed prior to field investigation which resulted in 43 well sites being visited. Of these, 15 wells (six observation and seven stock wells) were field screened. Of the 15 existing wells field screened, eight wells (Table 18) returned positive FID responses ranging from 2.0 to 36.7 ppm as C1 (Figure 28). The occurrence of FID responses are located mostly in the northeastern part of the county in wells completed in the Tongue River Aquifer. 21 wells were not found.

## Sargent County

Field screening in Sargent County was conducted over an 11 non-consecutive day period from July 27 to August 12, 2009. Site information on over 1,600 well sites was reviewed prior to field investigation, which resulted in 561 well sites being visited in the field. Of these, 291 well site locations (271 observation and 20 stock wells) were field screened. Of the 291 existing wells field screened, 41 wells (Table 19) returned positive FID responses ranging from 0.2 to 933 ppm as C1 (Figure 29); 250 of the wells showed no response. Nine wells were found to have detectable concentrations of C1 emanating from the TOC (Table 19). Wells with positive FID responses are located dominantly in the central and eastern parts of the county in wells completed in the Brampton, Spirtwood, Gwinner, and Milnor Channel Aquifers. 121 wells were not visited due to access and/or time constraints. 149 wells were not found.

## Divide County

Field screening in Divide County was conducted over an eight, non-consecutive day period from August 5 to 18, 2009. Site information from 326 wells, was reviewed prior to field investigation, which resulted in 195 well sites being visited in the field. Of these, 88 wells (87 observation wells and 1 stock well) were field screened (Table 20), which returned 38 positive FID responses ranging from 0.1 to 16,155 ppm as C1 (Figure 30). Four wells were found to have detectable concentrations of C1 emanating from the TOC (Table 20). Wells with positive FID responses are located mostly in the northwestern and northeastern parts of the county, in the Columbus, Crosby, Little Muddy, Skjermo Lake, and Yellowstone Buried Channel Aquifers (Appendix I). 94 wells were not found.

**Table 17. Field screening information collected from ground-water observation wells in Grant County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **13508922CDD** | 08/03/09 | 14:45 | 0.0 | 4,238 | 87.31 | 90.4 | 1,069 |
| **13508615DDD2** | 08/03/09 | 16:55 | 0.0 | 420.9 | 5.47 | 87.4 | 1,071 |
| **13208401DAA** | 08/04/09 | 11:30 | 0.0 | 16.4 | 37.46 | 76.6 | 1,091 |
| **13308317DAA** | 08/04/09 | 12:35 | 0.0 | 8.1 | 30.94 | 80.6 | 1,093 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

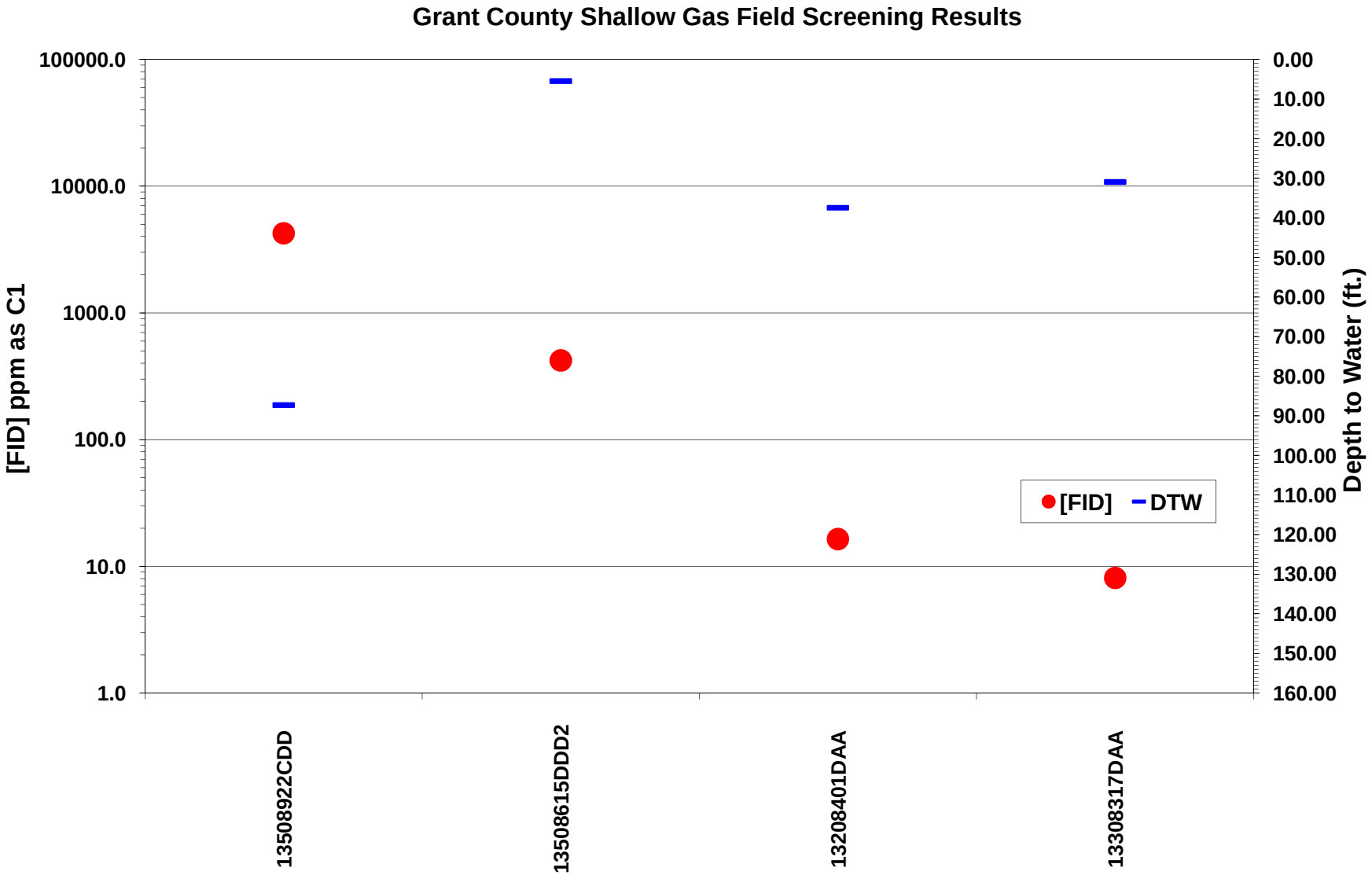


**Figure 28. Shallow gas field screening results in Grant County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.**

**Table 18. Field screening information collected from ground-water observation wells in Hettinger County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **S-13509301BCB1** | 08/06/09 | 15:50 | 2.9 | NM | NM | 68.7 | 1,064 |
| **S-13509428CBB2** | 08/10/09 | 10:20 | 6.9 | NM | NM | 70.3 | 1,063 |
| **S-13209209AAA** | 08/10/09 | 12:00 | 30.6 | NM | NM | 80.6 | 1,062 |
| **13409302DC** | 08/10/09 | 14:25 | 2.9 | NM | NM | 83.8 | 1,064 |
| **S-13509128CCB3** | 08/10/09 | 15:20 | 2 | NM | NM | 82.9 | 1,063 |
| **13309734BBB** | 08/11/09 | 9:10 | 36.7 | 0.0 | 157.92 | 71.2 | 1,057 |
| **13509519DDC2** | 08/11/09 | 11:15 | 2.7 | NM | NM | 81.7 | 1,060 |
| **S-13509120ACB** | 08/11/09 | 14:50 | 3.7 | NM | NM | 82.9 | 1,063 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
S = Stock Well
NM = Not Measured
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

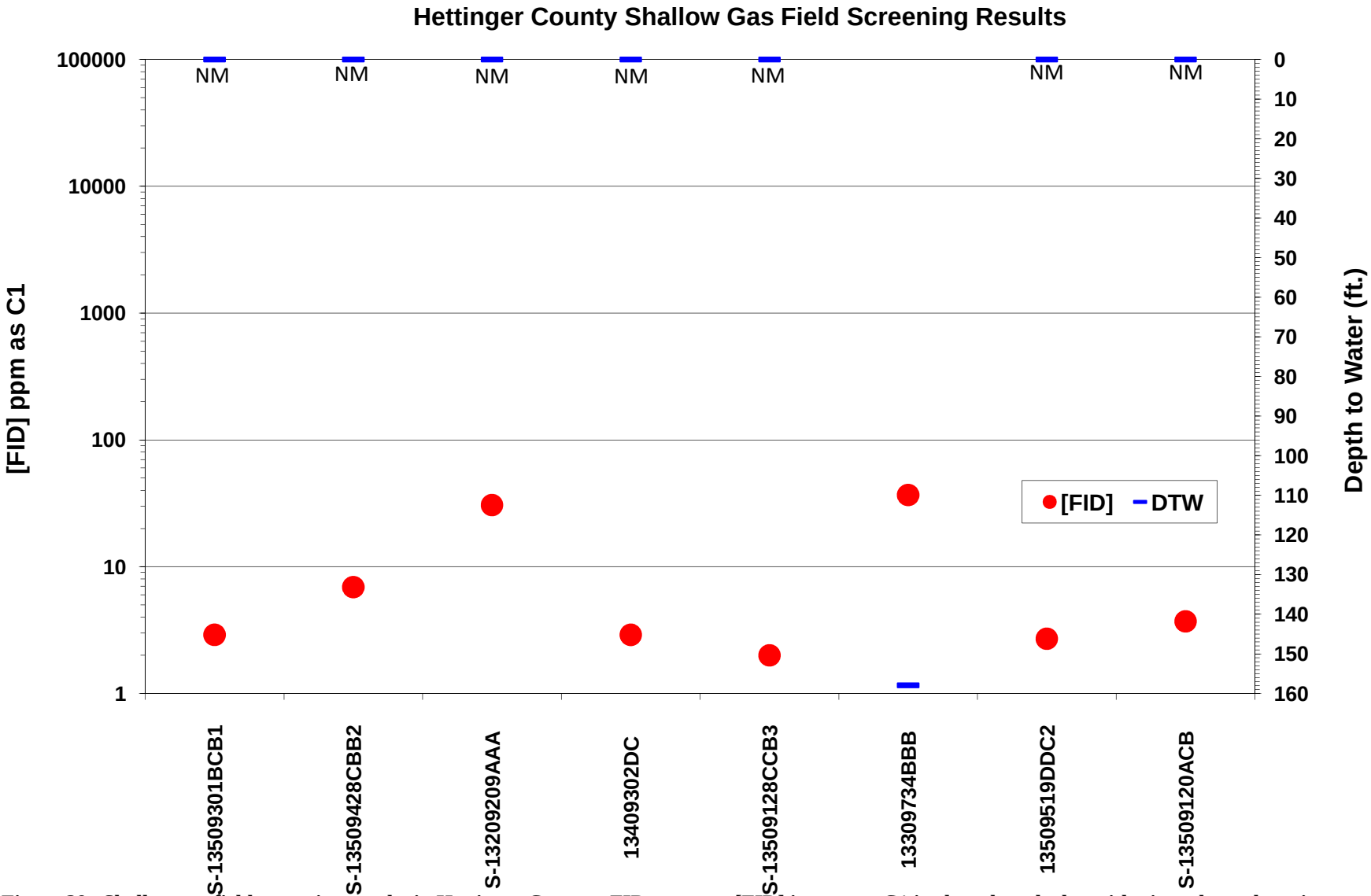


**Figure 29. Shallow gas field screening results in Hettinger County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. NM = Not Measured. S = Stock Well.**

**Table 19. Field screening information collected from ground-water observation wells in Sargent County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **13205331DDD** | 07/27/09 | 13:46 | 0.0 | 1.5 | 7.38 | 78.6 | 1,016 |
| **13105303DDD3** | 07/27/09 | 14:43 | 0.0 | 3.6 | 23.88 | 78.9 | 1,016 |
| **13105311CCC2** | 07/27/09 | 15:22 | 0.0 | 1.2 | 6.46 | 78.9 | 1,017 |
| **13105326DCB2** | 07/27/09 | 16:07 | 0.0 | 5.6 | 29.78 | 78.7 | 1,016 |
| **13005311DDD** | 07/27/09 | 17:28 | 0.0 | 5.5 | 56.62 | 78.2 | 1,014 |
| **13105319CCC** | 07/27/09 | 19:29 | 0.0 | 590.8 | 30.62 | 75.7 | 1,015 |
| **S-13005326BCC** | 07/28/09 | 11:46 | 1.0 | NM | NM | 71.3 | 1,016 |
| **S-13005332BDC** | 07/28/09 | 14:32 | 0.7 | NM | NM | 74.3 | 1,013 |
| **13005435CCC2S** | 07/28/09 | 16:35 | 0.0 | 23.6 | 42.16 | 72.4 | 1,013 |
| **S-13205307ADD** | 07/29/09 | 14:12 | 0.9 | NM | NM | 68.2 | 1,015 |
| **13005404CCC** | 07/29/09 | 17:23 | 0.0 | 2.5 | 51.90 | 67.7 | 1,014 |
| **13205626DAD** | 08/03/09 | 13:49 | 0.0 | 24.2 | 114.22 | 75.9 | 1,012 |
| **13205624BCC** | 08/03/09 | 14:31 | 0.0 | 0.5 | 103.76 | 76.5 | 1,012 |
| **13205614CDA1** | 08/03/09 | 15:56 | 0.0 | 3.7 | 103.12 | 75.2 | 1,012 |
| **13205622DDA** | 08/03/09 | 16:28 | 0.0 | 1.1 | 72.28 | 74.7 | 1,012 |
| **12905508AAA** | 08/04/09 | 12:18 | 0.0 | 4.7 | 104.20 | 75.7 | 1,009 |
| **12905635AAA** | 08/04/09 | 14:06 | 3.2 | 16.4 | 23.94 | 77.2 | 1,008 |
| **12905632BBB** | 08/04/09 | 14:47 | 3.3 | 3.6 | 16.38 | 75.4 | 1,007 |
| **12905609DDD** | 08/04/09 | 17:31 | 0.0 | 10.6 | 8.52 | 72.4 | 1,008 |
| **12905613BBB2** | 08/04/09 | 17:52 | 0.0 | 65.2 | 79.40 | 71.8 | 1,008 |
| **13005630DDD4** | 08/04/09 | 18:39 | 0.0 | 1.1 | 29.46 | 71.6 | 1,007 |
| **13005625BBB2** | 08/04/09 | 19:39 | 0.0 | 0.6 | 41.85 | 70.6 | 1,006 |
| **12905717AAA1** | 08/05/09 | 12:19 | 16.1 | 73.2 | 19.62 | 71.2 | 1,010 |
| **12905703AAA** | 08/05/09 | 14:48 | 0.0 | 16.7 | 21.62 | 73.4 | 1,009 |
| **12905704DDD1** | 08/05/09 | 15:36 | 0.0 | 11.4 | 21.98 | 74.1 | 1,010 |
| **12905708CCC1** | 08/05/09 | 17:44 | 0.0 | 16.4 | 6.82 | 73.8 | 1,008 |
| **12905705AAA1** | 08/05/09 | 19:08 | 0.0 | 0.5 | 16.58 | 69.6 | 1,008 |
| **13005824DDD1** | 08/05/09 | 19:48 | 1.4 | 0.0 | 18.72 | 68.6 | 1,008 |
| **13105620BBB** | 08/06/09 | 13:11 | 0.0 | 2.1 | 9.66 | 67.9 | 1,006 |
| **13105618AAA** | 08/06/09 | 13:22 | 0.0 | 4.3 | 13.02 | 67.8 | 1,006 |
| **13105825CCC5** | 08/10/09 | 11:43 | 10.6 | 9.8 | >150 | 74.1 | 1,005 |
| **13105825CCC1** | 08/10/09 | 11:43 | 0.0 | 8.4 | 10.88 | 74.1 | 1,005 |
| **13105825CCC3** | 08/10/09 | 11:43 | 0.0 | 0.5 | 6.08 | 74.1 | 1,005 |
| **13205821BBB2** | 08/10/09 | 20:13 | 0.0 | 3.4 | 10.80 | 73.9 | 1,004 |
| **13205816BBA2** | 08/10/09 | 20:24 | 0.0 | 19.7 | 13.10 | 73.6 | 1,004 |
| **13205802CCC** | 08/11/09 | 12:06 | 0.0 | 3.2 | 9.26 | 76.2 | 1,006 |
| **13205813CCC10** | 08/11/09 | 12:56 | 0.0 | 0.6 | 12.58 | 77.1 | 1,005 |
| **13105820DDD3** | 08/11/09 | 15:32 | 0.0 | 0.2 | 9.02 | 77.7 | 1,004 |
| **13005820CCC2** | 08/11/09 | 20:06 | 0.0 | 933 | 8.04 | 72.4 | 1,005 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **12905830CCC** | 08/12/09 | 12:54 | 0.0 | 152.6 | 5.90 | 78.4 | 1,004 |
| **S-13005716AAD** | 08/12/09 | 16:43 | 1.4 | NM | NM | 84.4 | 1,003 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
S = Stock Well
NM = Not Measured
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

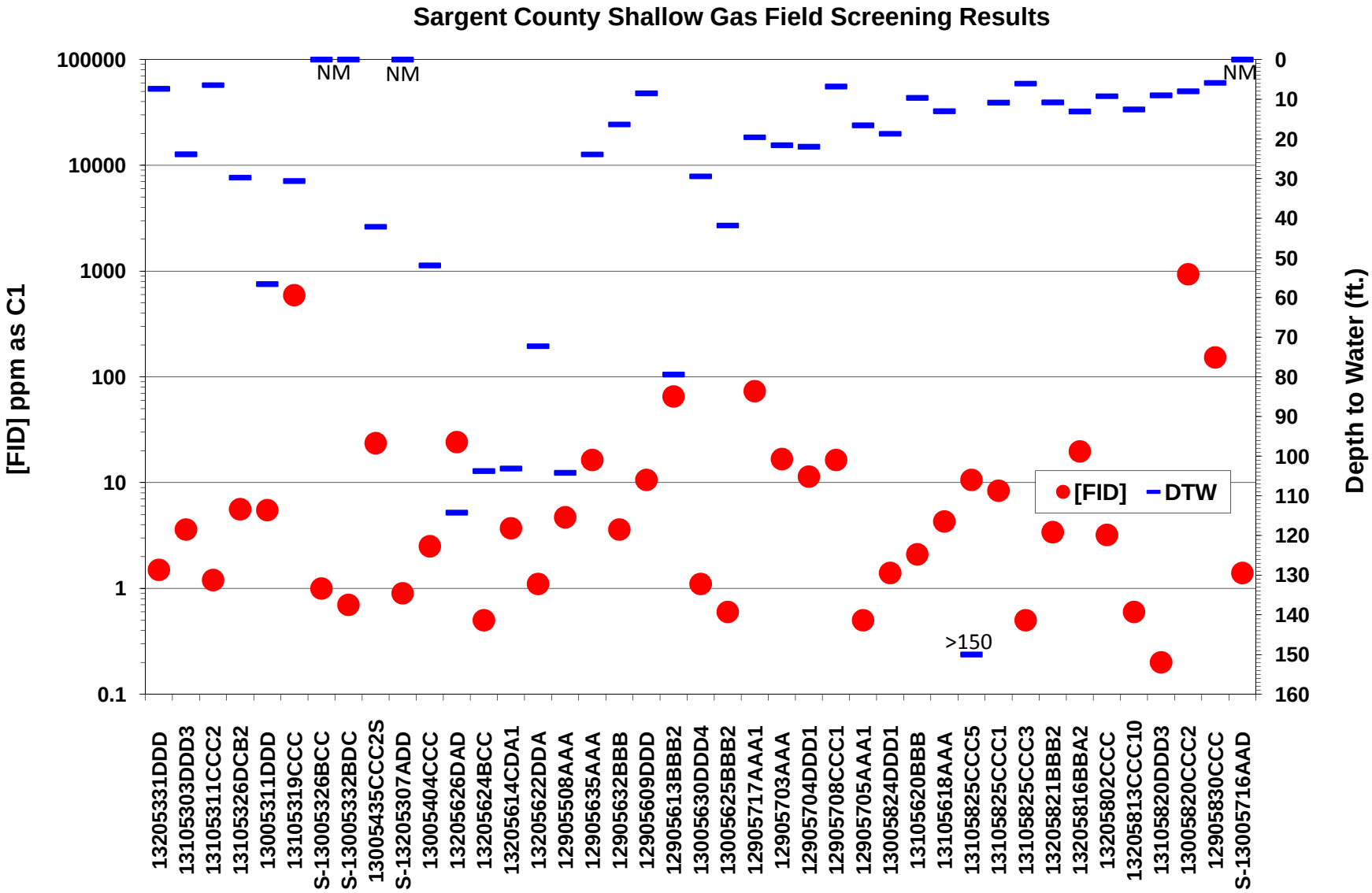


**Figure 30. Shallow gas field screening results in Sargent County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. NM = Not Measured. S = Stock Well.**

**Table 20. Field screening information collected from ground-water observation wells in Divide County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **16309727CCC** | 08/06/09 | 7:41 | 0.0 | 14.7 | 15.41 | 55.8 | 1,011 |
| **16309734ABB** | 08/06/09 | 8:01 | 2.2 | 1,069 | 30.00 | 57.7 | 1,011 |
| **16309726CBB1** | 08/06/09 | 8:34 | 176.7 | 16,155 | 23.15 | 61.2 | 1,011 |
| **16309726CBB2** | 08/06/09 | 8:34 | 0.0 | 1.4 | 6.40 | 61.2 | 1,011 |
| **16309723CBB** | 08/06/09 | 9:08 | 0.0 | 5.6 | 11.10 | 63.5 | 1,012 |
| **16309715ABB** | 08/06/09 | 9:26 | 0.0 | 0.7 | 11.37 | 64.4 | 1,012 |
| **16309715BCC** | 08/06/09 | 9:39 | 0.0 | 0.9 | 24.26 | 66.0 | 1,012 |
| **16309723DDD** | 08/06/09 | 10:07 | 0.0 | 310.8 | 42.06 | 70.9 | 1,012 |
| **16309726DDD** | 08/06/09 | 10:34 | 0.0 | 1.4 | 18.84 | 77.9 | 1,011 |
| **16309725AAA** | 08/06/09 | 11:29 | 0.0 | 7.6 | 66.54 | 77.5 | 1,010 |
| **16309724AAA** | 08/06/09 | 11:48 | 6.3 | 2,485 | 74.40 | 81.0 | 1,010 |
| **16310122ADB1** | 08/10/09 | 13:15 | 0.0 | 0.9 | 7.95 | 93.9 | 1,000 |
| **16310116DDD** | 08/10/09 | 13:34 | 0.5 | 2,709 | 134.40 | 92.1 | 1,000 |
| **16410235DDD** | 08/10/09 | 16:30 | 0.0 | 1.1 | 110.86 | 111.9 | 998 |
| **16410235AAA** | 08/10/09 | 16:47 | 0.0 | 0.8 | 119.34 | 114.8 | 997 |
| **16310234BBB** | 08/11/09 | 9:57 | 0.0 | 0.8 | 57.56 | 91.4 | 1,001 |
| **16310234CCB** | 08/11/09 | 10:20 | 0.0 | 2.4 | 51.10 | 88.5 | 1,000 |
| **16210203ABA** | 08/11/09 | 10:37 | 0.0 | 3.9 | 43.86 | 85.6 | 1,001 |
| **16310233CDD3** | 08/11/09 | 11:12 | 0.0 | 0.7 | 18.30 | 90.9 | 1,001 |
| **16210205BBB** | 08/11/09 | 11:43 | 0.0 | 1.5 | 43.07 | 89.8 | 1,001 |
| **16210312AAA** | 08/11/09 | 14:12 | 0.0 | 1.1 | 21.59 | 97.7 | 999 |
| **16210310AAA** | 08/11/09 | 15:07 | 0.0 | 1.0 | 26.85 | 109.8 | 999 |
| **16210324CBB** | 08/11/09 | 15:55 | 0.0 | 3.0 | 55.76 | 105.1 | 999 |
| **16210104DDA** | 08/12/09 | 10:01 | 0.0 | 0.3 | 10.40 | 79.2 | 994 |
| **16210102ABB** | 08/12/09 | 10:38 | 0.0 | 0.6 | 37.32 | 85.5 | 996 |
| **16310135CCA2** | 08/12/09 | 11:20 | 0.0 | 1.0 | 49.45 | 106.0 | 993 |
| **16210224BBC** | 08/12/09 | 14:42 | 0.0 | 0.6 | 9.60 | 95.5 | 998 |
| **16210215CDD2** | 08/12/09 | 14:56 | 0.0 | 1.2 | 43.96 | 95.7 | 999 |
| **16210217CCC** | 08/12/09 | 15:23 | 0.0 | 2.0 | 39.22 | 101.1 | 999 |
| **16210335CBC** | 08/13/09 | 8:20 | 0.0 | 0.3 | 53.40 | 66.9 | 1,002 |
| **16110312BBB** | 08/13/09 | 8:52 | 0.0 | 0.1 | 64.46 | 65.7 | 1,001 |
| **16110315CDC** | 08/13/09 | 10:47 | 0.0 | 0.2 | 22.10 | 80.8 | 1,001 |
| **S-16009604CCB** | 08/17/09 | 14:37 | 0.0 | 2.2 | NM | NM | NM |
| **16010023CDD1** | 08/17/09 | 17:15 | 0.0 | 4,729 | 46.50 | 86.5 | 1,002 |
| **16010023CDD2** | 08/17/09 | 17:15 | 0.0 | 14.8 | 46.00 | 86.5 | 1,002 |
| **16010023CCC2** | 08/17/09 | 17:30 | 0.0 | 892.8 | 12.00 | 81.1 | 1,002 |
| **16010023CCC1** | 08/17/09 | 17:30 | 0.0 | 121.5 | 30.30 | 81.1 | 1,002 |
| **16010015DDD1** | 08/17/09 | 18:05 | 0.0 | 1.8 | 47.60 | 82.6 | 1,003 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
S = Stock Well
NM = Not Measured
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

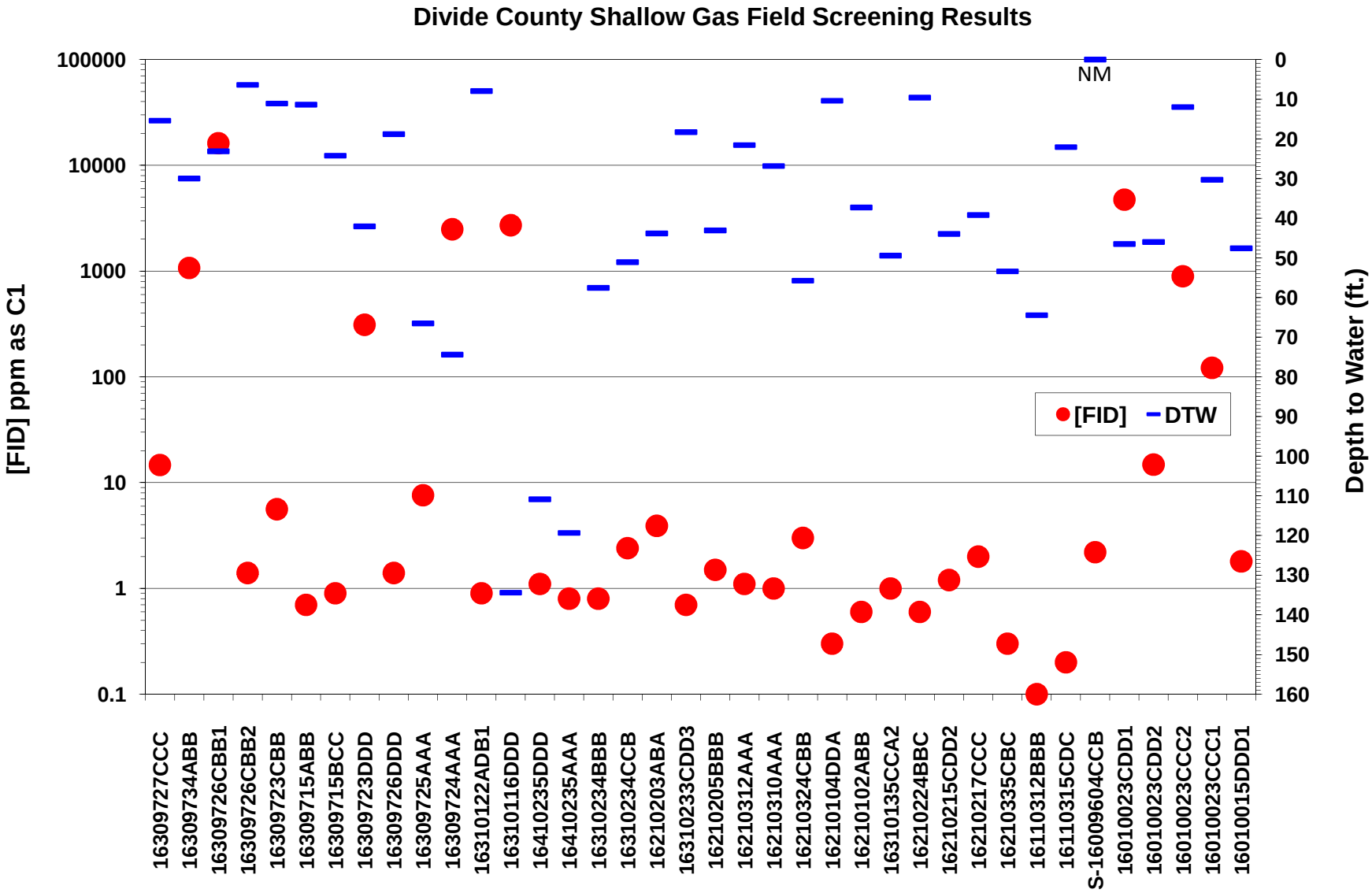


**Figure 31. Shallow gas field screening results in Divide County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. NM = Not Measured. S = Stock Well.**

**McIntosh County**

Field screening in McIntosh County, North Dakota was conducted over a four, non-consecutive day period from August 12 to18, 2009. Site information for 252 wells was reviewed prior to field investigation, which resulted in 114 wells being visited in the field. Of these, 48 wells (43 observation wells and five stock wells) were field screened (Table 21), which returned 13 positive FID responses ranging from 1.5 to 168.9 ppm as C1 (Figure 31). One well (132-67-14DDA2) was found to have a detectable concentration of C1 (13.4 ppm) emanating from the TOC. Wells with positive FID responses trend northwest to southeast in the Wishek and Spring Creek Aquifers (Appendix I). 25 wells were not found.

**Cass County**

Field screening in Cass County was conducted over an eight, non-consecutive day period from May 18 to August 19, 2009. Site information for 871 wells was reviewed prior to field investigation which resulted in 187 wells sites being visited in the field. Of these, 101 wells were field screened which returned 20 wells (Table 22) with positive FID responses ranging from 0.4 to 5,620 ppm as C1 (Figure 31). Wells with positive FID responses are located in the northwest and easternmost parts of the county in the Page and West Fargo Aquifers, respectively (Appendix I). 49 wells were not found.

**Wells County**

Field screening in Wells County was conducted over a three day period from August 18 to 20, 2009. Site information for 259 wells was reviewed prior to field investigation which resulted in 113 wells being visited in the field. Of these, 77 wells were field screened which returned 22 wells (Table 23) with positive FID responses ranging from 0.1 to 4,567 ppm as C1 (Figure 33). Three wells, 148-72-10DCC2, 150-70-33CDD, and 150-71-29AAB, were found to have detectable concentrations of C1 emanating from the TOC. Wells with positive FID responses are clustered in the north-central portion of the county, about seven miles north of Fessenden, in the New Rockford Aquifer (Appendix I). 28 wells were not found.

**McKenzie County**

Field screening in McKenzie County was conducted over a 23 non-consecutive day period from July 22 to August 27, 2009. Site information from over 655 wells was reviewed prior to field investigation which resulted in 379 wells being visited in the field. Of these, 68 wells were field screened which returned 29 wells (Table 24) with positive FID responses ranging from 0.3 to 13,487 ppm as C1 (Figure 34). Five wells (153-94-23CCC1, 150-99-15DDD, 149-95-9CDD, 151-103-11AAA, and 150-98-6AAA) were found to have detectable concentrations of C1 emanating from the TOC. Wells with positive FID responses are located in the northern half of McKenzie County, coincident with surficial (e.g. Charbonneau) and shallow bedrock (e.g. Fox Hills) aquifers (Appendix I). 39 wells were not found.

**Table 21. Field screening information collected from ground-water observation wells in McIntosh County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| 12906836DDD1 | 08/12/09 | 13:30 | 0.0 | 1.5 | 32.36 | 89.8 | 1,079 |
| 12906717DDD | 08/12/09 | 13:45 | 0.0 | 4.6 | 23.89 | 90.7 | 1,078 |
| 12906703BBB1 | 08/12/09 | 14:10 | 0.0 | 1.6 | 50.94 | 91.4 | 1,078 |
| 13106834CBB | 08/12/09 | 16:20 | 0.0 | 50.2 | 29.59 | 89.4 | 1,076 |
| 13207022BBB1 | 08/13/09 | 8:10 | 0.0 | 168.9 | 22.64 | 69.3 | 1,073 |
| S-13107002CCB | 08/13/09 | 8:40 | 2.1 | NM | NM | 71.6 | 1,075 |
| S-13206824AAA | 08/13/09 | 10:45 | 11.6 | NM | NM | 78.1 | 1,072 |
| 13206714DDA2 | 08/13/09 | 11:30 | 0.0 | 6.2 | 13.36 | 79.7 | 1,075 |
| 13006921BBB1 | 08/13/09 | 13:45 | 0.0 | 16.9 | 51.19 | 84.6 | 1,074 |
| 13006921BBB2 | 08/13/09 | 13:50 | 0.0 | 111.1 | 50.78 | 86.0 | 1,074 |
| 13207114BBC1 | 08/18/09 | 7:55 | 0.0 | 4.5 | 41.80 | 51.4 | 1,079 |
| 13207114BBC2 | 08/18/09 | 8:05 | 0.0 | 1.9 | 26.70 | 55.0 | 1,079 |
| 13207123ADD1 | 08/18/09 | 9:00 | 0.0 | 5.4 | 11.25 | 61.3 | 1,079 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
S = Stock Well
NM = Not Measured
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

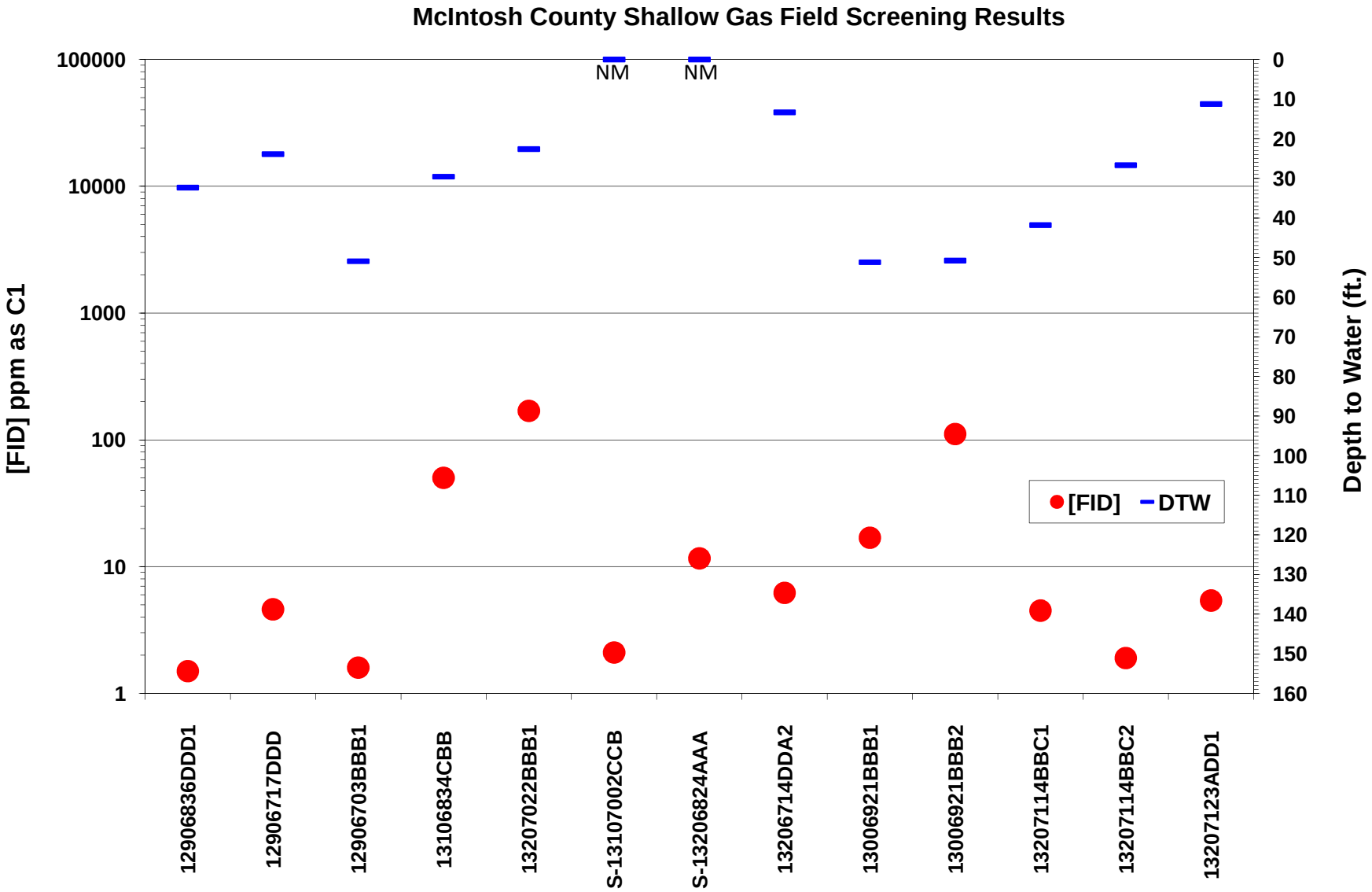


**Figure 32. Shallow gas field screening results in McIntosh County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. NM = Not Measured. S = Stock Well.**

**Table 22. Field screening information collected from ground-water observation wells in Cass County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **13704918BBB** | 05/18/09 | 14:30 | 0.0 | 8.2 | 59.60 | 79.6 | 1,047 |
| **13704920DAA** | 05/18/09 | 14:54 | 0.0 | 3.4 | 65.73 | 82.9 | 1,047 |
| **14305430BBB** | 06/04/09 | 11:15 | 0.0 | 3.2 | 14.16 | 77.2 | 1,039 |
| **14305502BBB2** | 06/04/09 | 12:22 | 0.0 | 1.9 | 29.86 | 82.5 | 1,038 |
| **14305412CCC3** | 06/04/09 | 14:36 | 0.0 | 1.1 | 44.30 | 83.2 | 1,035 |
| **14305435CCC3** | 06/04/09 | 16:04 | 0.0 | 8.7 | 56.69 | 79.8 | 1,034 |
| **14305435CCC2** | 06/04/09 | 16:04 | 0.0 | 2.2 | 61.00 | 79.8 | 1,034 |
| **14205418CCC** | 07/23/09 | 14:06 | 0.0 | 1.2 | 12.62 | 83.4 | 1,012 |
| **14205416BAA1** | 07/23/09 | 15:11 | 0.0 | 1.1 | 57.98 | 84.1 | 1,011 |
| **14205429DCC** | 07/23/09 | 18:16 | 0.0 | 575.6 | 23.78 | 82.1 | 1,008 |
| **14205434AAD3** | 07/23/09 | 18:31 | 0.0 | 87.1 | 6.78 | 81.2 | 1,009 |
| **14204922DDD** | 08/17/09 | 12:07 | 0.0 | 5,620 | 40.68 | 68.7 | 1,017 |
| **14104930AAB** | 08/17/09 | 14:59 | 0.0 | 0.8 | 79.84 | 69.8 | 1,016 |
| **14004935BAA** | 08/17/09 | 17:39 | 0.0 | 55.8 | 111.30 | 70.1 | 1,016 |
| **13905002BAA** | 08/17/09 | 19:21 | 0.0 | 0.4 | 61.82 | 66.7 | 1,017 |
| **13704915BAA** | 08/18/09 | 13:51 | 0.0 | 8.7 | 86.24 | 73.6 | 1,015 |
| **13704914BAA** | 08/18/09 | 14:17 | 0.0 | 1.3 | 67.90 | 73.9 | 1,016 |
| **13704925CCC** | 08/18/09 | 14:48 | 0.0 | 5.4 | 70.08 | 74.3 | 1,016 |
| **13805014DDD** | 08/18/09 | 17:58 | 0.0 | 1.8 | 60.82 | 71.1 | 1,014 |
| **13904905BDD** | 08/19/09 | 14:16 | 0.0 | 23.1 | 132.80 | 69.2 | 1,008 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

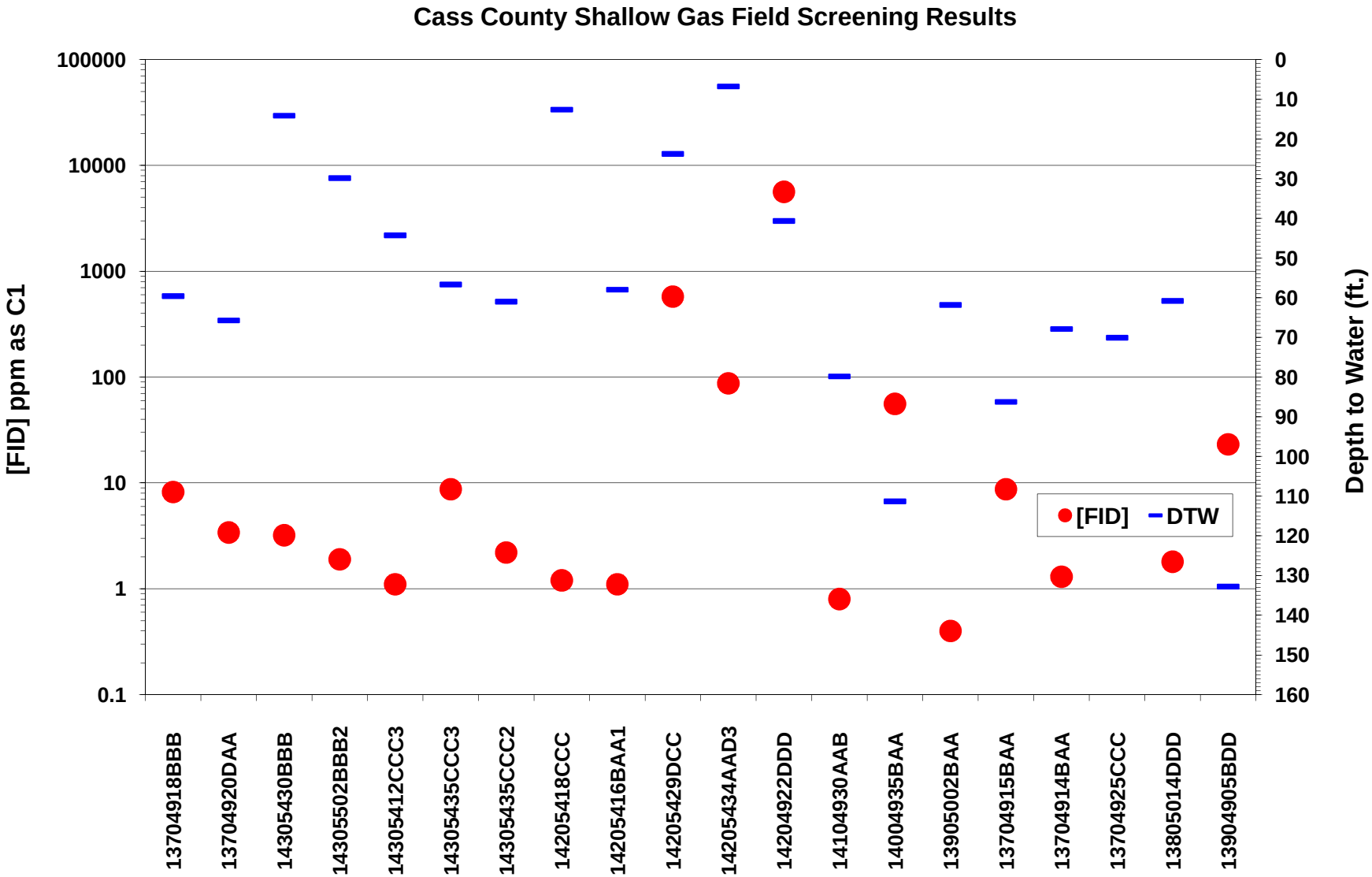


**Figure 33. Shallow gas field screening results in Cass County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.**

**Table 23. Field screening information collected from ground-water observation wells in Wells County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **15007129AAB** | 08/18/09 | 12:48 | 1.2 | 61.9 | 7.15 | 83.8 | 1,016 |
| **15007028ADA** | 08/18/09 | 16:43 | 0.0 | 0.4 | 5.91 | 86.4 | 1,015 |
| **15007136ADD** | 08/18/09 | 17:00 | 0.0 | 7.8 | 80.02 | 86.9 | 1,013 |
| **14907101ADD** | 08/19/09 | 7:53 | 0.0 | 0.5 | 92.90 | 64.8 | 1,010 |
| **15007033CDD** | 08/19/09 | 9:28 | 3.2 | 2,289 | 8.00 | 75.4 | 1,010 |
| **14907003CBB2** | 08/19/09 | 10:02 | 0.0 | 6.8 | 7.28 | 82.8 | 1,009 |
| **14907003CBB3** | 08/19/09 | 10:02 | 0.0 | 2.0 | 6.20 | 82.8 | 1,009 |
| **14907003CBB4** | 08/19/09 | 10:02 | 0.0 | 1.5 | 6.64 | 82.8 | 1,009 |
| **15007027DDA** | 08/19/09 | 14:28 | 0.0 | 0.9 | 7.25 | 82.9 | 1,008 |
| **15007027DDA1** | 08/19/09 | 14:28 | 0.0 | 0.4 | 8.40 | 82.9 | 1,008 |
| **15007025CCC** | 08/19/09 | 15:06 | 0.0 | 5.6 | 2.53 | 88.9 | 1,007 |
| **15007035AAD** | 08/19/09 | 15:20 | 0.0 | 0.5 | 4.91 | 85.8 | 1,009 |
| **14907002AAA1** | 08/19/09 | 15:32 | 0.0 | 0.6 | 55.26 | 83.1 | 1,009 |
| **15006931CBC1** | 08/19/09 | 15:56 | 0.0 | 0.3 | 5.00 | 81 | 1,008 |
| **15006931CBC** | 08/19/09 | 15:56 | 0.0 | 0.1 | 3.80 | 81 | 1,008 |
| **15006932CCC** | 08/19/09 | 16:14 | 0.0 | 2.1 | 6.44 | 81.3 | 1,009 |
| **14807210DCC2** | 8/20/2009 | 8:42 | 14.3 | 4,567 | 6.58 | 63.7 | 1,013 |
| **14807210DCC3** | 8/20/2009 | 8:42 | 0 | 4.4 | 6.29 | 63.3 | 1,013 |
| **14807215ABA** | 8/20/2009 | 9:27 | 0 | 2.5 | 7.00 | 63.5 | 1,013 |
| **14906913BCC** | 08/20/09 | 9:57 | 0.0 | 3.2 | 42.60 | 66.5 | 1,086 |
| **14807211DDDC** | 8/20/2009 | 10:09 | 0 | 1.0 | 4.32 | 64.2 | 1,013 |
| **14906924BCC** | 08/20/09 | 10:10 | 0.0 | 0.9 | 38.20 | 64.1 | 1,086 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

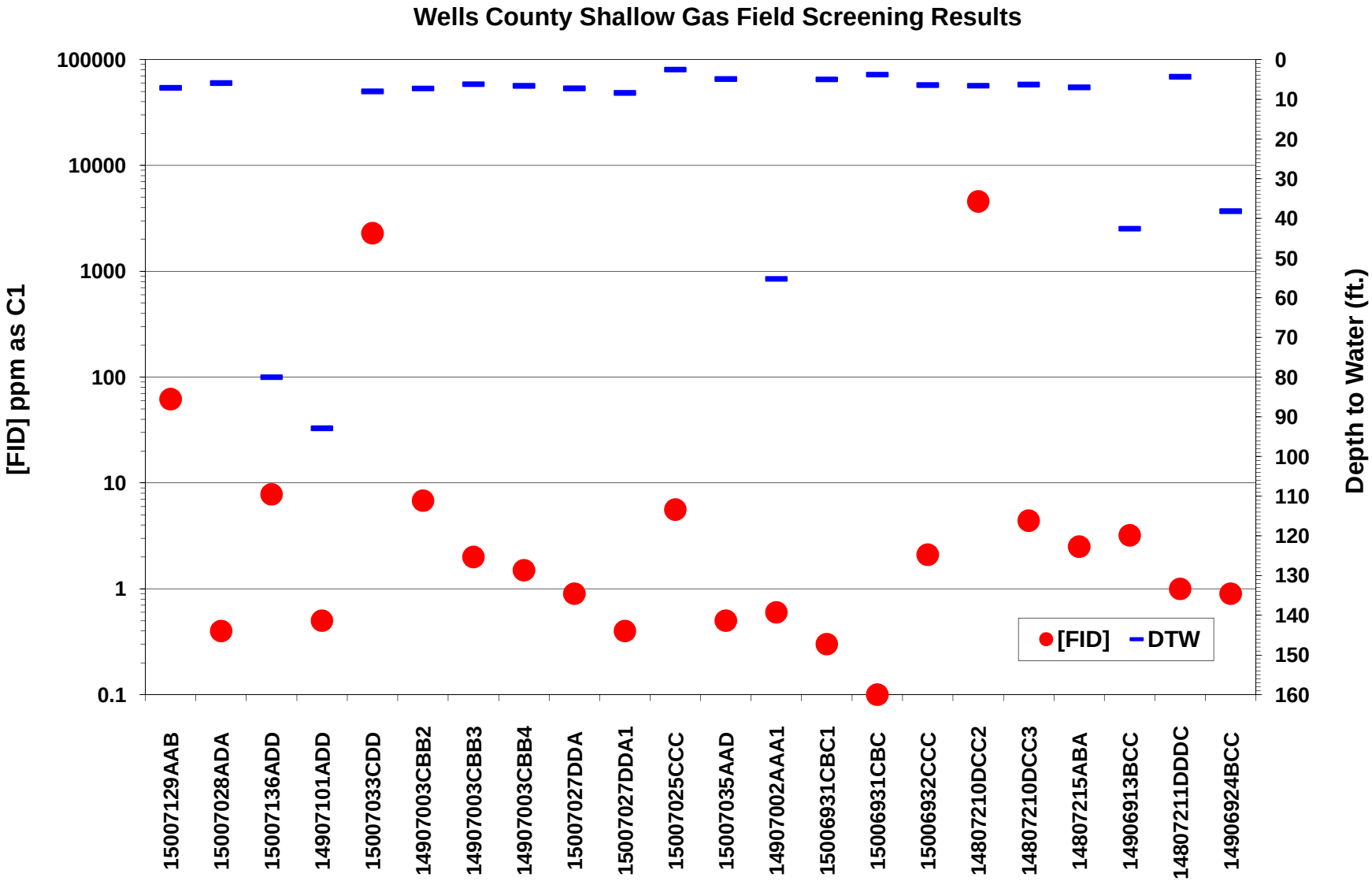


**Figure 34. Shallow gas field screening results in Wells County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.**

**Table 24. Field screening information collected from ground-water observation wells in McKenzie County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **15110311AAA** | 7/23/2009 | 10:39 | 616.8 | 13,487 | 107.22 | 81.2 | 929 |
| **S-15010410BAB** | 7/23/2009 | 17:19 | 218.6 | NM | NM | 102.2 | 939 |
| **15110436ADA** | 7/23/2009 | 17:36 | 0.0 | 2.1 | 17.99 | 99.3 | 938 |
| **15110109BCB** | 7/24/2009 | 9:19 | 0.0 | 2.5 | 88.38 | 76.6 | 940 |
| **15110212CCB** | 7/24/2009 | 10:11 | 0.0 | 1.3 | 80.05 | 85.1 | 940 |
| **15110214CCC** | 7/24/2009 | 10:39 | 0.0 | 21.1 | 116.04 | 80.8 | 938 |
| **S-15110428BCB** | 7/28/2009 | 12:55 | 4,004 | NM | NM | 80.2 | 946 |
| **15010303AAC** | 7/28/2009 | 14:42 | 0.3 | NM | NM | 73.7 | 934 |
| **S-15110222DDD** | 7/29/2009 | 9:27 | 367.1 | NM | NM | 68.5 | 939 |
| **S-15110234BCCD** | 7/29/2009 | 10:14 | 4.3 | NM | NM | 65.1 | 936 |
| **15010214DDD2** | 7/29/2009 | 11:28 | 0.0 | 3.9 | 118.57 | 74.9 | 933 |
| **15010213DDA** | 7/30/2009 | 9:20 | 0.0 | 6.3 | 109.50 | 60.6 | 934 |
| **15210124CBB1** | 7/30/2009 | 12:47 | 0.0 | 11.4 | 9.24 | 79.0 | 946 |
| **S-15010233BDC** | 8/3/2009 | 14:02 | 105.8 | NM | NM | NM | NM |
| **15009915DDD** | 8/5/2009 | 9:25 | 5.6 | 13.8 | 4.65 | 63.3 | 946 |
| **15009806AAA** | 8/5/2009 | 10:56 | 7.2 | 1.7 | 13.10 | 85.5 | 947 |
| **S-15309719CDB2** | 8/6/2009 | 11:09 | 1,877 | NM | NM | 70.1 | 938 |
| **S-14609819AAA** | 8/10/2009 | 16:09 | 34.1 | NM | NM | 87.0 | 922 |
| **15309423CCC1** | 8/18/2009 | 14:23 | 552.3 | 10,351 | 109.58 | 90.6 | 928 |
| **S-15309734CBD** | 8/19/2009 | 10:45 | 8,261 | NM | NM | 78.6 | 932 |
| **S-15209635BCC** | 8/20/2009 | 12:03 | 0.3 | NM | NM | 63.9 | 928 |
| **15209603BBB** | 8/24/2009 | 12:37 | 1.2 | NM | >300 | 81.3 | 932 |
| **15209516ADD** | 8/24/2009 | 13:31 | 1.0 | NM | >300 | 87.1 | 933 |
| **14909509CDD** | 8/24/2009 | 14:56 | 27.8 | 818.9 | 138.33 | 71.4 | 930 |
| **15109504DBD2** | 8/24/2009 | 16:39 | 0.6 | NM | 232.03 | 66.2 | 929 |
| **S-14810414B** | 8/26/2009 | 13:54 | 419 | NM | NM | 96.0 | 928 |
| **S-14810414DAD** | 8/26/2009 | 14:15 | 21 | NM | NM | 96.0 | 928 |
| **S-15210103CAC** | 8/27/2009 | 9:44 | 2,077 | NM | NM | 73.7 | 936 |
| **S-15210211ABC** | 8/27/2009 | 10:34 | 1,641 | NM | NM | 82.2 | 938 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
S = Stock Well
NM = Not Measured
> = Depth to water greater than depth indicated.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

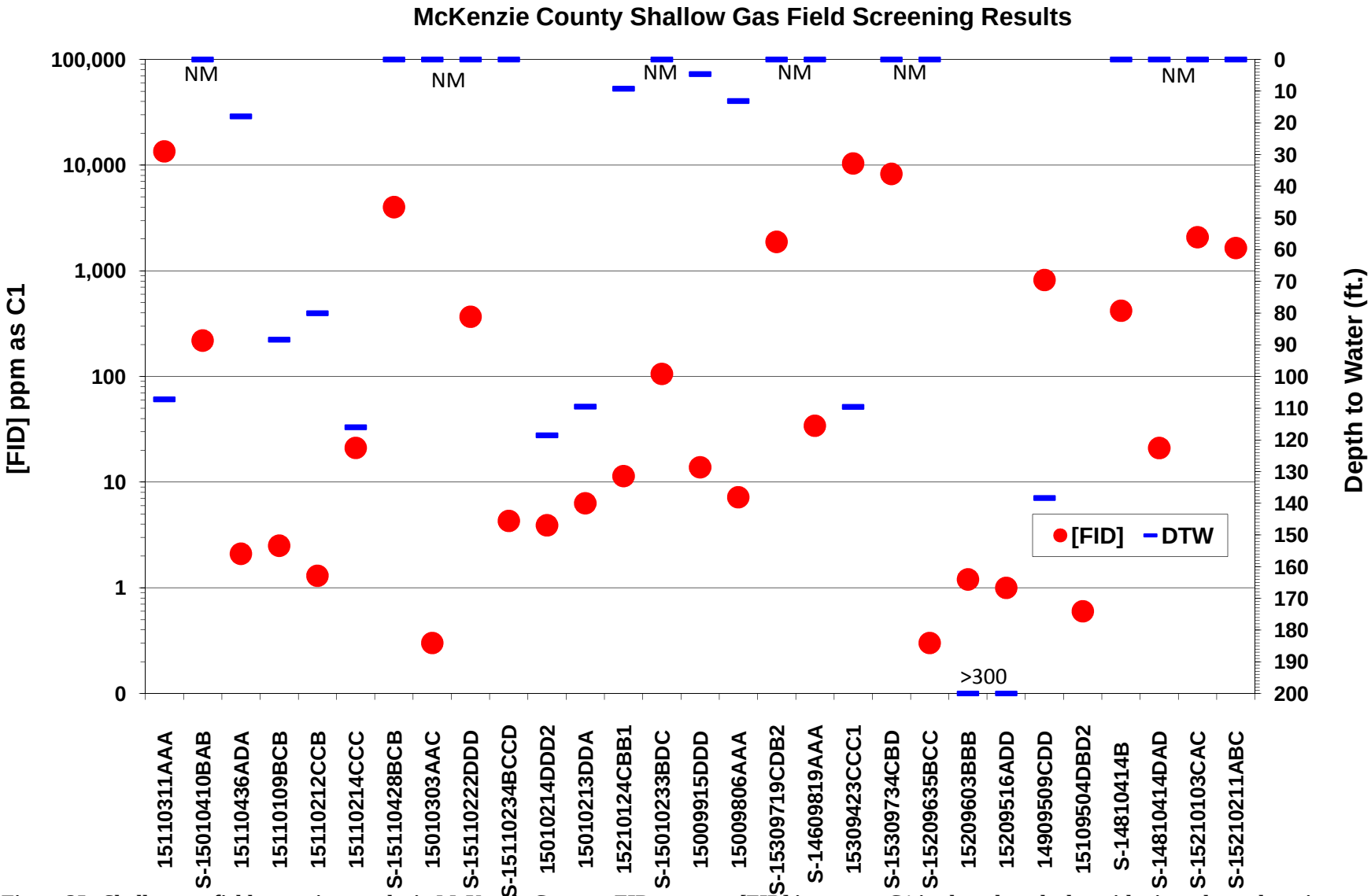


**Figure 35. Shallow gas field screening results in McKenzie County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. NM = Not Measured. S = Stock Well.**

**Williams County**

Field screening in Williams County, North Dakota was conducted over a 14 non-consecutive day period from August 31 to September 23, 2009. Site information for 655 wells was reviewed prior to field investigation which resulted in 331 wells being visited in the field. Of these, 167 wells were field screened, which resulted in 66 wells returning positive FID responses ranging from 0.1 to 14,290 ppm as C1 (Figure 35). A total of 31 wells (highest number in all counties field screened to date) were found to have detectable concentrations of C1 emanating from the TOC. The occurrence of FID responses are located in the central and southeastern part of the county in the surficial (e.g. Little Muddy, Hofflund) and shallow bedrock (e.g. Fox Hills) aquifers. 132 wells were not found.

**Eddy County**

Field screening in Eddy County was conducted over a seven, non-consecutive day period from September 28 - October 7, 2009. Site information for 237 wells was reviewed prior to field investigation, where 172 wells were selected to be visited in the field. Of these, 70 observation wells were field screened which returned seven wells (Table 26) with positive FID responses ranging from 0.1 to 210.6 ppm as C1 (Figure 36). Wells with positive FID responses are located in the northeastern and southwestern parts of the county in the Warwick and New Rockford Aquifers (Appendix I). 69 wells were not found.

**Foster County**

Field screening in Foster County, North Dakota was conducted over an eight, non-consecutive day period from October 8 - October 22, 2009. Site information for 121 wells was reviewed prior to field investigation, where 96 wells were selected to be visited in the field. Of these, 69 wells were field screened with 10 returning positive FID responses (Table 27) ranging from 0.1 to 185.6 ppm as C1 (Figure 37). Wells with positive FID responses are located in the northwestern and eastern parts of the county in the Carrington, Eastman, and New Rockford Aquifers. 14 wells were not found.

**Nelson County**

Field screening in Nelson County, North Dakota was conducted over a five, non-consecutive day period from October 22 - October 29, 2009. Site information for 164 wells was reviewed prior to field investigation which resulted in 115 wells being visited in the field. Of these, 32 wells were field screened, with nine returning positive FID responses (Table 28) ranging from 0.2 to 60.1 ppm as C1 (Figure 38). The occurrence of FID responses are located mostly in the southwestern part of the county in wells completed in the Mcville and Spiritwood Aquifers (Appendix I). 38 wells were not found.

**Table 25. Field screening information collected from ground-water observation wells in Williams County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **15910003CBC1** | 09/23/09 | 9:25 | 0.3 | 210 | 16.56 | 59.5 | 949 |
| **15409609DCC1** | 09/23/09 | 13:17 | 0.8 | 5.1 | 30.53 | 91.7 | 954 |
| **15409609DCC2** | 09/23/09 | 13:17 | 1.1 | 0.9 | 31.03 | 91.7 | 954 |
| **15509628CBD** | 09/23/09 | 13:51 | 0.2 | 0.0 | 18.76 | 91.3 | 951 |
| **15409609AAB** | 09/22/09 | 9:56 | 0.1 | 0.0 | 16.82 | 61.5 | 955 |
| **15409608AAA** | 09/22/09 | 12:40 | 1.9 | 7.2 | 36.52 | 80.0 | 954 |
| **15409616CBC** | 09/22/09 | 13:16 | 0.7 | 1.8 | 46.56 | 80.2 | 953 |
| **15409617BCB1** | 09/22/09 | 13:35 | 1.8 | 0.0 | 57.36 | 80.6 | 953 |
| **15409618DCC** | 09/22/09 | 13:52 | 0.3 | 0.0 | 44.79 | 71.7 | 953 |
| **15409618CCC1** | 09/22/09 | 14:16 | 0.5 | 0.8 | 55.53 | 79.4 | 952 |
| **15409618CCC2** | 09/22/09 | 14:16 | 1.0 | 0.0 | 55.49 | 79.4 | 952 |
| **15409714ACB** | 09/22/09 | 14:54 | 0.4 | 0.0 | 67.06 | 81.5 | 951 |
| **15409712BBB** | 09/22/09 | 15:09 | 0.2 | 0.0 | 69.29 | 81.6 | 951 |
| **15409606BBB2** | 09/22/09 | 16:17 | 0.0 | 1.9 | 86.86 | 83.8 | 950 |
| **15409605BBB** | 09/22/09 | 17:04 | 0.0 | 11.8 | 83.11 | 82.1 | 950 |
| **15609632CCC2** | 09/21/09 | 14:50 | 2.5 | 8.6 | 192.13 | 61.3 | 940 |
| **15609635DDA** | 09/21/09 | 15:26 | 0.5 | 0.0 | 108.14 | 59.1 | 935 |
| **15509701DDD** | 09/17/09 | 9:57 | 0.0 | 0.6 | 67.71 | 77.5 | 939 |
| **15509714DAA** | 09/17/09 | 10:23 | 2.2 | NM | NM | 77.6 | 937 |
| **15509621BCB1** | 09/17/09 | 11:23 | 0.0 | 103.1 | 19.01 | 89.7 | 947 |
| **15509621BCB2** | 09/17/09 | 11:23 | 0.0 | 1.7 | 19.56 | 89.7 | 947 |
| **15609620DCD** | 09/16/09 | 16:26 | 8,665 | 14,290 | 89.71 | 90.0 | 941 |
| **15910022ABA1** | 09/15/09 | 12:30 | 0.0 | 0.8 | 22.38 | 90.7 | 943 |
| **15910022ABA2** | 09/15/09 | 12:30 | 0.0 | 0.6 | 21.20 | 90.7 | 943 |
| **15809913DDD** | 09/15/09 | 13:49 | 0.0 | 1.4 | 135.11 | 106.5 | 935 |
| **15910310BBB** | 09/14/09 | 15:35 | 0.0 | 3.3 | 32.40 | 96.6 | 933 |
| **15910306DDD** | 09/14/09 | 15:57 | 0.0 | 4.0 | 24.61 | 97.2 | 934 |
| **15910310ABB1** | 09/14/09 | 16:14 | 0.0 | 1.7 | 31.18 | 94.2 | 932 |
| **15910310ABB2** | 09/14/09 | 16:14 | 0.0 | 0.4 | 31.59 | 94.2 | 932 |
| **15910310CAA3** | 09/14/09 | 16:52 | 0.0 | 2.0 | 15.23 | 97.6 | 933 |
| **15910028DCD1** | 09/10/09 | 10:40 | 1.0 | 2,884 | 17.00 | 86.1 | 942 |
| **15910028DCD2** | 09/10/09 | 10:40 | 60.1 | 5,416 | 16.00 | 86.1 | 942 |
| **15910028ADD** | 09/10/09 | 12:36 | 0.4 | 20.9 | 25.00 | 91.1 | 941 |
| **15910027CCD1** | 09/10/09 | 13:07 | 0.0 | 1.3 | 34.00 | 88.2 | 941 |
| **15910027CCD2** | 09/10/09 | 13:07 | 0.0 | 0.2 | 32.00 | 88.2 | 941 |
| **15910027DDC2** | 09/10/09 | 13:37 | 0.4 | 0.7 | 25.00 | 92.1 | 941 |
| **15910027DDC** | 09/10/09 | 13:37 | 0.0 | 0.3 | 25.00 | 92.1 | 941 |
| **15910025CBC** | 09/10/09 | 14:03 | 0.5 | 6.6 | 55.00 | 84.7 | 940 |
| **15810112ADD** | 09/09/09 | 12:45 | 0.0 | 0.3 | 19.00 | 98.9 | 942 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **15810017ADA** | 09/09/09 | 13:45 | 0.0 | 1.5 | 27.00 | 89.2 | 941 |
| **15810021BBB** | 09/09/09 | 14:04 | 0.0 | 0.6 | 93.00 | 86.4 | 939 |
| **15810016AAB** | 09/09/09 | 16:03 | 0.3 | 0.0 | 48.00 | 85.5 | 940 |
| **15610007DDD** | 09/08/09 | 13:12 | 0.1 | 0.0 | 26.74 | 64.8 | 941 |
| **15610017AAA** | 09/08/09 | 13:35 | 0.0 | 0.8 | 44.19 | 71.7 | 941 |
| **15610006AAB** | 09/08/09 | 16:45 | 0.8 | 0.0 | 38.68 | 75.0 | 941 |
| **15710013AAD** | 09/08/09 | 19:11 | 0.0 | 10.8 | 108.11 | 66.2 | 936 |
| **15310216DDD** | 09/02/09 | 11:15 | 1.2 | 0.0 | 6.34 | 80.0 | 948 |
| **15410017BBD2** | 09/02/09 | 13:11 | 1.7 | 1.7 | 18.12 | 89.6 | 942 |
| **15410017BDC** | 09/02/09 | 13:40 | 1.7 | NM | NM | 100.6 | 940 |
| **15410017BDA1** | 09/02/09 | 14:30 | 0.0 | 3.8 | 83.46 | 97.5 | 940 |
| **15510034BAB** | 09/02/09 | 15:13 | 1.2 | 29.3 | 184.30 | 92.0 | 939 |
| **15610033CCB** | 09/02/09 | 17:00 | 2.8 | 0.0 | 15.26 | 92.3 | 945 |
| **15210301BBB2** | 09/01/09 | 9:05 | 1.2 | 0.8 | 6.95 | 78.6 | 947 |
| **15210307DDD1** | 09/01/09 | 9:19 | 0.0 | 247.6 | 5.86 | 69.7 | 945 |
| **15310233DBB** | 09/01/09 | 9:42 | 0.0 | 0.3 | 8.15 | 73.9 | 947 |
| **15310231CDC** | 09/01/09 | 13:53 | 0.0 | 2.2 | 0.63 | 96.2 | 944 |
| **15310229CDC** | 09/01/09 | 14:21 | 0.0 | 12.6 | 11.64 | 90.6 | 944 |
| **15310233BBB** | 09/01/09 | 15:07 | 0.0 | 675.8 | 7.51 | 95.3 | 943 |
| **15210206CCB1** | 09/01/09 | 16:23 | 0.3 | 1.4 | 17.46 | 95.3 | 943 |
| **15210206CCB2** | 09/01/09 | 16:23 | 0.3 | 0.0 | 17.76 | 95.3 | 943 |
| **15210301ADD1** | 09/01/09 | 16:46 | 0.0 | 0.7 | 11.24 | 89.6 | 943 |
| **15210301ADD2** | 09/01/09 | 16:46 | 0.0 | 0.6 | 10.72 | 89.6 | 943 |
| **15210301AAD2** | 09/01/09 | 17:10 | 0.0 | 0.7 | 10.88 | 112.6 | 944 |
| **15210301AAD1** | 09/01/09 | 17:10 | 0.0 | 0.7 | 12.13 | 112.6 | 944 |
| **15310233DDD2** | 09/01/09 | 17:30 | 0.0 | 0.8 | 10.12 | 89.8 | 943 |
| **15310233DDD1** | 09/01/09 | 17:30 | 0.0 | 0.7 | 10.55 | 89.8 | 943 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
NM = Not Measured
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

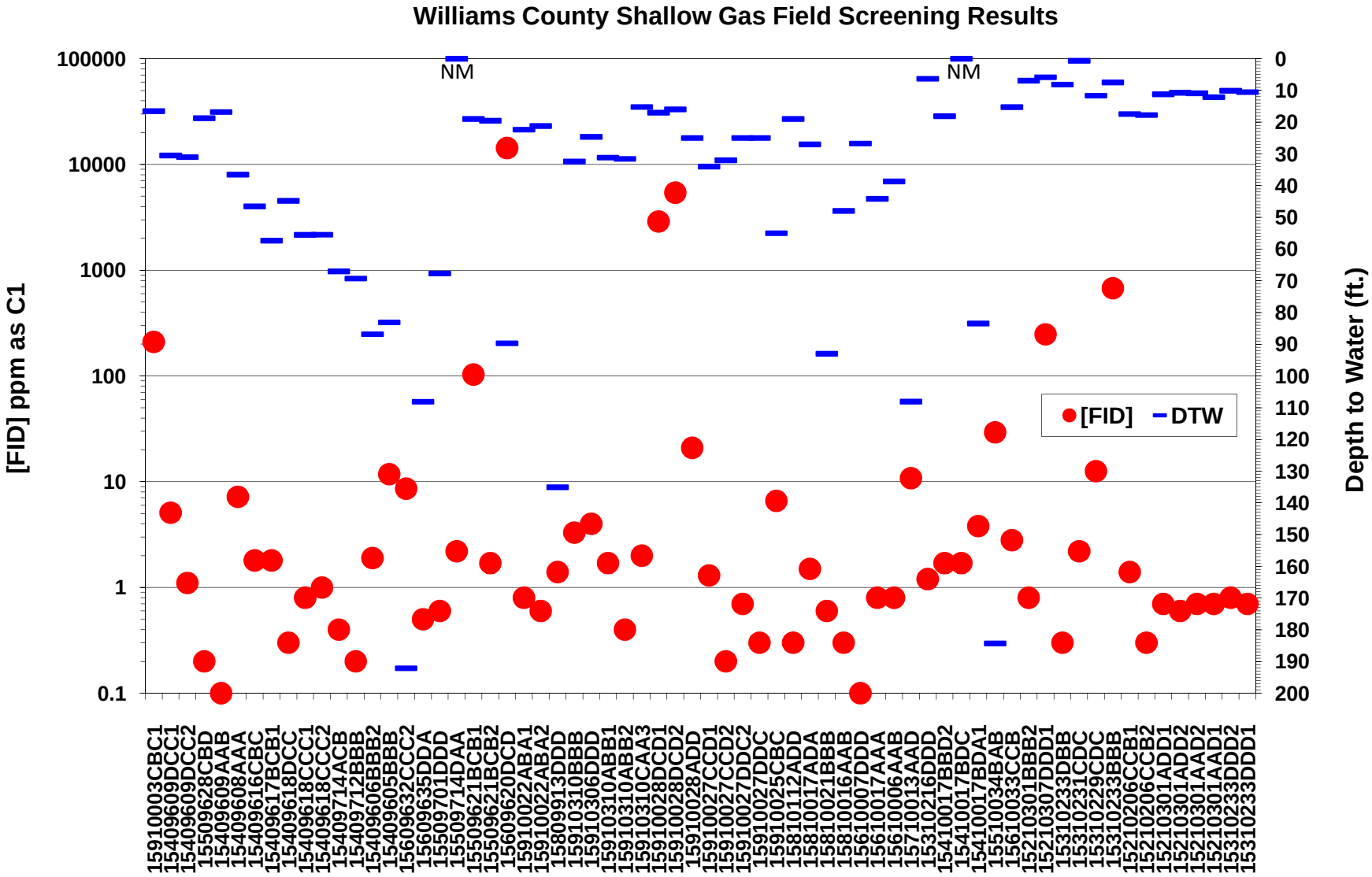


**Figure 36. Shallow gas field screening results in Williams County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. NM = Not Measured.**

**Table 26. Field screening information collected from ground-water observation wells in Eddy County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **14806607CCC** | 09/28/09 | 13:30 | 0.0 | 2.1 | 18.58 | 66.7 | 961 |
| **14806611CCD** | 09/28/09 | 15:26 | 0.0 | 1.4 | 13.88 | 68.0 | 961 |
| **14806603DDC** | 09/29/09 | 10:30 | 0.0 | 5.7 | 35.08 | 57.7 | 966 |
| **15006213CCC** | 10/05/09 | 14:23 | 0.0 | 0.2 | 3.19 | 47.6 | 962 |
| **15006315BBB** | 10/07/09 | 12:32 | 0.0 | 210.6 | 25.60 | 52.5 | 947 |
| **15006302CCC1** | 10/07/09 | 13:13 | 0.0 | 5.5 | 8.70 | 54.1 | 948 |
| **14906722DDD2** | 10/07/09 | 17:39 | 0.0 | 0.1 | 7.20 | 50.8 | 948 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

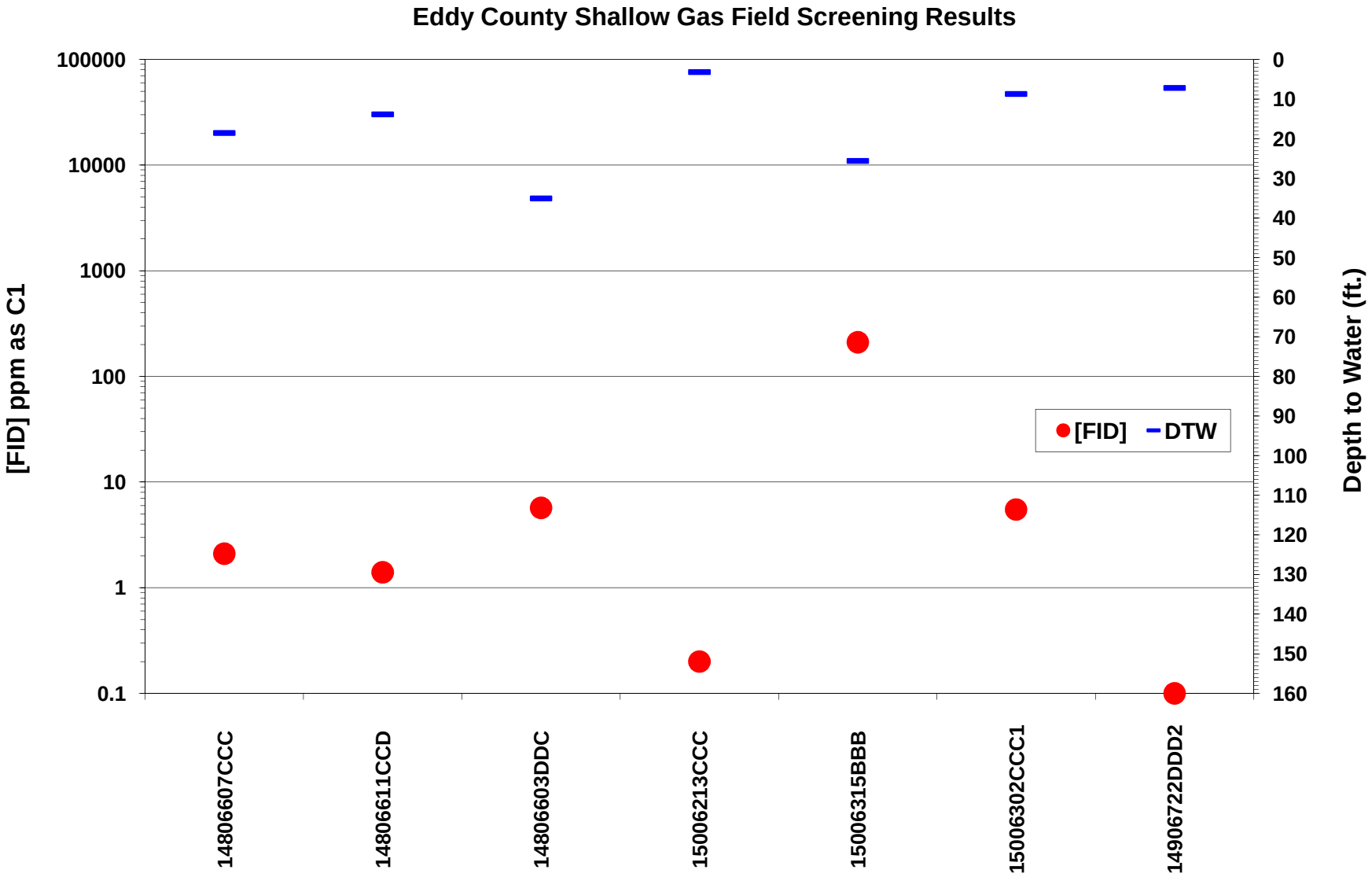


**Figure 37. Shallow gas field screening results in Eddy County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.**

**Table 27. Field screening information collected from ground-water observation wells in Foster County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **14706736BBB** | 10/08/09 | 13:20 | 0.0 | 150.1 | 19.84 | 46.0 | 959 |
| **14506201BBB** | 10/12/09 | 13:59 | 0.0 | 40.9 | 21.86 | 43.3 | 966 |
| **14606236BBB** | 10/12/09 | 14:18 | 0.0 | 10.2 | 21.22 | 31.8 | 966 |
| **14506212BBB** | 10/12/09 | 14:45 | 0.0 | 4.4 | 25.00 | 47.9 | 966 |
| **14506214CCC** | 10/12/09 | 15:06 | 0.0 | 1.6 | 16.87 | 43.0 | 966 |
| **14506227BBB2** | 10/12/09 | 15:25 | 0.0 | 0.1 | 16.07 | 48.7 | 965 |
| **14706210ABB** | 10/13/09 | 9:29 | 0.0 | 0.5 | 8.60 | 33.7 | 973 |
| **14706425ADD** | 10/13/09 | 14:48 | 0.0 | 0.8 | 4.85 | 49.7 | 972 |
| **14606605DDD** | 10/14/09 | 10:12 | 0.0 | 185.6 | 10.09 | 35.5 | 961 |
| **14706629BCC1** | 10/15/09 | 8:50 | 0.0 | 0.1 | 15.01 | 34.1 | 960 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

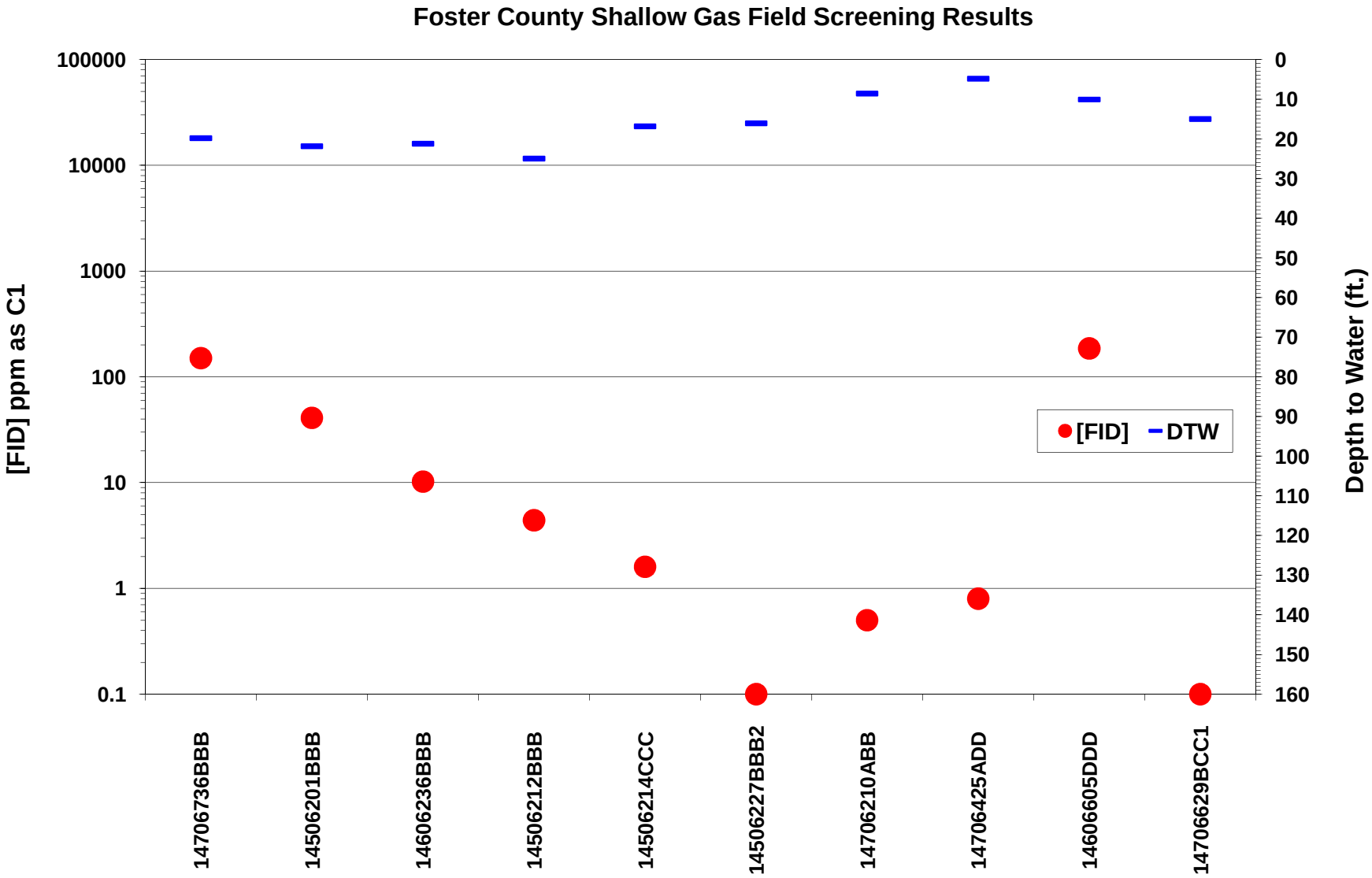


**Figure 38. Shallow gas field screening results in Foster County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.**

**Table 28. Field screening information collected from ground-water observation wells in Nelson County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **15006116DDD** | 10/22/09 | 13:09 | 0.2 | 0.7 | 94.41 | 55.8 | 967 |
| **15006130ABB** | 10/22/09 | 13:44 | 0.0 | 1.4 | 89.11 | 70.4 | 967 |
| **14906133CCC** | 10/26/09 | 15:11 | 0.0 | 60.1 | 44.70 | 58.3 | 953 |
| **15006009CCC** | 10/26/09 | 17:21 | 0.0 | 30 | 31.38 | 49.1 | 953 |
| **15006009DDD** | 10/26/09 | 17:40 | 0.0 | 0.5 | 28.97 | 47.4 | 953 |
| **15006005AAC** | 10/27/09 | 12:34 | 0.0 | 1.2 | 27.95 | 51.6 | 941 |
| **15006024CCC** | 10/27/09 | 18:00 | 0.0 | 0.6 | 48.00 | 49.8 | 941 |
| **15005927CDD** | 10/28/09 | 16:22 | 0.0 | 0.2 | 27.06 | 49.9 | 954 |
| **15005919BCC** | 10/29/09 | 9:29 | 0.0 | 16.8 | 83.48 | 41.0 | 954 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

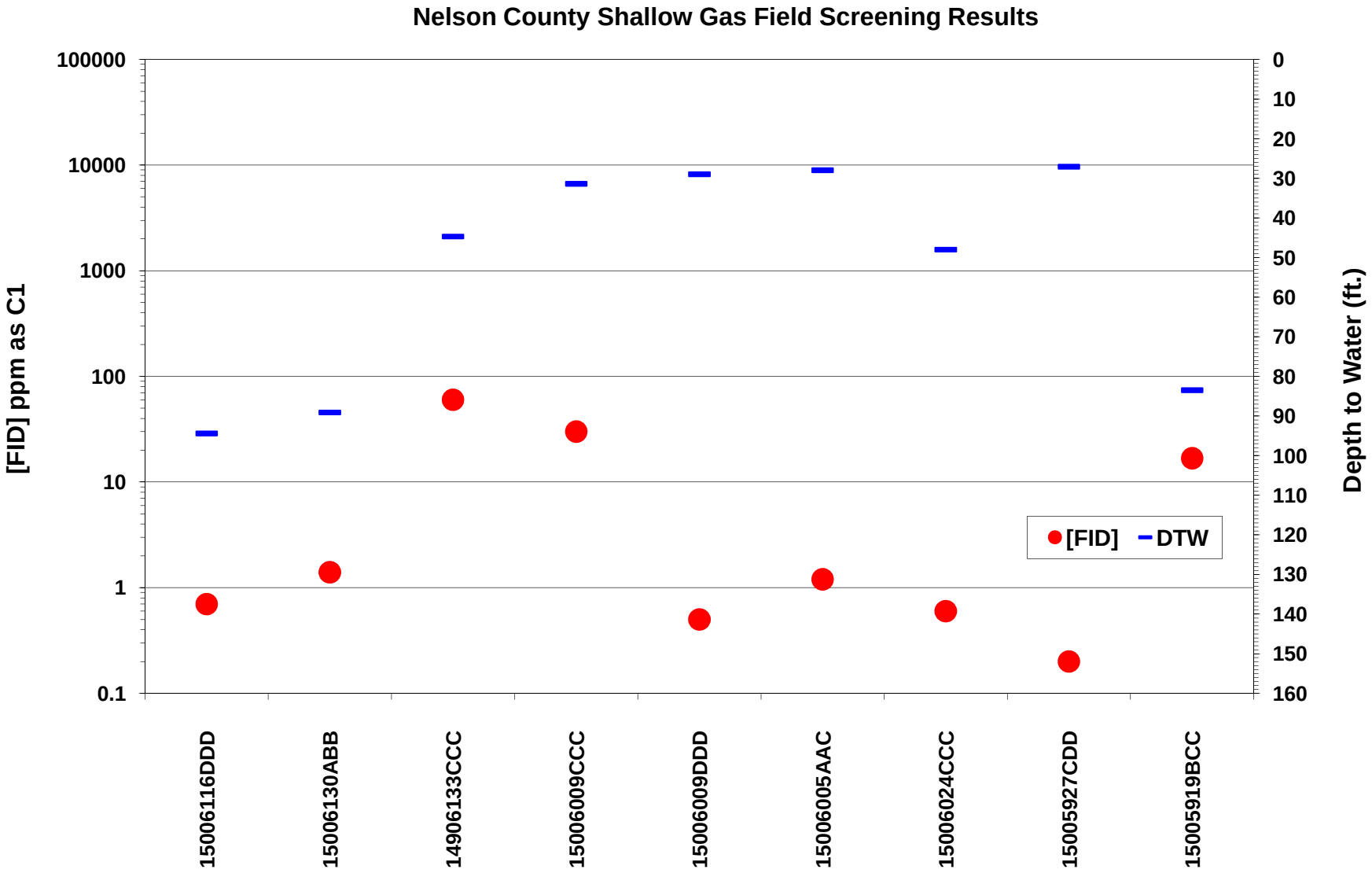


**Figure 39. Shallow gas field screening results in Nelson County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.**

## Ramsey County

Field screening in Ramsey County was conducted over a ten, non-consecutive day period from November 2 - 17, 2009. Site information for 259 wells was reviewed prior to field investigation which resulted in 161 wells being visited in the field. Of these, 68 wells were field screened which returned 16 wells (Table 29) with positive FID responses ranging from 0.2 to 294.1 ppm as C1 (Figure 39). Wells with positive FID responses are located dominantly in the southwestern part of the county in the Pierre Formation and Spiritwood Aquifers. 93 wells were not found.

## Cavalier County

Field Screening in Cavalier County was conducted over a consecutive three-day period from November 17 - 19, 2009. Site information for 127 wells was reviewed prior to field investigation which resulted in 65 wells being visited in the field. Of these, five observation wells were field screened (Table 30) which returned three positive FID responses of 0.1 ppm as C1 (163-64-21AAD), 1.3 ppm as C1 (159-62-21AAA2), and 6,087 ppm as C1 (103-61-33AAA) (Figure 40). 43 wells were not found.

## Shallow Gas Field Screening Conducted in 2010

The remaining four counties to be field screened; Grand Forks, Walsh, Pembina, and Dickey, were completed during the 2010 field season which started in late May in Grand Forks County (Figure 11) and ran to mid-August where field screening was completed in southeastern Dickey County (Figure 8). During the 2010 field season, a total of 1,355 wells were investigated which resulted in 536 wells being visited in the field and field screened for shallow gas. FID instrument responses consistent with a shallow gas (C1) occurrence were found at 68 of the wells field screened. The balance, 468 wells, showed no response. A brief discussion of the results for each county where field screening was performed in 2010, follows.

## Grand Forks County

Field screening in Grand Forks County, North Dakota was conducted over a 28, non-consecutive day period from May 17, 2010 – July 28, 2010. Site information for 561 wells was reviewed prior to field investigation. Of these, 341 wells were selected to be visited in the field which resulted in180 wells being field screened. Of these, 16 returned positive FID responses (Table 31) ranging from 0.3 ppm to 555.6 ppm as C1 (Figure 41). Wells with positive FID responses are located mostly in the eastern part of the county in in the shallow Cretaceous shale subcrop and the Inkster and Elk Valley Aquifers (Appendix I). 131 wells were not found.

**Table 29. Field screening information collected from ground-water observation wells in Ramsey County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **15506530BBB** | 11/02/09 | 15:46 | 1.4 | 1.5 | 4.54 | 44.0 | 970 |
| **15506634CCC** | 11/02/09 | 16:18 | 1.1 | 77.3 | 9.57 | 37.9 | 970 |
| **15406507CDD** | 11/03/09 | 8:27 | 1.0 | 284.7 | 22.57 | 39.8 | 961 |
| **15406535BBB** | 11/03/09 | 11:39 | 0.0 | 9.6 | 22.34 | 54.3 | 959 |
| **15306404BBB** | 11/03/09 | 14:17 | 0.2 | 0.0 | 10.03 | 60.1 | 959 |
| **15306409BBC3** | 11/03/09 | 14:33 | 0.0 | 0.2 | 3.47 | 52.5 | 959 |
| **15306429BBBA3** | 11/03/09 | 16:17 | 0.0 | 10.7 | 19.42 | 41.3 | 959 |
| **15106203DDAA** | 11/04/09 | 8:58 | 0.8 | 0.5 | 93.25 | 39.1 | 966 |
| **15106203DDAD** | 11/04/09 | 9:21 | 0.0 | 1.1 | 87.04 | 40.9 | 966 |
| **15206234DDA** | 11/04/09 | 13:21 | 0.0 | 18.1 | 77.34 | 58.5 | 965 |
| **15206234AAD2** | 11/04/09 | 13:38 | 0.0 | 0.7 | 7.08 | 58.1 | 965 |
| **15206207ACA1** | 11/04/09 | 15:26 | 0.0 | 0.4 | 41.48 | 54.2 | 966 |
| **15306409BAD1** | 11/09/09 | 14:58 | 0.2 | 0.0 | 8.87 | 48.8 | 971 |
| **15806129AAA** | 11/13/09 | 9:04 | 222.1 | 222.1 | NM | 33.7 | 949 |
| **S-15406405AAD1** | 11/17/09 | 10:40 | 0.0 | 294.1 | 15.29 | 52.5 | 962 |
| **15406405AAD3** | 11/17/09 | 10:40 | 217.5 | 220.9 | 13.56 | 52.5 | 962 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
NM = Not Measured
S = Stock Well
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

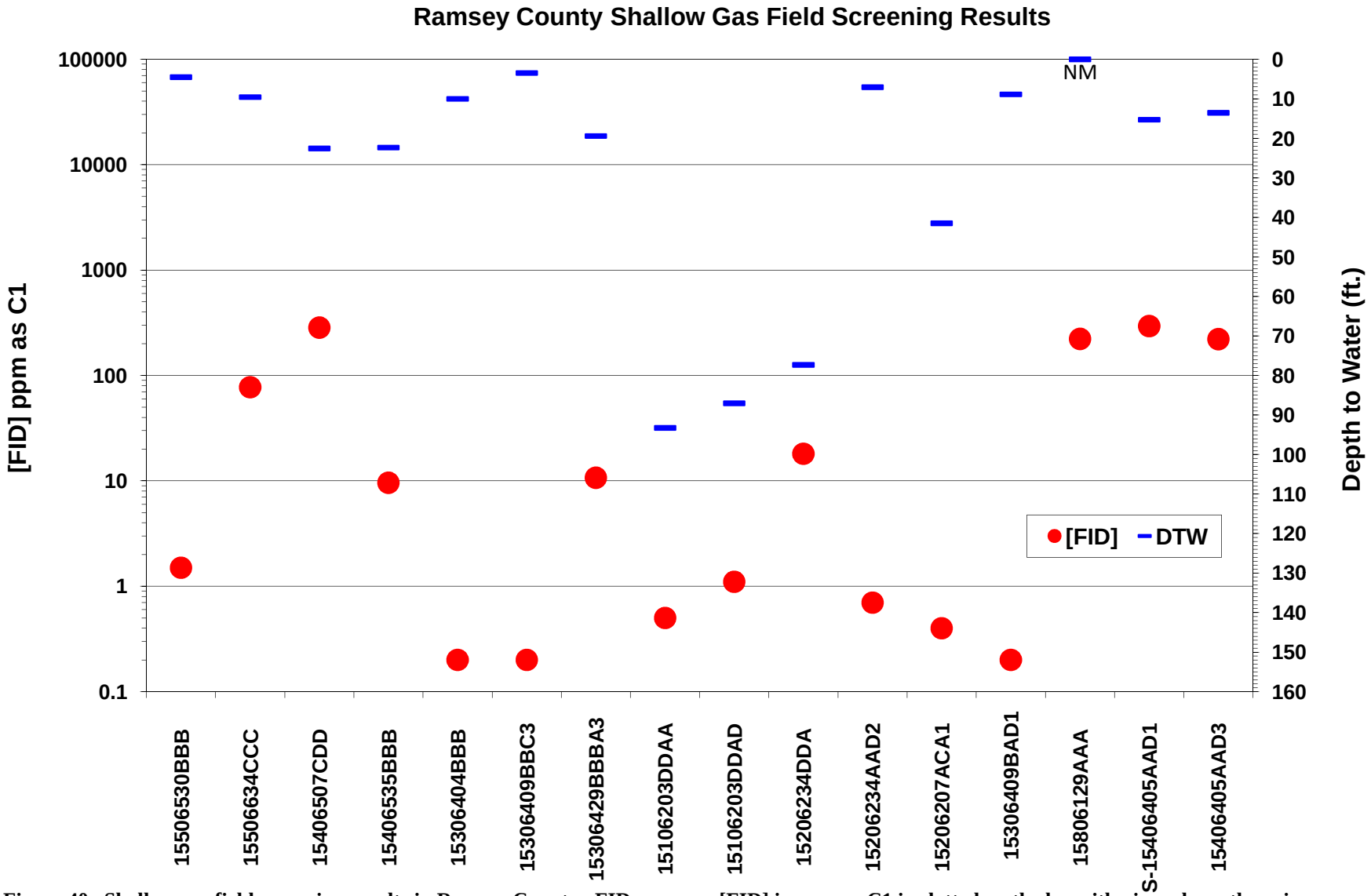


**Figure 40. Shallow gas field screening results in Ramsey County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. NM = Not Measured. S = Stock Well.**

**Table 30. Field screening information collected from ground-water observation wells in Cavalier County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **16306133AAA** | 11/18/09 | 14:07 | 0.0 | 6,087 | 6.30 | 57.1 | 953 |
| **16306421AAD** | 11/18/09 | 16:11 | 0.0 | 0.1 | 6.73 | 48.7 | 952 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

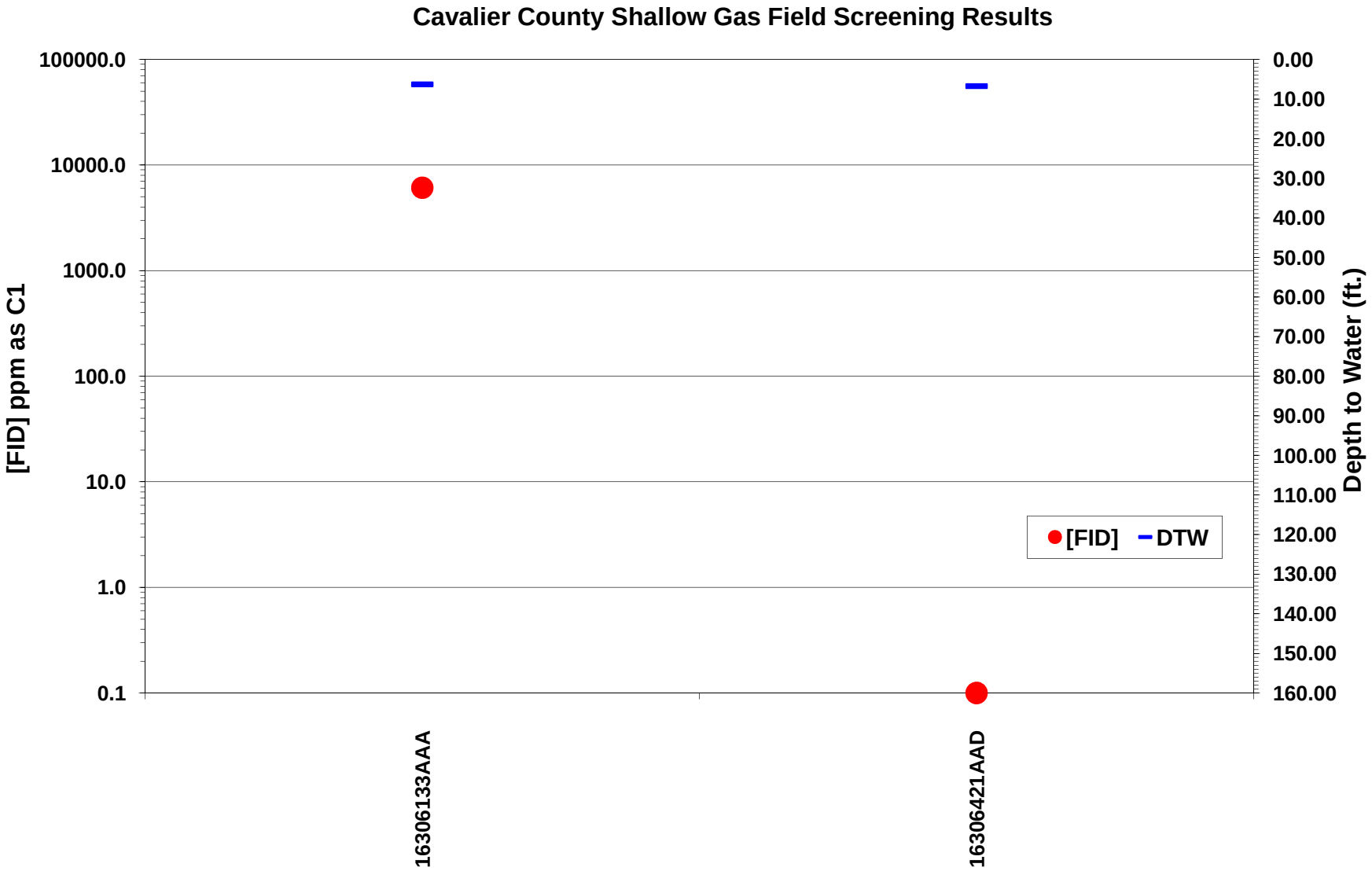


**Figure 41. Shallow gas field screening results in Cavalier County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.**

**Table 31. Field screening information collected from ground-water observation wells in Grand Forks County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **14905205CDD** | 05/17/10 | 17:34 | 0.4 | 0.0 | 1.80 | 81.0 | 981 |
| **14905403AAA** | 05/18/10 | 16:49 | 0.8 | 0.0 | 3.05 | 79.0 | 1005 |
| **14905502CDD** | 05/18/10 | 17:46 | 0.8 | 0.0 | 8.50 | NM | NM |
| **15105523BBB2** | 05/26/10 | 15:50 | 0.0 | 555.6 | 15.05 | 79.0 | 1,010 |
| **15105523BBB3** | 05/26/10 | 15:50 | 0.0 | 37.2 | 4.25 | 79.0 | 1,010 |
| **15105523BBB** | 05/26/10 | 15:50 | 0.0 | 22.2 | 3.80 | NM | NM |
| **15105419CCC2** | 05/27/10 | 9:30 | 0.0 | 290.4 | 9.25 | 71.5 | 1,012 |
| **15005405ABB1** | 05/27/10 | 12:15 | 0.0 | 1.8 | 12.30 | 70.0 | 1,010 |
| **15105428CDA** | 05/27/10 | 13:16 | 0.0 | 0.8 | 17.90 | 72.0 | 1,008 |
| **15305514DCC** | 06/03/10 | 14:49 | 0.4 | 0.9 | 2.75 | 72.0 | 1,006 |
| **15205504DCC38** | 06/07/10 | 12:10 | 0.3 | 1.1 | 23.00 | 83.0 | 1,005 |
| **15205515BBB** | 06/07/10 | 12:20 | 0.3 | 0.0 | 4.49 | 83.0 | 1,005 |
| **15205527DDD2** | 06/07/10 | 14:09 | 0.0 | 2.1 | 13.45 | 84.0 | 1,004 |
| **15405522BAA** | 06/07/10 | 15:27 | 0.5 | 0.0 | 30.55 | NM | NM |
| **15405522BAA2** | 06/07/10 | 15:27 | 0.3 | 2.1 | 30.60 | NM | NM |
| **15405515BCBBB** | 06/09/10 | 10:30 | 1.2 | 1.6 | 22.27 | 64.0 | 1,004 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
NM = Not Measured
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

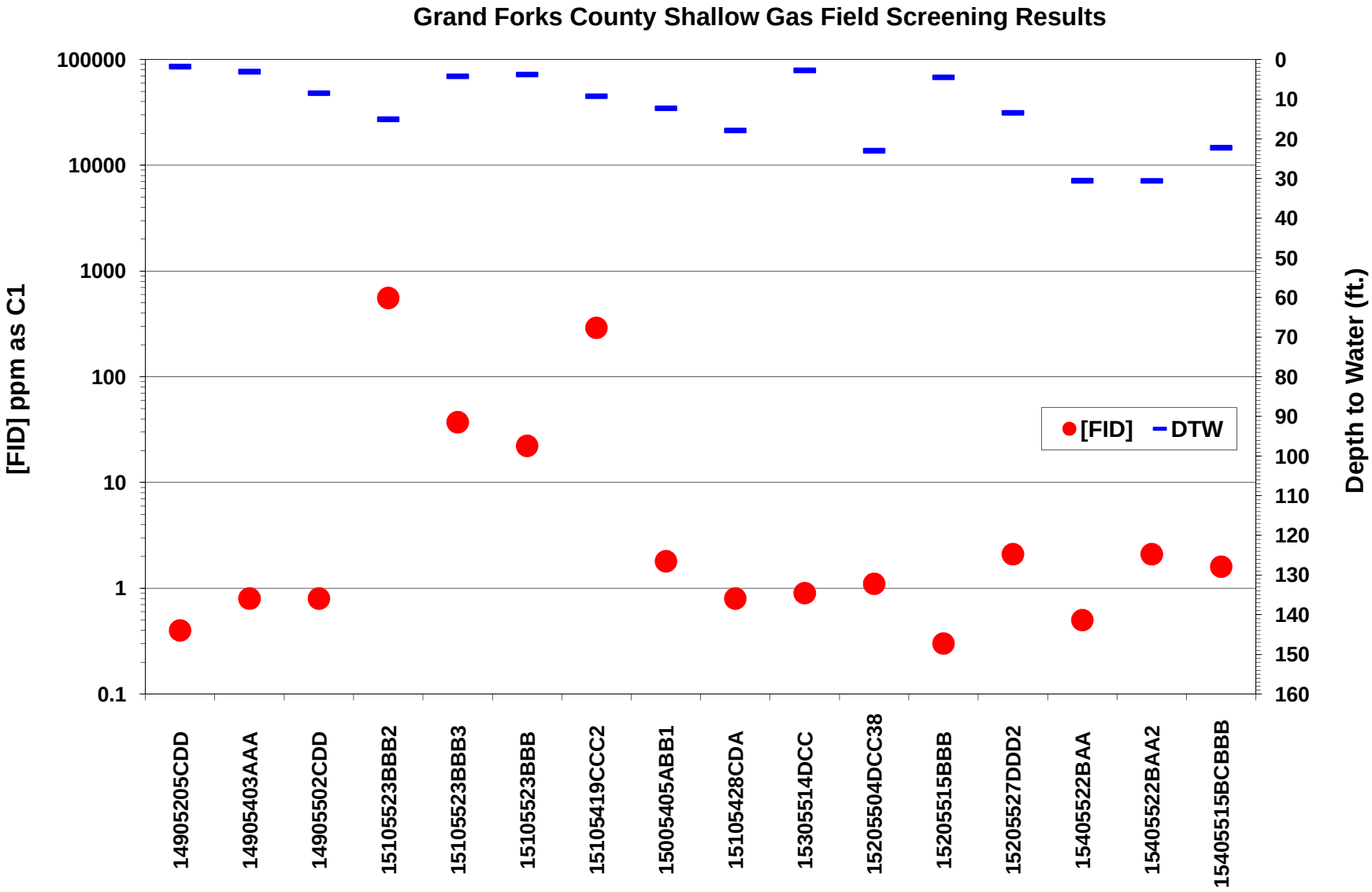


**Figure 42. Shallow gas field screening results in Grand Forks County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.**

## Walsh County

Field screening in Walsh County, North Dakota was conducted over a five, non-consecutive day period from June 16, 2010 - July 28, 2010. Site information for 146 wells was reviewed prior to field investigation. Of these, 111 wells were visited in the field which resulted in 41 wells being field screened, which returned 22 positive FID responses (Table 32) ranging from 0.4 ppm to 41.9 ppm as C1 (Figure 42).

Wells with positive FID responses are located mostly in the south-central part of the county just north of Fordville, in the Fordville Aquifer (Appendix I). 69 wells were not found.

## Pembina County

Field screening in Pembina County, North Dakota was conducted over a five, non-consecutive day period from July 15, 2010 – July 26, 2010. Site information for 239 wells was reviewed prior to field investigation. Of these, 160 wells were selected to be visited in the field which resulted in 70 wells being field screened. 18 wells returned positive FID responses ranging from 0.3 ppm to 879.3 ppm as C1 (Figure 43). Wells with positive FID responses are found mostly in the eastern part of the county just west of Cavalier, in the Icelandic and Pembina Aquifers (Appendix I). 80 wells were not found.

## Dickey County

Field screening in Dickey County, North Dakota was conducted over a twelve, non-consecutive day period from August 2, 2010 - August 19, 2010. Site information for 1,114 wells was reviewed prior to field investigation. Of these, 708 wells were visited in the field which resulted in 257 wells being field screened. 17 wells returned positive FID responses (Table 34) ranging from 0.4 ppm to 3,051 ppm as C1 (Figure 44). Wells with positive FID responses are found mostly in the southeastern part of the county near Oakes in the Spiritwood Aquifer (Appendix I). 451 wells were not found.

**Table 32. Field screening information collected from ground-water observation wells in Walsh County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **15605624BCC** | 06/15/10 | 12:21 | 0.4 | 9.3 | 70.25 | 80.0 | 1,001 |
| **15805625AAA** | 06/15/10 | 12:23 | 1.0 | 0.6 | 5.60 | 79.0 | 1,000 |
| **15605616BAA** | 06/15/10 | 13:55 | 0.9 | 0.0 | 6.70 | 77.0 | 1,000 |
| **15605615DDD** | 06/16/10 | 12:03 | 0.7 | 41.9 | 17.50 | 87.0 | 1,003 |
| **15605623CDD** | 06/16/10 | 14:35 | 0.0 | 1.1 | 18.90 | 83.0 | 1,002 |
| **15605622DCC** | 06/16/10 | 14:52 | 2.5 | 0.0 | 13.95 | 82.0 | 1,002 |
| **15805530DDC** | 07/09/10 | 12:17 | 1.9 | 0.0 | 7.54 | 90.0 | 1,001 |
| **15605624CCC** | 07/09/10 | 13:40 | 0.0 | 7.6 | 40.24 | 74.0 | 1,000 |
| **15605634DCC** | 07/09/10 | 16:00 | 1.4 | 0.0 | 23.45 | 76.0 | 1,000 |
| **15605634DDD** | 07/09/10 | 16:10 | 3.3 | 0.0 | 20.50 | 70.0 | 1,000 |
| **15605636CDD** | 07/09/10 | 17:07 | 1.9 | 0.0 | 42.27 | 72.0 | 1,000 |
| **15605635AAA** | 07/09/10 | 17:23 | 2.3 | 0.0 | 16.95 | 73.0 | 1,000 |
| **15605626DCC** | 07/09/10 | 17:48 | 2.5 | 0.0 | 9.50 | 73.0 | 1,000 |
| **15605627ADD1** | 07/09/10 | 18:20 | 1.5 | 0.0 | 18.40 | 73.0 | 1,000 |
| **15505611DDD** | 07/12/10 | 11:07 | 0.8 | 0.0 | 6.25 | 87.0 | 1,001 |
| **15505624ABB** | 07/12/10 | 11:47 | 0.8 | 0.0 | 17.24 | 80.0 | 1,001 |
| **15505623AAA2** | 07/12/10 | 12:03 | 0.4 | 0.7 | 28.19 | 83.0 | 1,000 |
| **15605623BCC** | 07/28/10 | 10:47 | 0.0 | 1.3 | 14.67 | 82.0 | 1,001 |
| **15605624CCC2** | 07/28/10 | 10:59 | 0.0 | 5.6 | 30.20 | 82.0 | 1,001 |
| **15605625CDD** | 07/28/10 | 11:08 | 1.2 | 0.0 | 12.72 | 82.0 | 1,001 |
| **15605626DAA** | 07/28/10 | 11:20 | 1.0 | 0.0 | 14.00 | 82.0 | 1,001 |
| **15505611ABB** | 07/28/10 | 12:01 | 2.5 | 0.0 | 7.50 | 85.0 | 1,001 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

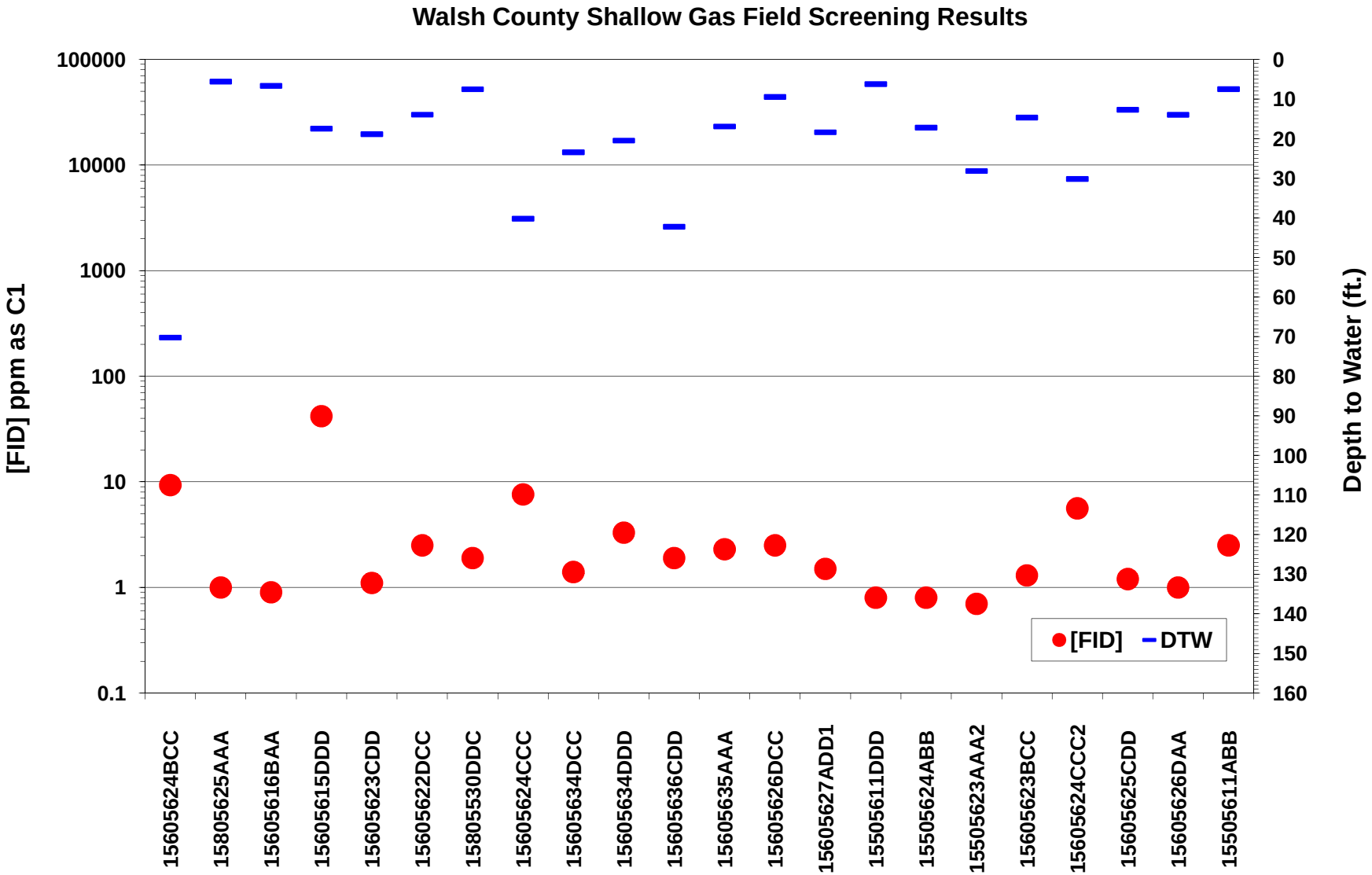


**Figure 43. Shallow gas field screening results in Walsh County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.**

**Table 33. Field screening information collected from ground-water observation wells in Pembina County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **16305627DBA** | 07/15/10 | 12:03 | 0.9 | 0.0 | 8.23 | 79.0 | 1005 |
| **16305628DBB** | 07/15/10 | 12:26 | 0.3 | 0.0 | 7.55 | 77.0 | 1005 |
| **16305628ABD** | 07/15/10 | 15:22 | 2.0 | 0.0 | 10.27 | 80.0 | 1005 |
| **15905630ACD** | 07/19/10 | 11:47 | 17.9 | NM | 3.75 | 77.0 | 999 |
| **16105530CBB** | 07/19/10 | 13:33 | 0.0 | 2.7 | 5.34 | 79.0 | 1005 |
| **16105527CDD** | 07/20/10 | 10:20 | 1.4 | 879.3 | 4.80 | 73.0 | 1009 |
| **16105516DBB** | 07/20/10 | 12:21 | 1.0 | 2.1 | 24.41 | 70.0 | 1012 |
| **16105528CDD** | 07/20/10 | 13:24 | 3.5 | NM | 4.30 | 73.0 | 1009 |
| **16105528BAB** | 07/21/10 | 10:20 | 0.5 | 0.5 | 10.99 | 69.0 | 1011 |
| **16105527CBB** | 07/26/10 | 12:38 | 0.7 | 2.0 | 4.70 | 86.0 | 1003 |
| **16105528AAA** | 07/26/10 | 12:43 | 2.5 | 2.9 | 6.79 | 86.0 | 1003 |
| **16105528ABC** | 07/26/10 | 12:57 | 0.3 | 1.8 | 12.09 | 86.0 | 1003 |
| **16105528AAD** | 07/26/10 | 13:15 | 2.2 | 2.8 | 7.58 | 92.0 | 1003 |
| **16105528BCB1** | 07/26/10 | 13:33 | 0.0 | 1.8 | 10.30 | 92.0 | 1003 |
| **16105529CBC** | 07/26/10 | 13:51 | 0.0 | 94.3 | 9.24 | 92.0 | 1003 |
| **16105530DBC** | 07/26/10 | 14:00 | 0.0 | 3.8 | 12.02 | 92.0 | 1003 |
| **16105531BBB** | 07/26/10 | 14:14 | 0.0 | 2.6 | 9.76 | 92.0 | 1003 |
| **16105529BBB** | 07/26/10 | 14:38 | 0.0 | 4.8 | 4.98 | 92.0 | 1003 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
NM = Not Measured
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

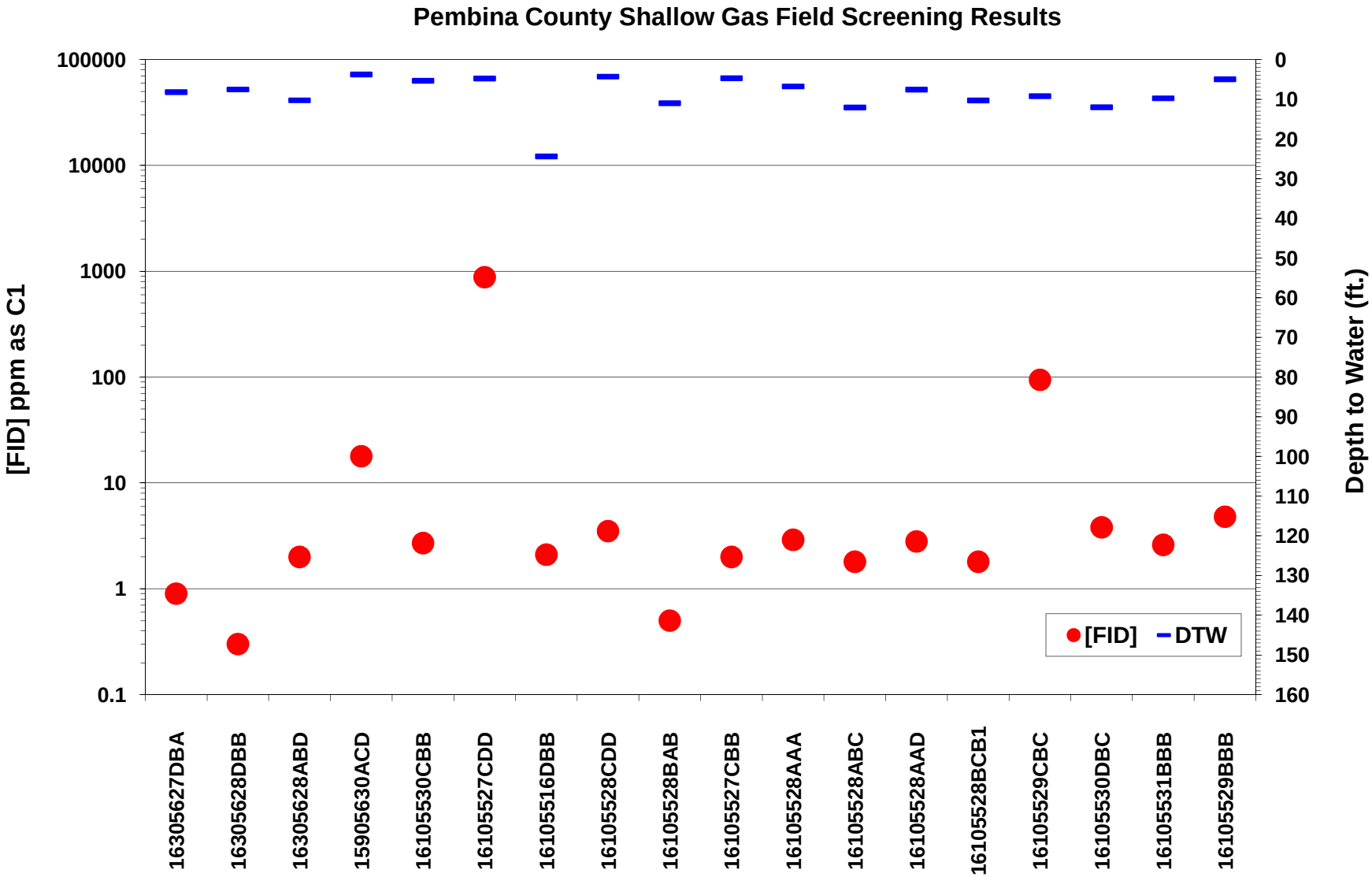


**Figure 44. Shallow gas field screening results in Pembina County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.**

**Table 34. Field screening information collected from ground-water observation wells in Dickey County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector (FID).**

| Location | Shallow Gas Field Screening Field Data | | | | | [2]Atmospheric Conditions | |
|---|---|---|---|---|---|---|---|
| | Date | Time | FID @ TOC (ppm) | FID @ GWI (ppm) | [1]Depth to Water (ft) | Temp. ($^{o}$F) | Pressure (mB) |
| **13205904CCC** | 08/02/10 | 14:32 | 0.0 | 11.6 | 37.08 | 84.0 | 993 |
| **13106006BBB** | 08/03/10 | 13:12 | 0.0 | 50.1 | 25.41 | 82.0 | 997 |
| **13206019ABB** | 08/03/10 | 13:28 | 0.0 | 22.1 | 5.15 | 82.0 | 997 |
| **12906236ADA2** | 08/04/10 | 14:02 | 0.0 | 6.9 | 16.54 | 92.0 | 995 |
| **12906236ADA3** | 08/04/10 | 14:02 | 0.0 | 4.6 | 15.33 | 92.0 | 995 |
| **12906236CDD** | 08/04/10 | 14:28 | 0.0 | 5.9 | 17.20 | 92.0 | 995 |
| **13205927ADD** | 08/10/10 | 10:42 | 3.1 | 3,051 | 15.67 | 79.0 | 993 |
| **13205927CCC** | 08/10/10 | 11:42 | 0.0 | 1.0 | 7.11 | 79.0 | 993 |
| **13106001BAA** | 08/11/10 | 12:13 | 1.2 | 0.0 | 53.26 | 80.0 | 994 |
| **13105915AAA2** | 08/11/10 | 13:48 | 0.0 | 0.4 | 25.02 | 84.0 | 993 |
| **13105927CBB2** | 08/12/10 | 11:50 | 0.0 | 0.6 | 9.81 | 77.0 | 991 |
| **13105932DCC2** | 08/16/10 | 12:46 | 0.0 | 1.3 | 19.67 | 83.0 | 997 |
| **13105934DCC** | 08/16/10 | 14:35 | 0.0 | 4.7 | 12.65 | 82.0 | 997 |
| **13005902DBB** | 08/16/10 | 17:36 | 0.0 | 2.7 | 15.40 | 85.0 | 997 |
| **13005926CCC2** | 08/17/10 | 17:55 | 0.0 | 3.5 | 12.45 | 83.0 | 992 |
| **13005924DDD2** | 08/17/10 | 18:30 | 1.0 | 5.8 | 17.22 | 83.0 | 997 |
| **13005921DBB** | 08/18/10 | 8:00 | 1.4 | 14.7 | 7.67 | 67.0 | 993 |

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

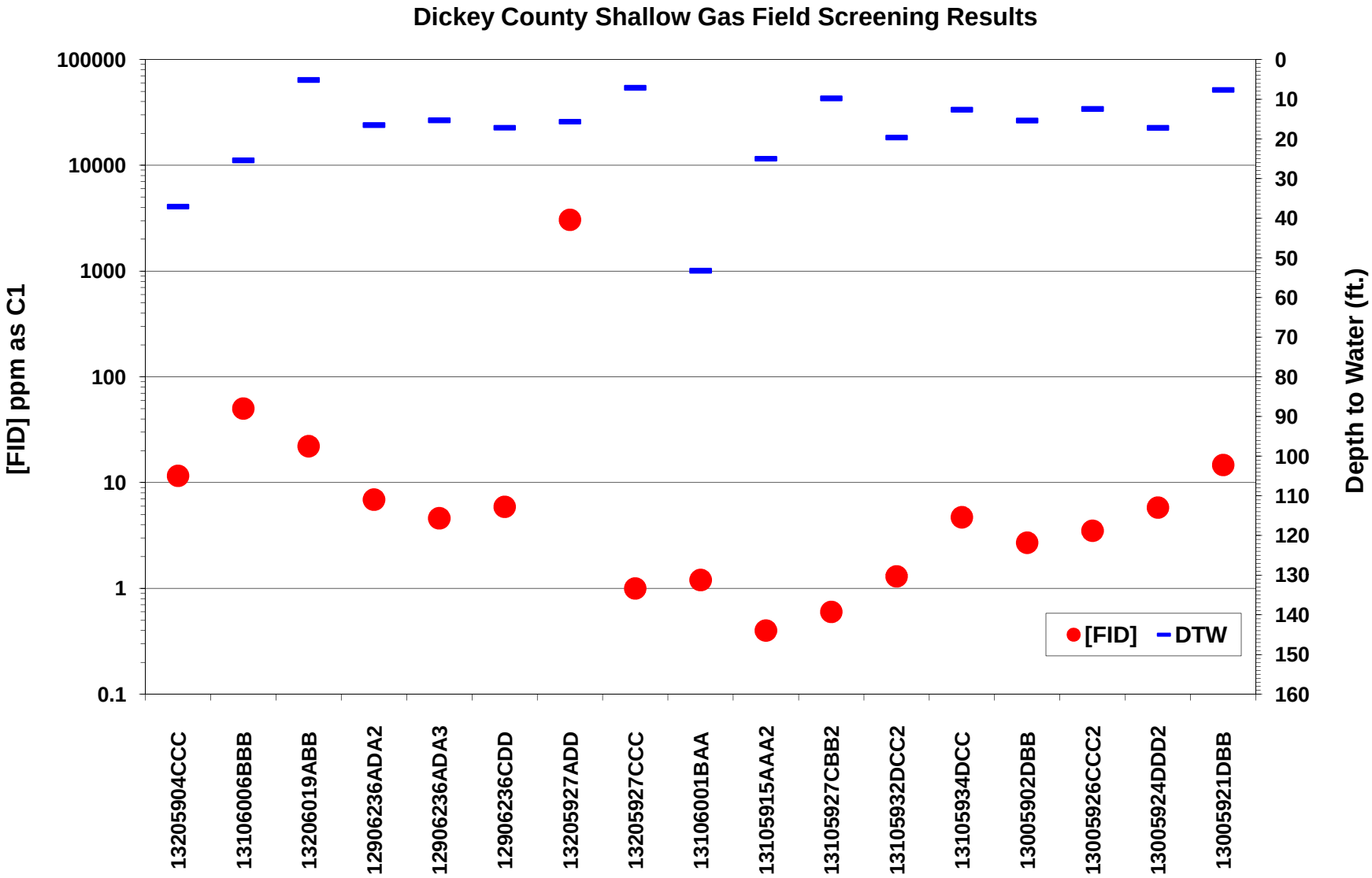


**Figure 45. Shallow gas field screening results in Dickey County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.**

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## Appendix I
## Ground-Water Well Construction Information* Summary

| Location/Well ID | Date Well Drilled | Screened Interval | | Total Well Depth (ft.) | Aquifer | Geographic Coordinates[1] | |
|---|---|---|---|---|---|---|---|
| | | Top (ft.) | Bottom (ft.) | | | Latitude | Longitude |
| **Traill Co.** | | | | | | | |
| S-14605113CBB1 | 1/1/1962 | -- | 90 | -- | Hillsboro | 47.460724 | -97.111968 |
| **Griggs Co.** | | | | | | | |
| 14606122BCC | 10/21/1970 | 147 | 150 | 200 | Spiritwood | 47.450601 | -98.434305 |
| 14606008CCD | 10/22/1970 | 197 | 203 | 300 | Spiritwood | 47.472265 | -98.346611 |
| 14606016AAA | 10/22/1970 | 177 | 180 | 240 | Spiritwood | 47.470444 | -98.309291 |
| 14506107AAA | 8/9/1971 | 188 | 194 | 380 | New Rockford | 47.398099 | -98.479537 |
| 14406027BCB1 | 8/12/1971 | 198 | 204 | 240 | Spiritwood | 47.265328 | -98.277633 |
| 14606112CCC1 | 8/19/1971 | 138 | 141 | 430 | Spiritwood | 47.472351 | -98.391695 |
| 14806124DCC | 8/24/1971 | 318 | 321 | 380 | Spiritwood | 47.617128 | -98.381210 |
| 14706101CCC | 8/24/1971 | 237 | 240 | 340 | Spiritwood | 47.573602 | -98.391691 |
| 14806110CCC2 | 8/26/1971 | 398 | 407 | 470 | Spiritwood | 47.645892 | -98.434869 |
| 14405923CCC | 9/1/1971 | 197 | 200 | 260 | Spiritwood | 47.270886 | -98.129684 |
| 14606112CCC2 | 9/2/1971 | 478 | 487 | 550 | Spiritwood | 47.472351 | -98.391695 |
| 14606111CDD | 4/20/1972 | 198 | 204 | 260 | Spiritwood | 47.472304 | -98.405093 |
| 14606017ABB | 5/3/1972 | 177 | 183 | 310 | Spiritwood | 47.470435 | -98.338620 |
| 14606010DDD | 9/27/1972 | 97 | 103 | 140 | Spiritwood | 47.472278 | -98.287927 |
| 14606124DDC | 9/24/1974 | 138 | 144 | 200 | Spiritwood | 47.443357 | -98.375475 |
| 14405930ADD | 10/29/1975 | 195 | 198 | 220 | Spiritwood | 47.263680 | -98.196404 |
| 14806110CCC3 | 7/10/1979 | 281 | 284 | 340 | Spiritwood | 47.645892 | -98.434869 |
| 14606110AAA2 | 7/17/1979 | 65 | 68 | 100 | Spiritwood | 47.484945 | -98.415803 |
| 14806111DCC2 | 10/29/1986 | 102 | 107 | 1200 | Spiritwood | 47.645986 | -98.402710 |
| 14706111DDD | 10/26/1995 | 128 | 133 | 140 | Spiritwood | 47.559121 | -98.394315 |
| **Oliver Co.** | | | | | | | |
| 14408227BBB1 | 6/28/1967 | 47 | 50 | 80 | Missouri River | 47.270523 | -101.064731 |
| 14208514CCC | 10/22/1968 | -- | -- | 400 | Unknown | 47.112067 | -101.425194 |
| 14108527DDD | 10/24/1968 | 289 | 292 | 440 | Unknown | 46.996495 | -101.427553 |
| **Mercer Co.** | | | | | | | |
| 14408836BCC | 7/14/1961 | 118 | 121 | 160 | Knife River | 47.249541 | -101.784357 |
| 14408618ADC2 | 1/1/1967 | 58 | 61 | 100 | Knife River | 47.292885 | -101.621190 |
| 14508428BAD | 6/28/1967 | 97 | 100 | 220 | Knife River | 47.354405 | -101.388858 |
| 14408714AAA | 10/31/1968 | 216 | 228 | 260 | Knife River | 47.298214 | -101.660193 |
| 14509021AAA1 | 5/8/1969 | 198 | 201 | 240 | Goodman Creek | 47.370588 | -102.143272 |
| 14409004DDC | 5/8/1969 | 157 | 160 | 260 | Unknown | 47.314698 | -102.085194 |
| 14408510AAA | 5/12/1969 | 107 | 110 | 160 | Knife River | 47.312840 | -101.428184 |
| 14408511CCC | 5/13/1969 | 97 | 100 | 180 | Knife River | 47.300177 | -101.425525 |
| 14408836BBC2 | 7/11/1969 | 98 | 104 | 160 | Knife River | 47.253120 | -101.784346 |
| 14409022DAD | 7/28/1969 | -- | -- | 220 | Unknown | 47.274814 | -102.061327 |
| 14508810DDA | 3/16/1977 | 114 | 117 | 140 | Antelope Creek | 47.388680 | -101.866646 |
| 14508806DCC | 4/25/1977 | 317 | 323 | 325 | Unknown | 47.401193 | -101.938910 |
| 14508829DDD | 9/15/1977 | 199 | 205 | 220 | Unknown | 47.343334 | -101.909672 |
| 14508817CCC | 9/16/1977 | 237 | 243 | 243 | Unknown | 47.372263 | -101.928152 |
| 14408923ACC1 | 11/7/1978 | 118 | 121 | 180 | Goodman Creek | 47.278354 | -101.921739 |
| 14408930AAA | 11/8/1978 | 190 | 193 | 240 | Goodman Creek | 47.269288 | -101.998727 |
| 14508535ABB | 7/23/1984 | 62 | 67 | 80 | Knife River | 47.341618 | -101.471147 |
| 14408506DBA1 | 7/24/1984 | 210 | 215 | 260 | Knife River | 47.319989 | -101.497064 |
| 14508526CCB | 7/24/1984 | 24 | 29 | 80 | Knife River | 47.345294 | -101.481695 |
| 14408504BBB | 7/24/1984 | 176 | 181 | 260 | Knife River | 47.327238 | -101.468188 |
| 14408714ADD | 7/26/1984 | 218 | 223 | 320 | Knife River | 47.292790 | -101.660217 |
| 14408714DDC | 7/26/1984 | 75 | 80 | 80 | Knife River | 47.285478 | -101.662867 |
| 14608730AAA | 7/31/1984 | 388 | 394 | 469 | Renner Bay | 47.442951 | -101.802502 |
| 14608827CCD | -- | -- | -- | -- | Unknown | 47.430146 | -101.882414 |
| **Bowman Co.** | | | | | | | |
| 12910132BCD | 1/1/1960 | -- | 438 | 490 | Tongue River-Ludlow | 45.953245 | -103.344639 |
| S-12910408DDD | 1/1/1969 | -- | 390 | -- | 2060 | 46.004016 | -103.702958 |
| S-12910201ADD | 1/1/1969 | -- | 632 | -- | Hell Creek | 46.025782 | -103.370604 |
| 13109925BBB2 | 4/17/1974 | 188 | 200 | 200 | Undefined | 46.146926 | -103.014855 |
| 13109936BBB2 | 4/18/1974 | 90 | 110 | 110 | Undefined | 46.132442 | -103.014878 |
| 13109921CCC2 | 4/22/1974 | -- | 80 | 100 | Undefined | 46.148890 | -103.077448 |
| 13109922CCB | 4/22/1974 | 155 | 167 | 180 | Undefined | 46.150629 | -103.056549 |
| 13109917BBB | 4/25/1974 | 158 | 164 | 180 | Undefined | 46.176003 | -103.098275 |
| 13109926DDD | 9/24/1975 | 64 | 76 | 78 | Undefined | 46.134239 | -103.017463 |
| 13109933DAA | 9/24/1975 | 92 | 104 | 110 | Undefined | 46.125302 | -103.059266 |

## Appendix I
## Ground-Water Well Construction Information* Summary

| Location/Well ID | Date Well Drilled | Screened Interval | | Total Well Depth (ft.) | Aquifer | Geographic Coordinates[1] | |
|---|---|---|---|---|---|---|---|
| | | Top (ft.) | Bottom (ft.) | | | Latitude | Longitude |
| 13109922DCC1 | 9/14/1976 | 64 | 76 | 0 | Tongue River-Ludlow | 46.148789 | -103.046073 |
| 13109929ADD4 | -- | 100 | 118 | 118 | Undefined | 46.141655 | -103.080110 |
| 13109927ADD | -- | 108 | 120 | 120 | Undefined | 46.141543 | -103.038307 |
| **Ransom Co.** | | | | | | | |
| 13305432BBA | 1/1/1956 | -- | -- | -- | Unknown | 46.296054 | -97.507287 |
| 13305825CCC1 | 5/21/1975 | 198 | 201 | 220 | Englevale | 46.296956 | -97.930410 |
| 13305825CCC2 | 5/21/1975 | 43 | 46 | 60 | Englevale-Upper | 46.297034 | -97.930450 |
| 13305605DDD | 10/27/1975 | 118 | 121 | 220 | Elliot | 46.355896 | -97.743192 |
| 13305416DDD | 10/28/1975 | 47 | 50 | 120 | Milnor Channel | 46.326935 | -97.470881 |
| 13405731CCC1 | 11/5/1975 | 48 | 51 | 180 | Englevale-Upper | 46.370338 | -97.909240 |
| 13305825BBB | 6/22/1976 | 61 | 64 | 0 | Englevale-Upper | 46.311106 | -97.930320 |
| 13405836CCC | 6/28/1976 | 48 | 51 | 120 | Englevale-Upper | 46.369706 | -97.929960 |
| 13505836CDD | 8/16/1977 | 83 | 86 | 100 | Englevale-Upper | 46.456547 | -97.919948 |
| 13305714DDD | 8/19/1977 | 170 | 173 | 200 | Elliot | 46.326924 | -97.806308 |
| 13305710AAB | 8/22/1977 | 110 | 113 | 0 | Elliot | 46.354286 | -97.829928 |
| 13305534BBB | 9/13/1977 | 113 | 116 | 180 | Unknown | 46.295971 | -97.593997 |
| 13505835CDC | 6/19/1979 | 18 | 21 | 40 | Englevale-Upper | 46.457299 | -97.944252 |
| 13405811BBB | 6/25/1979 | 30 | 33 | 50 | Englevale-Upper | 46.441707 | -97.950939 |
| 13305716AAA | 7/22/1980 | 208 | 211 | 240 | Elliot | 46.339716 | -97.848327 |
| 13305430DDD | 9/9/1993 | 48 | 53 | 120 | Milnor Channel | 46.297847 | -97.512430 |
| 13305431BBB | 9/9/1993 | 48 | 53 | 100 | Milnor Channel | 46.296035 | -97.530871 |
| 13405825DCCCC2 | 12/5/1996 | 38 | 40.5 | 50 | Englevale-Upper | 46.384059 | -97.919144 |
| 13405825DCCCC1 | 12/5/1996 | 60 | 62.5 | 75 | Englevale-Upper | 46.384059 | -97.919144 |
| 13405825DCCCD2 | 12/6/1996 | 19 | 24 | 31 | Englevale-Upper | 46.384058 | -97.918482 |
| 13405825DCCCD1 | 12/6/1996 | 22 | 24.5 | 33 | Englevale-Upper | 46.384058 | -97.918482 |
| 13405825DCCCC3 | 12/6/1996 | 27 | 29.5 | 38 | Englevale-Upper | 46.384059 | -97.919144 |
| 13305825CCC3 | 8/27/1997 | 43 | 45.5 | 51 | Englevale-Upper | 46.297741 | -97.928838 |
| 13305825CCC4 | 8/27/1997 | 30 | 32.5 | 37 | Englevale-Upper | 46.297741 | -97.928838 |
| 13305825CCC5 | 8/28/1997 | 20 | 25 | 32 | Englevale-Upper | 46.297741 | -97.928838 |
| 13305825CDCC4 | 9/3/1997 | 5 | 10 | 16 | Englevale-Upper | 46.297277 | -97.924240 |
| 13305825CDCC2 | 9/3/1997 | 35 | 40 | 47 | Englevale-Upper | 46.297277 | -97.924240 |
| 13305825CDCC1 | 9/3/1997 | 108 | 113 | 120 | Englevale-Lower | 46.297277 | -97.924240 |
| 13305406CCB2 | 8/11/1998 | 43 | 48 | 60 | Milnor Channel | 46.358135 | -97.531542 |
| 13305409DDD2 | 8/12/1998 | 33 | 38 | 40 | Milnor Channel | 46.341641 | -97.470802 |
| 13305420DCD2 | 8/13/1998 | 48 | 53 | 60 | Milnor Channel | 46.312441 | -97.496981 |
| 13305421DDD2 | 8/17/1998 | 17 | 22 | 30 | Milnor Channel | 46.312661 | -97.470840 |
| 13505433CCC2 | 6/10/2005 | 18 | 23 | 40 | Sheyenne Delta | 46.458316 | -97.488498 |
| 13405401DDD2 | 6/15/2005 | 18 | 23 | 40 | Sheyenne Delta | 46.442912 | -97.407482 |
| **Dunn Co.** | | | | | | | |
| 14309309BCB | 10/22/1973 | 378 | 396 | 965 | Sentinel Butte-Tongue River | 47.222766 | -102.481981 |
| 14609135BBC | 6/24/1974 | 218 | 221 | 320 | Goodman Creek | 47.426606 | -102.246760 |
| 14509504CAABA1 | 9/12/2008 | 157 | 162 | 220 | Killdeer | 47.408022 | -102.791809 |
| 14509505AAAAA2 | 9/15/2008 | 112 | 117 | 120 | Killdeer | 47.415356 | -102.801208 |
| 14509522DDBA | 9/25/2008 | 57 | 52 | 130 | Killdeer | 47.360728 | -102.761909 |
| **Stark Co.** | | | | | | | |
| 14009921CDD1 | -- | -- | 88 | 88 | Sentinel Butte-Tongue River | 46.920339 | -103.180644 |
| 14009828CCC2 | -- | -- | 48 | 48 | Undefined | 46.906041 | -103.061258 |
| 14009821AAA | -- | -- | 90 | 90 | Undefined | 46.933480 | -103.043276 |
| 13909821AAA | -- | -- | 66 | 66 | Undefined | 46.846490 | -103.043656 |
| S-13709909ABA | -- | -- | 55 | -- | Sentinel Butte-Tongue River | 46.701280 | -103.174820 |
| 14009309BBC | 11/22/1968 | 503 | 509 | -- | Tongue River | 46.960662 | -102.431549 |
| 14109326BBB2 | 5/5/1969 | -- | 60 | 100 | Unknown | 47.009370 | -102.439644 |
| **Billings Co.** | | | | | | | |
| S-14110210ABD | 8/16/1979 | 1365 | 1428 | 1440 | Fox Hills | 47.049340 | -103.588890 |
| **Slope Co.** | | | | | | | |
| S-13309820CBC | 6/23/1950 | -- | 91 | 94 | Tongue River-Ludlow | 46.313869 | -103.027959 |
| S-13610125ACC | 2/18/1965 | 512 | 515 | 515 | Tongue River-Ludlow | 46.563302 | -103.309559 |
| S-13610314ADC | 1/1/1969 | -- | -- | 840 | Fox Hills | 46.591993 | -103.575658 |
| 13310111DCC | 5/18/1976 | 136 | 142 | 220 | Undefined | 46.338730 | -103.330443 |
| S-13610211BBB | -- | -- | -- | 1060 | Fox Hills | 46.612109 | -103.466412 |
| **McLean Co.** | | | | | | | |
| 14808033CCC | 7/3/1962 | 45 | 48 | 50.5 | Lake Nettie | 47.589891 | -100.884990 |
| 14908003CCD | 9/6/1967 | 33 | 38 | 60 | Horseshoe Valley | 47.747729 | -100.903333 |

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| Location/Well ID | Date Well Drilled | Screened Interval | | Total Well Depth (ft.) | Aquifer | Geographic Coordinates[1] | |
|---|---|---|---|---|---|---|---|
| | | Top (ft.) | Bottom (ft.) | | | Latitude | Longitude |
| 14808103AAB | 9/7/1967 | 32 | 37 | 60 | Horseshoe Valley | 47.673573 | -100.975693 |
| 14808707AAA2 | 7/29/1968 | 278 | 298 | 420 | White Shield | 47.659994 | -101.802963 |
| 15008025DCD | 12/2/1969 | 137 | 143 | 180 | Strawberry Lake | 47.776683 | -100.849394 |
| 14908125CCD | 12/11/1969 | 47 | 50 | 100 | Horseshoe Valley | 47.689727 | -100.988952 |
| 14708314BCC | 7/9/1970 | 144 | 147 | 260 | Wolf Creek | 47.553615 | -101.226407 |
| 14808620DAA | 7/9/1970 | 188 | 208 | 240 | White Shield | 47.623823 | -101.654674 |
| 14308103BAA | 10/26/1973 | 157 | 163 | 260 | Lost Lake | 47.243108 | -100.930473 |
| 15008035CBC | 11/5/1973 | 57 | 60 | 80 | Strawberry Lake | 47.765789 | -100.884439 |
| 15008025CCC | 6/25/1975 | 58 | 61 | 80 | Strawberry Lake | 47.776672 | -100.863054 |
| 15008036BAA | 6/25/1975 | 78 | 81 | 120 | Strawberry Lake | 47.774876 | -100.854913 |
| 14908015BBB | 6/26/1975 | 58 | 61 | 80 | Horseshoe Valley | 47.731368 | -100.906094 |
| 14908020AAA2 | 6/26/1975 | 43 | 46 | 60 | Horseshoe Valley | 47.717008 | -100.930096 |
| 15008022CDC | 6/26/1975 | 32 | 35 | 60 | Horseshoe Valley | 47.791108 | -100.900422 |
| 14708119BBB1 | 8/14/1975 | 3 | 28 | 28 | Till | 47.544660 | -101.055349 |
| 15008015DDD | 6/21/1978 | 63 | 66 | 120 | Horseshoe Valley | 47.805659 | -100.887003 |
| 14708019CBC | 7/22/1981 | 84 | 87 | 101 | Turtle Lake | 47.535503 | -100.927414 |
| 15008016DDC | 11/9/1982 | 24 | 29 | 40 | Horseshoe Valley | 47.805582 | -100.911228 |
| 15008015DAA | 11/10/1982 | 67 | 72 | 120 | Strawberry Lake | 47.811059 | -100.887026 |
| 15008011CDC | 9/19/1983 | 78 | 83 | 160 | Strawberry Lake | 47.820265 | -100.879141 |
| 14808222BBB | 10/10/1984 | 125 | 130 | 220 | Lake Nettie | 47.631461 | -101.119666 |
| 14708315BBA | 10/10/1984 | 57 | 61 | 80 | Fort Union | 47.559122 | -101.245141 |
| 14608322CCC | 10/24/1984 | 210 | 220 | 220 | Fort Union | 47.444946 | -101.247530 |
| 14607906AAA1 | 12/20/1984 | 220 | 225 | 235 | Lake Nettie | 47.500867 | -100.780982 |
| 14707926DDA | 5/31/1985 | 168 | 173 | 260 | Lake Nettie | 47.519071 | -100.695668 |
| 14807936CDC | 6/5/1985 | 66 | 71 | 73 | Fort Union | 47.589725 | -100.687600 |
| 14608006CBB2 | 6/24/1985 | 48 | 53 | 60 | Fort Union | 47.493859 | -100.927618 |
| 14708312CCC | 6/26/1985 | 35 | 40 | 86 | Wolf Creek | 47.560818 | -101.204914 |
| 14808213BAB | 7/16/1985 | 168 | 173 | 180 | Lake Nettie | 47.645939 | -101.071402 |
| 14708022AAD | 7/30/1985 | 38 | 43 | 120 | Lake Nettie | 47.542678 | -100.844776 |
| 14808135DDD | 7/31/1985 | 63 | 68 | 100 | Lake Nettie | 47.589909 | -100.951489 |
| 14808134CBB | 8/1/1985 | 18 | 23 | 70 | Lake Nettie | 47.595429 | -100.991699 |
| 14607906AAA2 | 8/8/1985 | 155 | 160 | 160 | Lake Nettie | 47.500867 | -100.780982 |
| 14808211DCC1 | 1/9/1986 | 38 | 43 | 60 | Lake Nettie | 47.647721 | -101.087429 |
| 14808224ABB2 | 6/10/1986 | 32 | 37 | 40 | Lake Nettie | 47.631518 | -101.066072 |
| 14808109BAA | 6/9/1987 | 25.1 | 27 | -- | Horseshoe Valley | 47.660644 | -101.005037 |
| 14808116BCC | 6/11/1987 | 20 | 21.9 | -- | Lake Nettie | 47.640668 | -101.013105 |
| 14808108DAA | 6/11/1987 | 19 | 20.9 | -- | Lake Nettie | 47.653343 | -101.015743 |
| 14708103BBB | 6/16/1987 | 16.2 | 17.6 | -- | Lake Nettie | 47.588224 | -100.991730 |
| 14708104DAA | 6/16/1987 | 16.1 | 17.9 | -- | Lake Nettie | 47.580906 | -100.994502 |
| 14608223DCA | 8/14/1989 | 37 | 42 | 42 | Undefined | 47.446707 | -101.084882 |
| 14708118DDB | -- | -- | -- | -- | Undefined | 47.548292 | -101.039826 |
| 14608033BCC | -- | -- | -- | -- | Undefined | 47.422895 | -100.885008 |
| **Richland Co.** | | | | | | | |
| 13505210ACA1 | 9/12/1963 | 238 | 258 | 294 | Undefined | 46.524111 | -97.203937 |
| 13404832DAA | 5/26/1970 | 58 | 78 | 120 | Wahpeton Sand Plain | 46.375820 | -96.737837 |
| 13605131DDD | 5/9/1972 | 55 | 60 | 120 | Undefined | 46.544691 | -97.137199 |
| 13605222CCC | 5/15/1972 | 38 | 41 | 140 | Sheyenne Delta | 46.573276 | -97.217786 |
| 13605212CBB | 8/14/1972 | 37 | 40 | 140 | Sheyenne Delta | 46.607907 | -97.175818 |
| 13004924DDD | 8/5/1981 | 226 | 229 | 260 | Sonora | 46.052304 | -96.764082 |
| 13304720AAD2 | 9/5/1985 | 129 | 134 | 135 | Wahpeton Sand Plain | 46.322918 | -96.612025 |
| 13304720AAD1 | 9/5/1985 | 195 | 200 | 210 | Wahpeton Buried Valley | 46.322918 | -96.611926 |
| 13304720AAD3 | 9/5/1985 | 54 | 59 | 60 | Wahpeton Shallow Sand | 46.322918 | -96.612025 |
| 13304720ABDC1 | 10/10/1985 | 278 | 283 | 286 | Wahpeton Buried Valley | 46.322619 | -96.618827 |
| 13304720BAD1 | 10/14/1985 | 255 | 260 | 271 | Wahpeton Buried Valley | 46.324018 | -96.623927 |
| 13304720BAD3 | 10/16/1985 | 51 | 56 | 70 | Wahpeton Shallow Sand | 46.323920 | -96.624025 |
| 13304720BAD2 | 10/16/1985 | 135 | 140 | 150 | Wahpeton Sand Plain | 46.324018 | -96.623927 |
| 13304720ADB3 | 10/22/1985 | 115 | 120 | 125 | Wahpeton Sand Plain | 46.321120 | -96.616826 |
| 13304720BABB | 7/22/1987 | 53 | 63 | 66 | Wahpeton Shallow Sand | 46.325519 | -96.627125 |
| 13104919BBB3 | 9/21/1988 | 87 | 92 | 100 | Undefined | 46.152060 | -96.884808 |
| 13204728CCC2 | 6/26/1989 | 98 | 103 | 220 | Undefined | 46.210917 | -96.595324 |
| 13005006AAA2 | 8/5/1994 | 58 | 63 | 80 | Hankinson | 46.108789 | -96.991754 |
| 13005018DDD | 8/11/1994 | 98 | 103 | 200 | Milnor Channel | 46.067332 | -96.991695 |
| 13005029BBC | 8/11/1994 | 158 | 163 | 260 | Brightwood | 46.049516 | -96.989251 |

## Appendix I
## Ground-Water Well Construction Information* Summary

| Location/Well ID | Date Well Drilled | Screened Interval | | Total Well Depth (ft.) | Aquifer | Geographic Coordinates[1] | |
|---|---|---|---|---|---|---|---|
| | | Top (ft.) | Bottom (ft.) | | | Latitude | Longitude |
| 12905214AAA | 10/11/1995 | 78 | 83 | 270 | Brightwood | 45.989531 | -97.126947 |
| 13304720ADB4 | 10/24/1997 | 270 | 275 | 283 | Wahpeton Buried Valley | 46.321120 | -96.616826 |
| 13404901DDD2 | 9/23/1998 | 111 | 116 | 140 | Undefined | 46.443121 | -96.778840 |
| 13304720ADD5 | 4/15/2003 | 15 | 25 | 25 | Wahpeton Shallow Sand | 46.319573 | -96.612617 |
| 12904705DDD | 8/27/2007 | 91 | 97 | 158 | Fairmount | 46.008685 | -96.597910 |
| 12904708BCC | 8/30/2007 | 96 | 101 | 105 | Fairmount | 46.001371 | -96.616640 |
| 13304720ADD6 | 8/27/2008 | 124 | 129 | 130 | Wahpeton Sand Plain | 46.319573 | -96.612617 |
| 13105032BCD2 | -- | -- | -- | -- | Hankinson | 46.117831 | -96.986377 |
| **Golden Valley Co.** | | | | | | | |
| 14110507DDD3 | -- | -- | 44 | 44 | Undefined | 47.038321 | -104.027803 |
| 14110521AAA1 | -- | -- | 371 | 371 | Ludlow | 47.022890 | -103.985422 |
| 14110521AAA2 | -- | -- | 150 | 150 | Undefined | 47.022890 | -103.985422 |
| 14110514DDA | -- | -- | 345 | 345 | Undefined | 47.025691 | -103.943609 |
| 14110520BBB | -- | -- | 107 | 107 | Undefined | 47.022581 | -104.024674 |
| 14110520CCC2 | -- | -- | 152 | 152 | Undefined | 47.009352 | -104.024672 |
| 14110520CCC1 | -- | -- | 360 | 360 | Ludlow | 47.009352 | -104.024672 |
| 14110528AAB | -- | -- | 142 | 142 | Undefined | 47.008391 | -103.988192 |
| 14110529ADD3 | -- | -- | 131 | 131 | Undefined | 47.002450 | -104.006983 |
| 14110529ADD1 | -- | -- | 129 | 129 | Undefined | 47.002450 | -104.006983 |
| 14010506BBB2 | -- | -- | -- | -- | Undefined | 46.978673 | -103.985128 |
| 14010506BBB1 | -- | -- | 201 | 201 | Undefined | 46.979010 | -103.985141 |
| 14110503BBB | -- | -- | 279 | 279 | Undefined | 47.065990 | -103.982362 |
| 13810522BCB | -- | -- | 118 | 118 | Undefined | 46.755500 | -103.922350 |
| 13810610DAA | -- | -- | 238 | 238 | Ludlow | 46.780740 | -104.030694 |
| 14310533BAB | 8/25/1975 | 1153 | 1177 | 1483 | Fox Hills | 47.166937 | -103.997363 |
| **Adams Co.** | | | | | | | |
| S-12909715AAB | 1/1/1960 | -- | 240 | 270 | Tongue River-Ludlow | 46.002138 | -102.791885 |
| 13209707CAB4 | 6/15/1972 | 329 | 335 | -- | Tongue River-Ludlow | 46.270005 | -102.864762 |
| **Mountrail Co.** | | | | | | | |
| S-15408930DDD | 1/1/1956 | -- | 130 | -- | Undefined | 48.125370 | -102.161188 |
| 15709136DDD | 8/8/1965 | 168 | 188 | 200 | Unnamed | 48.373369 | -102.365639 |
| 15509012DDD | 8/4/1966 | 158 | 178 | 200 | White Lake Br. of Shell | 48.255748 | -102.182438 |
| 15508806DDD | 8/23/1966 | -- | 165 | 200 | Shell Creek | 48.270070 | -102.032604 |
| 15308929AAA | 9/30/2008 | 97 | 102 | 120 | Shell Creek | 48.050563 | -102.138177 |
| 15209019BBB | 10/9/2008 | 65 | 70 | 120 | Shell Creek | 47.977556 | -102.256767 |
| 15209124BAB1 | 10/12/2008 | 57 | 62 | 100 | Shell Creek | 47.977528 | -102.270452 |
| 15209124BAB2 | 10/13/2008 | 25 | 30 | 30 | Till | 47.977529 | -102.270375 |
| 15209009BCC1 | 10/13/2008 | 97 | 102 | 136 | Shell Creek | 48.000317 | -102.214769 |
| 15309036DAA1 | 10/16/2008 | 77 | 82 | 109 | Shell Creek | 48.029215 | -102.181681 |
| 15309036DAA2 | 10/21/2008 | 45 | 46.33 | 47 | Till | 48.029261 | -102.181728 |
| 15309036DAA3 | 10/21/2008 | 17 | 23 | 25 | Shell Creek | 48.029291 | -102.181757 |
| 15308916DDD1 | 10/21/2008 | 97 | 102 | 120 | Shell Creek | 48.066693 | -102.116442 |
| 15308916DDD2 | 10/22/2008 | 75.5 | 77 | 79 | Till | 48.066729 | -102.116443 |
| 15308916DDD3 | 10/22/2008 | 36 | 41 | 43 | Shell Creek | 48.066764 | -102.116444 |
| 15308910BBA2 | 10/23/2008 | 37 | 42 | 45 | Shell Creek | 48.095574 | -102.110962 |
| 15308910BBA1 | 10/23/2008 | 97 | 102 | 120 | Shell Creek | 48.095579 | -102.111011 |
| 15408935BBB | 10/27/2008 | 57 | 62 | 105 | Shell Creek | 48.124349 | -102.094742 |
| 15408934AAB1 | 10/28/2008 | 77 | 82 | 107 | Shell Creek | 48.124341 | -102.098328 |
| **Burke Co.** | | | | | | | |
| 15909336AAA | 8/12/1966 | 68 | 78 | 120 | Shell Creek | 48.560191 | -102.627329 |
| 16209410AAA1 | 10/9/1976 | 120 | 126 | 160 | Sentinel Butte-Tongue River | 48.879357 | -102.854167 |
| 16208807AAA2 | 5/24/1977 | 56 | 59 | 60 | Columbus | 48.878638 | -102.132506 |
| 16208806CCC | 5/25/1977 | 198 | 201 | 280 | Columbus | 48.880467 | -102.150734 |
| 16209330DDD1 | -- | -- | 145 | 145 | Sentinel Butte-Tongue River | 48.822527 | -102.788725 |
| **Grant Co.** | | | | | | | |
| 13308317DAA | 11/11/1971 | 238 | 244 | 320 | Shields | 46.334317 | -101.133312 |
| 13208401DAA | 11/13/1971 | 62 | 68 | 340 | Shields | 46.280132 | -101.127102 |
| 13508922CDD | 11/9/1972 | 189 | 201 | 420 | Tongue River | 46.487775 | -101.851510 |
| 13508615DDD2 | 5/22/1973 | 360 | 366 | 366 | Cannonball | 46.502787 | -101.467350 |
| **Hettinger Co.** | | | | | | | |
| 13509301BCB1 | 1/1/1926 | -- | 210 | -- | Tongue River | 46.540653 | -102.316751 |
| 13509519DDC2 | 1/1/1966 | -- | 61 | 81 | Tongue River | 46.486208 | -102.659535 |
| 13509128CCB3 | 1/1/1967 | -- | 105 | 120 | Tongue River | 46.474372 | -102.131267 |

## Appendix I
## Ground-Water Well Construction Information* Summary

| Location/Well ID | Date Well Drilled | Screened Interval | | Total Well Depth (ft.) | Aquifer | Geographic Coordinates[1] | |
|---|---|---|---|---|---|---|---|
| | | Top (ft.) | Bottom (ft.) | | | Latitude | Longitude |
| 13309734BBB | 10/26/1967 | 668 | 714 | 1000 | Tongue River-Ludlow | 46.295223 | -102.860630 |
| 13509120ACB | 1/1/1968 | -- | 370 | 420 | Tongue River | 46.496057 | -102.142019 |
| 13509428CBB2 | 1/1/1968 | -- | 30 | 60 | Sentinel Butte-Tongue River | 46.477813 | -102.505347 |
| 13409302DC | -- | -- | 135 | -- | Tongue River | 46.445459 | -102.325926 |
| 13209209AAA | -- | -- | 225 | -- | Tongue River | 46.276984 | -102.186958 |
| **Sargent Co.** | | | | | | | |
| S-13005716AAD | 7/30/1972 | 125 | 130 | 130 | Spiritwood | 46.078147 | -97.821374 |
| S-13005332BDC | 7/3/1973 | 103 | 113 | 113 | Undefined | 46.044220 | -97.337044 |
| S-13005326BCC | 10/30/1974 | 107 | 113 | 113 | Undefined | 46.044192 | -97.299882 |
| 12905708CCC1 | 11/22/1974 | 158 | 161 | 180 | Unknown | 45.994592 | -97.860754 |
| 12905609DDD | 11/27/1974 | 153 | 156 | 260 | Brampton | 45.994360 | -97.697228 |
| 13205821BBB2 | 5/21/1975 | 33 | 36 | 60 | Crete | 46.239726 | -97.965599 |
| 13205816BBA2 | 5/21/1975 | 167 | 170 | 200 | Crete | 46.254185 | -97.961727 |
| 13205802CCC | 5/28/1975 | 108 | 111 | 180 | Englevale-Upper | 46.269113 | -97.923848 |
| 12905830CCC | 10/7/1975 | 93 | 96 | 160 | Oakes | 45.950506 | -98.007936 |
| 13005311DDD | 10/9/1975 | 123 | 126 | 240 | Undefined | 46.080423 | -97.281717 |
| 13005404CCC | 10/9/1975 | 128 | 131 | -- | Unknown | 46.095299 | -97.466426 |
| 13105319CCC | 10/10/1975 | 148 | 151 | 180 | Undefined | 46.138366 | -97.382976 |
| 13205614CDA1 | 10/14/1975 | 153 | 156 | 180 | GWN | 46.242772 | -97.665130 |
| 13205626DAD | 8/24/1977 | 170 | 173 | 220 | GWN | 46.215633 | -97.654805 |
| 13205331DDD | 9/8/1977 | 33 | 39 | 140 | Milnor Channel | 46.196209 | -97.364790 |
| 12905703AAA | 7/16/1980 | 138 | 142 | 220 | Unknown | 46.022069 | -97.801044 |
| 12905635AAA | 8/11/1981 | 173 | 176 | 200 | Unknown | 45.948956 | -97.655925 |
| 12905632BBB | 8/11/1981 | 155 | 158 | 180 | Unknown | 45.949168 | -97.736468 |
| 13105620BBB | 8/16/1984 | 117 | 122 | 230 | Unknown | 46.152411 | -97.735954 |
| 13105618AAA | 8/17/1984 | 118 | 123 | 240 | Unknown | 46.166948 | -97.738318 |
| 13005820CCC2 | 9/16/1985 | 25 | 30 | 30 | Oakes | 46.051865 | -97.986956 |
| 12905705AAA1 | 9/25/1985 | 165 | 170 | 180 | Unknown | 46.022088 | -97.842622 |
| 12905704DDD1 | 9/26/1985 | 184 | 189 | 202 | Unknown | 46.009241 | -97.821723 |
| 13205622DDA | 9/20/1989 | 111 | 116 | 200 | GWN | 46.228321 | -97.675592 |
| 13205624BCC | 9/26/1989 | 168 | 173 | 200 | GWN | 46.233711 | -97.652205 |
| 13105825CCC1 | 10/2/1989 | 205 | 210 | 217 | Spiritwood | 46.125376 | -97.903230 |
| 13105825CCC3 | 10/3/1989 | 102 | 107 | 107 | Unnamed | 46.125376 | -97.903230 |
| 13105820DDD3 | 10/4/1989 | 55 | 60 | 60 | Oakes | 46.139285 | -97.968068 |
| 13105825CCC5 | 9/2/1992 | 235.5 | 240.5 | 240 | Carlisle Formation | 46.125376 | -97.903230 |
| 13005824DDD1 | 9/4/1992 | 181.5 | 186.5 | 189 | Spiritwood | 46.052689 | -97.884784 |
| 12905717AAA1 | 9/10/1992 | 222 | 227 | 227 | Carlisle Formation | 45.992785 | -97.842588 |
| 12905508AAA | 8/15/1995 | 150 | 155 | 230 | Undefined | 46.006938 | -97.593885 |
| 13205813CCC10 | 9/5/1997 | 19 | 21.5 | -- | Englevale-Upper | 46.240889 | -97.901698 |
| S-13205307ADD | 12/8/1998 | 50 | 60 | 60 | Undefined | 46.261481 | -97.364941 |
| 13005630DDD4 | 8/2/2006 | 143 | 148 | 160 | Spiritwood | 46.038387 | -97.738322 |
| 13005625BBB2 | 8/2/2006 | 158 | 163 | 180 | Spiritwood | 46.050948 | -97.652830 |
| 12905613BBB2 | 8/8/2006 | 178 | 183 | 200 | Spiritwood | 45.992512 | -97.653048 |
| 13105326DCB2 | 8/10/2006 | 78 | 83 | 100 | Gwinner | 46.125669 | -97.289402 |
| 13005435CCC2S | 8/10/2006 | 188 | 193 | 200 | Spiritwood | 45.402819 | -108.173906 |
| 13105311CCC2 | 8/14/2006 | 48 | 53 | 60 | Milnor Channel | 46.167287 | -97.299814 |
| 13105303DDD3 | 8/15/2006 | 38 | 43 | 60 | Milnor Channel | 46.181740 | -97.302368 |
| **Divide Co.** | | | | | | | |
| 16310233CDD3 | 6/12/1964 | 68 | 71 | 94 | Skjermo Lake | 48.895627 | -103.937717 |
| 16309715ABB | 6/12/1971 | 238 | 244 | 540 | Yellowstone Buried Channel | 48.950810 | -103.254171 |
| 16309727CCC | 12/3/1971 | 258 | 264 | 500 | Yellowstone Buried Channel | 48.909228 | -103.268162 |
| 16309723DDD | 12/5/1971 | 315 | 327 | 360 | Columbus | 48.923376 | -103.224786 |
| 16309725AAA | 12/6/1971 | 378 | 390 | 440 | Crosby | 48.923207 | -103.202601 |
| 16309734ABB | 12/20/1971 | 366 | 378 | 400 | Crosby | 48.908773 | -103.256346 |
| 16309724AAA | 5/25/1972 | 399 | 411 | 460 | Columbus | 48.937731 | -103.202315 |
| 16309715BCC | 6/7/1972 | 546 | 558 | 575 | Yellowstone Buried Channel | 48.946423 | -103.267985 |
| 16309726DDD | 6/14/1972 | 357 | 369 | 380 | Crosby | 48.909083 | -103.224416 |
| 16210203ABA | 10/8/1980 | 91 | 94 | 127 | Skjermo Lake | 48.893625 | -103.910244 |
| 16210104DDA | 10/10/1980 | 77 | 97 | -- | NE Missouri Buried Channel | 48.882936 | -103.795172 |
| 16210224BBC | 10/14/1980 | 46 | 58 | -- | Skjermo Lake | 48.848538 | -103.880014 |
| 16310122ADB1 | 10/15/1980 | 106 | 126 | -- | Skjermo Lake | 48.933704 | -103.775878 |
| 16210205BBB | 10/18/1980 | 65 | 68 | 180 | Skjermo Lake | 48.893881 | -103.967944 |
| 16210335CBC | 3/31/1981 | 78 | 81 | 180 | Skjermo Lake | 48.812338 | -104.033391 |

## Appendix I
## Ground-Water Well Construction Information* Summary

| Location/Well ID | Date Well Drilled | Screened Interval | | Total Well Depth (ft.) | Aquifer | Geographic Coordinates[1] | |
|---|---|---|---|---|---|---|---|
| | | Top (ft.) | Bottom (ft.) | | | Latitude | Longitude |
| 16210217CCC | 3/31/1981 | 92 | 95 | 180 | Skjermo Lake | 48.852168 | -103.967840 |
| 16410235AAA | 4/9/1981 | 178 | 181 | 320 | Skjermo Lake | 48.995213 | -103.882591 |
| 16110312BBB | 10/14/1981 | 184 | 189 | 220 | Skjermo Lake | 48.792468 | -104.011373 |
| 16210312AAA | 10/15/1981 | 72 | 77 | 87 | Skjermo Lake | 48.879360 | -103.992218 |
| 16210324CBB | 5/12/1982 | 98 | 103 | 140 | Skjermo Lake | 48.843158 | -104.011306 |
| 16110315CDC | 5/25/1982 | 55 | 58 | 73 | Skjermo Lake | 48.765216 | -104.044129 |
| 16310116DDD | 10/4/1982 | 1055 | 1079 | 1527 | Fox Hills | 48.939152 | -103.795166 |
| 16210310AAA | 6/14/1984 | 82 | 87 | 110 | Skjermo Lake | 48.879346 | -104.035590 |
| 16210215CDD2 | 6/19/1984 | 108 | 113 | 120 | Skjermo Lake | 48.852108 | -103.915696 |
| 16310135CCA2 | 6/17/1998 | 245 | 250 | 270 | Undefined | 48.897106 | -103.768160 |
| 16210102ABB | 6/25/1998 | 138 | 143 | 180 | Undefined | 48.894375 | -103.759959 |
| 16410235DDD | 6/10/1999 | 157 | 162 | 220 | Skjermo Lake | 48.982425 | -103.882657 |
| 16310234BBB | 6/16/1999 | 78 | 83 | 100 | Skjermo Lake | 48.908203 | -103.923924 |
| 16309723CBB | 10/7/2003 | 317 | 322 | 360 | Crosby | 48.930458 | -103.246066 |
| 16309726CBB1 | 10/7/2003 | 338 | 343 | 366 | Crosby | 48.915894 | -103.246129 |
| 16309726CBB2 | 10/7/2003 | 138 | 143 | 160 | Crosby | 48.915892 | -103.246008 |
| 16010023CCC1 | 6/22/2004 | 91 | 101 | 140 | Little Muddy | 48.663702 | -103.578827 |
| 16010023CDD1 | 6/22/2004 | 267 | 272 | 320 | Little Muddy | 48.663676 | -103.570659 |
| 16010023CDD2 | 6/22/2004 | 151 | 156 | 170 | Little Muddy | 48.663676 | -103.570659 |
| 16010023CCC2 | 6/23/2004 | 45 | 50 | 60 | Little Muddy | 48.663702 | -103.578827 |
| 16010015DDD1 | 6/24/2004 | 131 | 136 | 200 | Little Muddy | 48.678223 | -103.581666 |
| S-16009604CCB | -- | -- | 180 | -- | Undefined | 48.708437 | -103.101632 |
| 16310234CCB | -- | 105 | 110 | -- | Skjermo Lake | 48.897335 | -103.923916 |
| **McIntosh Co.** | | | | | | | |
| S-13206824AAA | 8/26/1973 | 240 | 260 | 0 | Undefined | 46.243328 | -99.129527 |
| 12906717DDD | 11/21/1975 | 158 | 161 | 240 | Spring Creek | 45.984406 | -99.089349 |
| 13207114BBC1 | 8/12/1976 | 103 | 106 | 120 | Wishek | 46.256312 | -99.543588 |
| 13207114BBC2 | 8/12/1976 | 33 | 36 | 40 | Wishek | 46.256312 | -99.543588 |
| 13207022BBB1 | 8/26/1976 | 158 | 164 | 220 | Fox Hills | 46.243717 | -99.439636 |
| 13106834CBB | 9/22/1976 | 210 | 213 | 400 | Spring Creek | 46.120132 | -99.189243 |
| 12906836DDD1 | 8/25/1977 | 168 | 171 | 262 | Spring Creek | 45.940874 | -99.131780 |
| 12906703BBB1 | 8/30/1977 | 188 | 191 | 262 | Spring Creek | 46.025989 | -99.065666 |
| 13006921BBB1 | 9/13/1977 | 177 | 180 | 222 | Spring Creek | 46.069646 | -99.335907 |
| 13006921BBB2 | 9/13/1977 | 97 | 100 | 102 | Spring Creek | 46.069646 | -99.335907 |
| 13206714DDA2 | 9/26/1977 | 37 | 40 | 50 | Undefined | 46.246956 | -99.025386 |
| 13207123ADD1 | 9/15/1999 | 145 | 150 | 165 | Wishek | 46.237280 | -99.524150 |
| S-13107002CCB | -- | -- | 9 | -- | Wishek | 46.189257 | -99.418270 |
| **Cass Co.** | | | | | | | |
| 13704925CCC | 8/19/1964 | 228 | 238 | 257 | Horace | 46.645711 | -96.819319 |
| 13704920DAA | 7/28/1977 | 250 | 255 | 273 | Horace | 46.665666 | -96.885015 |
| 13704918BBB | 9/15/1977 | 128 | 132 | 292 | West Pleasant | 46.687434 | -96.924755 |
| 13904905BDD | 11/2/1979 | 218 | 223 | 226 | West Fargo North | 46.884544 | -96.894715 |
| 13805014DDD | 6/25/1981 | 155 | 158 | 220 | Undefined | 46.761857 | -96.948713 |
| 14204922DDD | 7/28/1981 | 228 | 234 | 280 | Undefined | 47.093558 | -96.859048 |
| 14104930AAB | 7/28/1981 | 180 | 186 | 260 | West Fargo North | 47.005412 | -96.926030 |
| 14305430BBB | 9/2/1981 | 125 | 130 | 160 | Page | 47.180206 | -97.577301 |
| 14004935BAA | 10/5/1982 | 171 | 176 | 220 | Nodak | 46.904198 | -96.831201 |
| 13704915BAA | 10/19/1982 | 198 | 203 | 270 | West Fargo South | 46.687238 | -96.853256 |
| 14205434AAD3 | 8/29/1991 | 50 | 60 | 80 | Page | 47.076921 | -97.495191 |
| 13704914BAA | 10/9/1991 | 178 | 183 | 190 | Horace | 46.687270 | -96.832164 |
| 13905002BAA | 10/22/1991 | 225 | 230 | 260 | Prosper | 46.890721 | -96.959391 |
| 14205416BAA1 | 5/26/1992 | 135 | 140 | 160 | Page | 47.122418 | -97.527046 |
| 14205429DCC | 5/28/1992 | 108 | 113 | 120 | Page | 47.080758 | -97.545546 |
| 14205418CCC | 6/22/2006 | 107 | 112 | 130 | Page | 47.109535 | -97.577224 |
| 14305502BBB2 | 6/28/2006 | 85 | 90 | 100 | Page | 47.238299 | -97.620102 |
| 14305435CCC3 | 7/25/2007 | 100 | 105 | 120 | Page | 47.153006 | -97.492209 |
| 14305435CCC2 | 7/25/2007 | 142 | 147 | 160 | Page | 47.153006 | -97.492209 |
| 14305412CCC3 | 8/13/2007 | 103 | 108 | 140 | Page | 47.210851 | -97.471188 |
| **Wells Co.** | | | | | | | |
| 14906924BCC | 10/15/1965 | 278 | 283 | 304.5 | New Rockford | 47.710129 | -99.445878 |
| 14807215ABA | 11/5/1965 | 95 | 100 | 126 | Rusland | 47.645240 | -99.826747 |
| 15007129AAB | 7/25/1966 | 100 | 103 | 147 | Manfred | 47.788442 | -99.773315 |
| 14907101ADD | 8/6/1986 | 258 | 263 | 320 | New Rockford | 47.753855 | -99.684668 |

## Appendix I
## Ground-Water Well Construction Information* Summary

| Location/Well ID | Date Well Drilled | Screened Interval | | Total Well Depth (ft.) | Aquifer | Geographic Coordinates[1] | |
|---|---|---|---|---|---|---|---|
| | | Top (ft.) | Bottom (ft.) | | | Latitude | Longitude |
| 15007136ADD | 8/7/1986 | 286 | 291 | 327 | New Rockford | 47.768238 | -99.684576 |
| 15007027DDA | 8/15/1986 | 15 | 20 | 40 | Heimdal | 47.777297 | -99.598792 |
| 15007027DDA1 | 8/18/1986 | 165 | 170 | 220 | New Rockford | 47.777297 | -99.598792 |
| 15007025CCC | 8/20/1986 | 218 | 223 | 250 | New Rockford | 47.775465 | -99.574569 |
| 15006931CBC | 8/21/1986 | 98 | 103 | 280 | New Rockford | 47.764495 | -99.553183 |
| 15006931CBC1 | 8/22/1986 | 18 | 38 | 38 | Till | 47.764495 | -99.553183 |
| 14906913BCC | 8/28/1986 | 215 | 220 | 260 | New Rockford | 47.724735 | -99.445892 |
| 14907002AAA1 | 9/3/1986 | 218 | A | 285 | New Rockford | 47.759055 | -99.577360 |
| 15007028ADA | 10/8/1986 | 24 | 29 | 220 | Heimdal | 47.784553 | -99.620267 |
| 15006932CCC | 10/16/1986 | 14 | 19 | 30 | Heimdal | 47.760941 | -99.532007 |
| 15007035AAD | 10/16/1986 | 18 | 23 | 30 | Heimdal | 47.771841 | -99.577292 |
| 14907003CBB2 | 11/6/1986 | 53 | 58 | 59 | Till | 47.752002 | -99.617751 |
| 14907003CBB3 | 11/7/1986 | 33 | 38 | 39 | Till | 47.752002 | -99.617751 |
| 14907003CBB4 | 11/7/1986 | 5 | 15 | 15 | Till | 47.752002 | -99.617751 |
| 15007033CDD | 5/20/1987 | 158 | 163 | 320 | New Rockford | 47.760990 | -99.631115 |
| 14807211DDDC | 8/8/1988 | 43 | 48 | 210 | Undefined | 47.646569 | -99.800665 |
| 14807210DCC2 | 5/16/1989 | 68 | 73 | 82 | Rusland | 47.647046 | -99.829401 |
| 14807210DCC3 | 5/16/1989 | 18 | 23 | 32 | Rusland | 47.647046 | -99.829401 |
| **McKenzie Co.** | | | | | | | |
| S-14810414B | 1/1/1968 | -- | -- | -- | Bullion Creek | 47.644100 | -103.898690 |
| S-14810414DAD | 11/15/1968 | 400 | 410 | 435 | Sentinel Butte-Tongue River | 47.637756 | -103.883936 |
| S-15309734CBD | 7/27/1974 | 1600 | 1660 | 1660 | Fox Hills | 48.028514 | -103.147780 |
| S-15110222DDD | 2/28/1975 | 58 | 72 | 72? | Fort Union | 47.878205 | -103.713315 |
| S-15010410BAB | 5/26/1977 | 1330 | 1380 | 1400 | Undefined | 47.832929 | -103.983456 |
| S-15209635BCC | 9/17/1977 | 90 | 111 | 112 | Undefined | 47.942322 | -102.939931 |
| S-15110428BCB | 5/26/1979 | 1367 | 1400 | 1405 | Fox Hills | 47.872634 | -104.010645 |
| 15009915DDD | 10/1/1979 | 73 | 82 | 182 | Tobacco Garden Creek | 47.805602 | -103.327260 |
| 15210124CBB1 | 10/8/1979 | 28 | 31 | 62 | Charbonneau | 47.970370 | -103.560675 |
| 15110214CCC | 10/16/1979 | 258 | 264 | 302 | Charbonneau | 47.892667 | -103.710548 |
| 15309423CCC1 | 8/5/1980 | 1743 | 1767 | 1855 | Fox Hills | 48.053366 | -102.740547 |
| 15110436ADA | 5/13/1981 | 71 | 74 | 83 | Charbonneau | 47.858134 | -103.927231 |
| 15010303AAC | 7/7/1981 | 798 | 816 | 1160 | Tongue River - Ludlow | 47.845566 | -103.844226 |
| 15209603BBB | 7/30/1981 | 790 | 817 | 940 | Tongue River - Ludlow | 48.022746 | -102.961376 |
| 15009806AAA | 9/23/1981 | 98 | 103 | 120 | Tobacco Garden Creek | 47.847029 | -103.263464 |
| 15110212CCB | 10/22/1981 | 230 | 235 | 260 | Charbonneau | 47.908915 | -103.688937 |
| 15209516ADD | 11/21/1981 | 670 | 690 | 1000 | Tongue River - Ludlow | 47.985714 | -102.834915 |
| 15109504DBD2 | 5/26/1983 | 1407 | 1432 | 1620 | Fox Hills | 47.924236 | -102.840489 |
| S-15110234BCCD | 4/18/1984 | 60 | 75 | 75 | Sentinel Butte-Tongue River | 47.855972 | -103.731324 |
| 14909509CDD | 7/17/1984 | 1539 | 1564 | 1740 | Fox Hills | 47.732879 | -102.846434 |
| 15110311AAA | 5/7/1985 | 1680 | 1753 | 1920 | Fox Hills | 47.919743 | -103.820048 |
| 15110109BCB | 9/20/2001 | 217 | 222 | 240 | Charbonneau | 47.916154 | -103.625014 |
| S-15309719CDB2 | 12/31/2003 | 1785 | 1848 | 1870 | Fox Hills | 48.055726 | -103.209815 |
| 15010213DDA | 10/4/2005 | 173 | 183 | 240 | Sentinel Butte-Tongue River | 47.808006 | -103.668986 |
| 15010214DDD2 | 10/10/2005 | 143 | 153 | 220 | Sentinel Butte-Tongue River | 47.804940 | -103.691056 |
| S-15010233BDC | 10/12/2006 | 440 | 485 | 500 | Tongue River | 47.769644 | -103.748102 |
| S-14609819AAA | -- | -- | -- | -- | Sentinel Butte-Tongue River | 47.457577 | -103.207166 |
| S-15210103CAC | -- | -- | -- | -- | Undefined | 48.012803 | -103.598428 |
| S-15210211ABC | -- | -- | -- | -- | Fox Hills | 48.004785 | -103.699808 |
| **Williams Co.** | | | | | | | |
| 15910310BBB | 10/21/1963 | -- | 248 | 275 | Grenora | 48.619074 | -103.993974 |
| 15910028ADD | 10/22/1963 | 88 | 98 | 375 | Little Muddy | 48.569361 | -103.603711 |
| 15910306DDD | 6/23/1964 | 138 | 158 | 346 | Grenora | 48.618564 | -104.040032 |
| 15210307DDD1 | 6/14/1965 | 151 | 154 | 199.5 | Trenton | 47.994014 | -103.906396 |
| 15809913DDD | 6/17/1965 | 256 | 259 | 294 | Ray | 48.503924 | -103.408236 |
| 15409712BBB | 9/13/1965 | 100 | 103 | 120 | Hofflund | 48.182133 | -103.107327 |
| 15409714ACB | 5/3/1966 | 115 | 130 | 147 | Hofflund | 48.164058 | -103.118111 |
| 15810017ADA | 5/9/1966 | 33 | 43 | 52.5 | Little Muddy | 48.513260 | -103.625829 |
| 15310231CDC | 6/19/1968 | 83 | 86 | 94 | Trenton | 48.025402 | -103.856149 |
| 15409608AAA | 5/21/1969 | 77 | 83 | 120 | Hofflund | 48.181963 | -103.045066 |
| 15310229CDC | 6/22/1971 | 49 | 54 | 80 | Trenton | 48.039882 | -103.834533 |
| 15310233BBB | 6/22/1971 | 47 | 50 | 80 | Trenton | 48.038073 | -103.818424 |
| 15210301BBB2 | 6/23/1971 | 22 | 25 | 40 | Trenton | 48.023400 | -103.817263 |
| 15510034BAB | 10/7/1976 | 236 | 248 | 260 | Undefined | 48.211329 | -103.532800 |

## Appendix I
## Ground-Water Well Construction Information* Summary

| Location/Well ID | Date Well Drilled | Screened Interval | | Total Well Depth (ft.) | Aquifer | Geographic Coordinates[1] | |
|---|---|---|---|---|---|---|---|
| | | Top (ft.) | Bottom (ft.) | | | Latitude | Longitude |
| 15509628CBD | 10/8/1976 | 38 | 44 | 100 | Undefined | 48.216226 | -103.040023 |
| 15509621BCB1 | 10/8/1976 | 82 | 88 | 100 | Undefined | 48.236403 | -103.042601 |
| 15509621BCB2 | 10/9/1976 | 52 | 58 | 58 | Undefined | 48.236403 | -103.042601 |
| 15609620DCD | 9/6/1984 | 1302 | 1350 | 1520 | Fox Hills | 48.313963 | -103.050669 |
| 15810112ADD | 6/20/1985 | 47 | 52 | 340 | Little Muddy | 48.525961 | -103.668889 |
| 15710013AAD | 6/16/1986 | 191 | 196 | 220 | Undefined | 48.428071 | -103.538642 |
| 15910022ABA1 | 6/18/1986 | 327 | 332 | 370 | Little Muddy | 48.589281 | -103.587294 |
| 15910022ABA2 | 6/18/1986 | 70 | 75 | 100 | Little Muddy | 48.589281 | -103.587294 |
| 15910027DDC | 6/18/1986 | 83 | 88 | 120 | Little Muddy | 48.562112 | -103.584499 |
| 15910025CBC | 6/18/1986 | 87 | 92 | 120 | Little Muddy | 48.565729 | -103.557145 |
| 15410017BDA1 | 5/10/1994 | 88 | 98 | 100 | Undefined | 48.164170 | -103.573173 |
| 15410017BDC | 5/12/1994 | 90 | 100 | 100 | Undefined | 48.162355 | -103.575871 |
| 15410017BBD2 | 5/17/1994 | 21 | 31 | 31 | Undefined | 48.165984 | -103.578568 |
| 15810021BBB | 7/17/1996 | 138 | 143 | 180 | Little Muddy | 48.502425 | -103.623026 |
| 15810016AAB | 7/17/1996 | 118 | 123 | 140 | Little Muddy | 48.516926 | -103.606687 |
| 15910028DCD1 | 8/14/1997 | 78 | 83 | 140 | Little Muddy | 48.562141 | -103.609159 |
| 15910028DCD2 | 8/14/1997 | 18 | 23 | 30 | Little Muddy | 48.562141 | -103.609159 |
| 15910027CCD1 | 8/14/1997 | 76 | 81 | 100 | Little Muddy | 48.562130 | -103.598199 |
| 15910027CCD2 | 8/14/1997 | 32 | 37 | 40 | Little Muddy | 48.562130 | -103.598199 |
| 15910027DDC2 | 8/14/1997 | 25 | 30 | 40 | Little Muddy | 48.562112 | -103.584499 |
| 15610007DDD | 7/22/1998 | 50 | 55 | 80 | Little Muddy | 48.342849 | -103.583811 |
| 15610006AAB | 7/23/1998 | 64 | 69 | 80 | Little Muddy | 48.372679 | -103.588912 |
| 15409617BCB1 | 10/30/1998 | 100 | 110 | 160 | Hofflund | 48.163964 | -103.064126 |
| 15610033CCB | 6/23/1999 | 38 | 43 | 60 | Little Muddy | 48.287190 | -103.560005 |
| 15409609DCC1 | 9/26/2000 | 128 | 133 | 160 | Hofflund | 48.169298 | -103.031638 |
| 15409609DCC2 | 9/26/2000 | 58 | 63 | 80 | Hofflund | 48.169298 | -103.031638 |
| 15409616CBC | 9/27/2000 | 104 | 109 | 140 | Hofflund | 48.158543 | -103.042456 |
| 15409618DCC | 9/27/2000 | 78 | 83 | 140 | Hofflund | 48.154971 | -103.074952 |
| 15409618CCC1 | 9/27/2000 | 78 | 83 | 140 | Hofflund | 48.154973 | -103.085739 |
| 15409618CCC2 | 9/27/2000 | 138 | 143 | 180 | Hofflund | 48.154973 | -103.085739 |
| 15210206CCB1 | 9/12/2001 | 110 | 115 | 120 | Trenton | 48.010574 | -103.795736 |
| 15210206CCB2 | 9/12/2001 | 37 | 42 | 50 | Trenton | 48.010574 | -103.795736 |
| 15210301ADD1 | 9/12/2001 | 94 | 99 | 120 | Trenton | 48.016959 | -103.798404 |
| 15210301ADD2 | 9/12/2001 | 32 | 37 | -- | Trenton | 48.016959 | -103.798404 |
| 15210301AAD2 | 9/13/2001 | 37 | 42 | 50 | Trenton | 48.021211 | -103.798425 |
| 15210301AAD1 | 9/13/2001 | 106 | 111 | 130 | Trenton | 48.021211 | -103.798425 |
| 15310233DDD2 | 9/14/2001 | 33 | 38 | -- | Trenton | 48.025316 | -103.799533 |
| 15310233DDD1 | 9/14/2001 | 106 | 111 | 140 | Trenton | 48.025316 | -103.799533 |
| 15310233DBB | 9/17/2001 | 52 | 57 | 80 | Trenton | 48.030814 | -103.807599 |
| 15910126DAA | 6/8/2004 | 33 | 38 | 160 | Little Muddy | 48.567553 | -103.690560 |
| 15910310CAA3 | 6/8/2004 | 17 | 22 | 40 | Grenora | 48.612227 | -103.983146 |
| 15910003CBC1 | 6/14/2004 | 259 | 264 | 320 | Little Muddy | 48.623823 | -103.600965 |
| 15910310ABB1 | 10/13/2005 | 245 | 250 | 280 | Grenora | 48.618311 | -103.981129 |
| 15610017AAA | 10/13/2005 | 67 | 72 | 100 | Little Muddy | 48.341526 | -103.562729 |
| 15910310ABB2 | 10/19/2005 | 210 | 215 | 225 | Grenora | 48.618311 | -103.981129 |
| 15409609AAB | 5/30/2006 | 30 | 35 | 80 | Hofflund | 48.181876 | -103.026238 |
| 15409605BBB | 5/31/2006 | 83 | 88 | 160 | Hofflund | 48.196440 | -103.064034 |
| 15609632CCC2 | -- | -- | 356 | 356 | Sentinel Butte-Tongue River | 48.284926 | -103.064354 |
| 15609635DDA | -- | -- | 163 | 163 | Undefined | 48.286555 | -102.980703 |
| 15509701DDD | -- | -- | 95 | 93 | Ray | 48.270485 | -103.089374 |
| 15509714DAA | -- | -- | 172 | 172 | Undefined | 48.247213 | -103.111104 |
| 15310216DDD | -- | -- | 21 | 21 | Trenton | 48.068458 | -103.800442 |
| **Eddy Co.** | | | | | | | |
| 14806603DDC | 8/6/1964 | 210 | 218 | 252 | New Rockford | 47.660816 | -99.056708 |
| 14806611CCD | 6/10/1988 | 185 | 190 | 200 | Unknown | 47.646317 | -99.048797 |
| 14806607CCC | 6/16/1988 | 178 | 183 | 220 | Unknown | 47.646622 | -99.136645 |
| 15006315BBB | -- | -- | -- | -- | Warwick | 47.817528 | -98.714976 |
| 15006302CCC1 | -- | -- | -- | -- | Warwick | 47.833804 | -98.693439 |
| 15006213CCC | -- | -- | 10.4 | 10.4 | Warwick | 47.804695 | -98.543500 |
| 14906722DDD2 | -- | -- | -- | 8 | Undefined | 47.702895 | -99.212736 |
| **Foster Co.** | | | | | | | |
| 14706425ADD | 7/8/1964 | 53 | 63 | 84 | Juanita | 47.523140 | -98.757009 |
| 14606236BBB | 7/10/1964 | 188 | 198 | 231 | New Rockford | 47.427000 | -98.519553 |

## Appendix I
## Ground-Water Well Construction Information* Summary

| Location/Well ID | Date Well Drilled | Screened Interval | | Total Well Depth (ft.) | Aquifer | Geographic Coordinates[1] | |
|---|---|---|---|---|---|---|---|
| | | Top (ft.) | Bottom (ft.) | | | Latitude | Longitude |
| 14706210ABB | 7/22/1964 | 43 | 48 | 63 | Undefined | 47.571923 | -98.551997 |
| 14606605DDD | 9/26/1978 | 93 | 96 | 120 | Carrington | 47.487239 | -99.097290 |
| 14706736BBB | 6/9/1987 | 58 | 63 | 100 | Carrington | 47.514465 | -99.158401 |
| 14706629BCC1 | 5/19/1988 | 68 | 73 | 80 | Carrington | 47.523546 | -99.116106 |
| 14506227BBB2 | 11/14/1991 | 118 | 123 | 140 | Eastman | 47.354598 | -98.561874 |
| 14506201BBB | 6/10/1992 | 158 | 163 | 220 | Eastman | 47.412527 | -98.519452 |
| 14506212BBB | 6/10/1992 | 98 | 103 | 180 | Eastman | 47.397997 | -98.519455 |
| 14506214CCC | 6/22/1994 | 158 | 163 | 200 | Eastman | 47.370871 | -98.540828 |
| **Nelson Co.** | | | | | | | |
| 15006130ABB | 6/18/1968 | 237 | 240 | 380 | Spiritwood | 47.787902 | -98.512629 |
| 15006009DDD | 6/19/1968 | 217 | 220 | 340 | McVille | 47.818157 | -98.334456 |
| 15006024CCC | 6/20/1968 | 67 | 77 | 140 | McVille | 47.789084 | -98.288757 |
| 15005927CDD | 7/21/1969 | 137 | 143 | 280 | McVille | 47.774701 | -98.194782 |
| 15006009CCC | 6/4/1970 | 97 | 100 | 160 | McVille | 47.818200 | -98.353252 |
| 15005919BCC | 6/11/1970 | 157 | 163 | 360 | McVille | 47.796339 | -98.267255 |
| 14906133CCC | 7/18/1979 | 90 | 92 | 220 | Spiritwood | 47.673314 | -98.481166 |
| 15006005AAC | 6/13/1990 | 78 | 83 | 140 | McVille | 47.843476 | -98.358742 |
| 15006116DDD | 7/31/2003 | 148 | 153 | 180 | Spiritwood | 47.802953 | -98.462301 |
| **Ramsey Co.** | | | | | | | |
| S-15806129AAA | 1/1/1964 | -- | 107 | -- | Pierre Shale | 48.484911 | -98.537262 |
| 15206207ACA1 | 8/21/1973 | 197 | 203 | 300 | Spiritwood | 48.000979 | -98.640083 |
| 15406507CDD | 9/5/1973 | 130 | 133 | 120 | Spiritwood | 48.166650 | -99.060946 |
| 15406535BBB | 8/12/1974 | 124 | 127 | 160 | Spiritwood | 48.121456 | -98.982662 |
| 15506634CCC | 8/14/1974 | 118 | 121 | 160 | Spiritwood | 48.195740 | -99.133882 |
| 15506530BBB | 8/14/1974 | 98 | 101 | 140 | Spiritwood | 48.222917 | -99.069002 |
| 15306404BBB | 9/30/1986 | 23 | 28 | 30 | Pierre Shale | 48.106907 | -98.896250 |
| 15306429BBBA3 | 8/28/1987 | 88 | 93 | 100 | Lake Clay Sed. | 48.049449 | -98.916999 |
| 15306409BBC3 | 5/24/1988 | 10 | 15 | 15 | Till | 48.090557 | -98.896171 |
| 15306409BAD1 | 5/24/1988 | 93 | 98 | 100 | Pierre Shale | 48.090558 | -98.888094 |
| 15406405AAD1 | 8/1/1988 | 18 | 23 | 23 | Undefined | 48.192036 | -98.899185 |
| 15406405AAD3 | 8/1/1988 | 31 | 36 | 36 | Undefined | 48.192036 | -98.899185 |
| 15206234DDA | 7/23/1991 | 238 | 243 | 280 | Spiritwood | 47.935863 | -98.569973 |
| 15206234AAD2 | 7/23/1991 | 128 | 133 | 140 | Spiritwood | 47.944943 | -98.569939 |
| 15106203DDAD | 9/24/2003 | 258 | 263 | 270 | Spiritwood | 47.921075 | -98.569209 |
| 15106203DDAA | 9/24/2003 | 258 | 263 | 280 | Spiritwood | 47.922023 | -98.569211 |
| **Cavalier Co.** | | | | | | | |
| 16306421AAD | 9/16/1969 | 20 | 40 | 40 | Unknown | 48.932514 | -98.935993 |
| 16306133AAA | 9/26/1970 | 38 | 41 | 60 | Unknown | 48.905065 | -98.542077 |
| **Grand Forks Co.** | | | | | | | |
| 14905205CDD | 8/18/1965 | 12 | 15 | 42 | Unknown | 47.745670 | -97.336928 |
| 15405509DDD | 8/20/1985 | 31 | 36 | 45 | Inkster | 48.166675 | -97.710169 |
| 15405522BAA | 10/31/1986 | 45 | 50 | 80 | Inkster | 48.150446 | -97.699438 |
| 15405522BAA2 | 9/30/1987 | 30 | 35 | 40 | Inkster | 48.150446 | -97.699438 |
| 15305514DCC | 9/12/1989 | 75 | 80 | 100 | Inkster | 48.065215 | -97.675058 |
| 15205515BBB | 5/30/1990 | 28 | 33 | 60 | Elk Valley | 47.990055 | -97.687025 |
| 15105523BBB | 5/30/1991 | 35 | 40 | 60 | Elk Valley | 47.888399 | -97.665440 |
| 15105428CDA | 6/13/1991 | 38 | 43 | 120 | Elk Valley | 47.862951 | -97.571709 |
| 15405515BCBBB | 6/18/1991 | 33 | 38 | 60 | Inkster | 48.161911 | -97.708525 |
| 15205504DCC3 8 | 9/30/1991 | 3.5 | 4 | 31 | Elk Valley | 48.006544 | -97.697899 |
| 14905403AAA | 9/16/1992 | 34 | 39 | 120 | Elk Valley | 47.757844 | -97.539169 |
| 15005405ABB1 | 10/15/2001 | 305 | 315 | 320 | Carlisle Formation | 47.844796 | -97.590566 |
| 15105419CCC2 | 10/16/2001 | 235 | 240 | 250 | Niobrara Formation | 47.875658 | -97.622375 |
| 15105523BBB2 | 10/17/2001 | 205 | 215 | 220 | Carlisle Formation | 47.888399 | -97.665440 |
| 15105523BBB3 | 10/17/2001 | 60 | 70 | 75 | Till | 47.888399 | -97.665440 |
| 15205527DDD2 | 7/27/2005 | 30 | 35 | 40 | Elk Valley | 47.948334 | -97.668184 |
| **Walsh Co.** | | | | | | | |
| 15605624CCC | 5/22/1968 | 32 | 35 | 300 | Fordville | 48.311696 | -97.793747 |
| 15605634DCC | 5/24/1968 | 37 | 40 | 65 | Fordville | 48.282751 | -97.826484 |
| 15605627ADD1 | 5/26/1968 | 42.5 | 45.5 | 100 | Undefined | 48.304470 | -97.818299 |
| 15505623AAA2 | 6/15/1970 | 37 | 40 | 60 | Fordville | 48.237488 | -97.796734 |
| 15605626DCC | 6/11/1991 | 25 | 30 | 40 | Fordville | 48.297192 | -97.804662 |
| 15505611DDD | 6/11/1991 | 11 | 16 | 68 | Fordville | 48.253727 | -97.796763 |
| 15505611ABB | 6/11/1991 | 23 | 28 | 34 | Fordville | 48.267372 | -97.804302 |

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## Ground-Water Well Construction Information* Summary

| Location/Well ID | Date Well Drilled | Screened Interval | | Total Well Depth (ft.) | Aquifer | Geographic Coordinates[1] | |
|---|---|---|---|---|---|---|---|
| | | Top (ft.) | Bottom (ft.) | | | Latitude | Longitude |
| 15605615DDD | 10/1/2001 | 45 | 50 | 60 | Fordville | 48.326219 | -97.818262 |
| 15605616BAA | 10/1/2001 | 24 | 29 | 40 | Fordville | 48.338928 | -97.850771 |
| 15605624BCC | 10/2/2001 | 101 | 106 | 140 | Fordville | 48.318936 | -97.793816 |
| 15605623CDD | 10/2/2001 | 28 | 33 | 60 | Fordville | 48.311685 | -97.807398 |
| 15605623BCC | 10/3/2001 | 38 | 43 | 60 | Fordville | 48.318940 | -97.815552 |
| 15605636CDD | 10/3/2001 | 53 | 58 | 120 | Fordville | 48.282639 | -97.785646 |
| 15605626DAA | 10/3/2001 | 38 | 43 | 80 | Fordville | 48.302625 | -97.796471 |
| 15605625CDD | 10/3/2001 | 75 | 80 | 160 | Fordville | 48.297190 | -97.785628 |
| 15605622DCC | 10/3/2001 | 32 | 37 | 60 | Fordville | 48.311694 | -97.826413 |
| 15605635AAA | 10/4/2001 | 47 | 52 | 80 | Fordville | 48.295389 | -97.796496 |
| 15605634DDD | 10/8/2001 | 27 | 32 | 60 | Fordville | 48.282747 | -97.818350 |
| 15505624ABB | 10/9/2001 | 42 | 47 | 70 | Fordville | 48.237466 | -97.783173 |
| 15605624CCC2 | 10/10/2001 | 30 | 35 | 40 | Fordville | 48.311696 | -97.793747 |
| 15805625AAA | 7/26/2005 | 34 | 39 | 43 | Unnamed | 48.484225 | -97.798058 |
| 15805530DDC | 7/26/2005 | 17 | 22 | 40 | Unnamed | 48.471527 | -97.779344 |
| **Pembina Co.** | | | | | | | |
| 16305628ABD | 6/29/1983 | 29 | 39 | 50 | Pembina River | 48.916936 | -97.890203 |
| 16305627DBA | 9/14/1989 | 34 | 39 | 47 | Pembina River | 48.911664 | -97.868594 |
| 16305628DBB | 9/14/1989 | 28 | 33 | 40 | Icelandic | 48.911581 | -97.892951 |
| 16105527CDD | 5/23/1990 | 47 | 53 | 60 | Icelandic | 48.733502 | -97.740938 |
| 15905630ACD | 6/20/1991 | 23 | 28 | 40 | Gardar | 48.565738 | -97.912455 |
| 16105516DBB | 10/23/1991 | 64 | 74 | 74 | Icelandic | 48.767484 | -97.761383 |
| 16105528AAD | 10/24/1991 | 68 | 78 | 80 | Icelandic | 48.744455 | -97.752111 |
| 16105528AAA | 10/25/1991 | 68 | 78 | 80 | Icelandic | 48.746461 | -97.752100 |
| 16105528ABC | 10/29/1991 | 62 | 72 | 74 | Icelandic | 48.744381 | -97.761010 |
| 16105528BAB | 10/30/1991 | 62 | 72 | 74 | Icelandic | 48.745857 | -97.766892 |
| 16105527CBB | 10/31/1991 | 24 | 34 | 42 | Icelandic | 48.738988 | -97.749226 |
| 16105529BBB | 10/30/1995 | 0 | 32 | 42 | Icelandic | 48.745574 | -97.794769 |
| 16105529CBC | 10/31/1995 | 46 | 56 | 58 | Icelandic | 48.736405 | -97.794894 |
| 16105528CDD | 11/1/1995 | 53 | 63 | 65 | Icelandic | 48.733246 | -97.764087 |
| 16105528BCB1 | 11/1/1995 | 53 | 63 | 67 | Icelandic | 48.742301 | -97.772940 |
| 16105530DBC | 11/2/1995 | 38 | 48 | 50 | Icelandic | 48.736472 | -97.805790 |
| 16105530CBB | 11/2/1995 | 25 | 35 | 40 | Icelandic | 48.738297 | -97.816773 |
| 16105531BBB | 11/2/1995 | 28 | 38 | 40 | Icelandic | 48.731048 | -97.816841 |
| **Dickey Co.** | | | | | | | |
| 13105915AAA2 | 9/20/1974 | 44 | 47 | 60 | Oakes | 46.167541 | -98.049083 |
| 13106006BBB | 9/30/1974 | 86 | 89 | 280 | Guelph | 46.196615 | -98.253683 |
| 13005924DDD2 | 8/27/1975 | 33 | 36 | 60 | Oakes | 46.052141 | -98.007930 |
| 13205904CCC | 6/7/1979 | 195 | 198 | 220 | Spiritwood | 46.269320 | -98.089865 |
| 13005921DBB | 10/5/1979 | 17.7 | 20.1 | 28.5 | Oakes | 46.059066 | -98.080684 |
| 13105934DCC | 10/16/1979 | 18.2 | 20.6 | 33 | Oakes | 46.110032 | -98.059339 |
| 13205927ADD | 10/30/1979 | 153 | 156 | 180 | Unknown | 46.219485 | -98.048822 |
| 13005926CCC2 | 7/23/1980 | 0 | 0 | 18.5 | Oakes | 46.037559 | -98.049208 |
| 13105927CBB2 | 7/8/1982 | 47 | 52 | 53 | Oakes | 46.131483 | -98.069484 |
| 13205927CCC | 7/22/1982 | 23 | 28 | 82 | Unknown | 46.211417 | -98.068031 |
| 13206019ABB | 9/13/1982 | 58 | 63 | 97 | Unknown | 46.240061 | -98.245701 |
| 13106001BAA | 9/16/1982 | 147 | 152 | 197 | Unknown | 46.196858 | -98.144110 |
| 13005902DBB | 11/16/1983 | 18.2 | 20.4 | 23 | Oakes | 46.102471 | -98.038597 |
| 13105932DCC2 | 7/16/1984 | 18.4 | 20.2 | 23 | Oakes | 46.109999 | -98.098714 |
| 12906236CDD | 4/24/1991 | 98 | 103 | 106 | Guelph | 45.937343 | -98.393784 |
| 12906236ADA2 | 9/4/1991 | 98 | 103 | 115 | Guelph | 45.946385 | -98.383291 |
| 12906236ADA3 | 9/4/1991 | 49 | 54 | 60 | Guelph | 45.946385 | -98.383291 |

***Well construction information compiled from online databases of the NDSWC: www.swc.state.nd.us.**

**[1]Geographical coordinates in decimal degrees. West longitude values shown as a negative (e.g., -100.11707).**

**-- Data unavailable.** **S = Stock Well.**