

SHALLOW GAS FIELD SCREENING IN NORTH DAKOTA

By Fred Anderson

During the fall of 2006 the NDGS conducted a shallow gas field screening investigation in order to document the presence of shallow gas within observation wells in several areas of interest in the glaciated portion of the state (i.e. east of the Missouri River). The observation well network in seven counties: Bottineau, Emmons, Renville, Rolette, Stutsman, Towner, and southeastern Steele counties were studied.

a sample of the air column within the monitoring well both at the top of the well at the well mouth, or top of casing (TOC), and at the ground-water/atmospheric interface, or GWI in order to sample any gas fluxing from the groundwater to the atmosphere across the interface. A depth-to-groundwater measurement was collected after the initial TOC reading was collected in order to determine the level at which to lower the extended probe within the well.

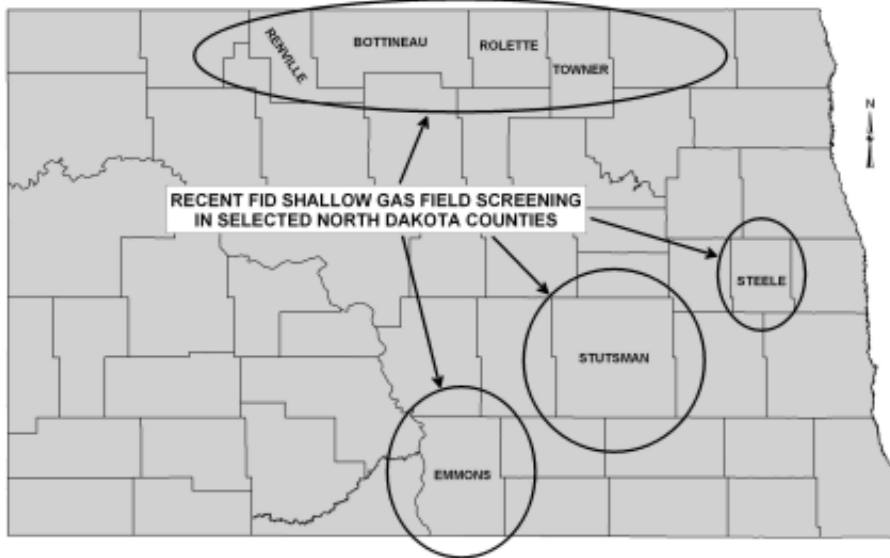


Figure 1. Location of counties in North Dakota where observation wells were field screened with a portable flame-ionization detector (FID) for the occurrence of shallow natural gas (methane).

Each observation well was visited in the field and subjected to shallow gas field screening using a portable Flame-Ionization Detector (FID). An FID is an analytical instrument - a detector - common to the standard analytical chemical laboratory and is often associated with environmental analyses and gas chromatographic laboratory analysis in the study of complex hydrocarbons. A portable version of this common laboratory instrument was used in the field for the direct detection of methane as a combustible hydrocarbon.

The FID used for this investigation was calibrated to a predetermined concentration of methane in air. Methane at a concentration of 101 parts per million (ppm) was used for instrument calibration and sampling at "low-span" concentrations ranging from zero to 10,000 ppm. Higher span calibration gas at a concentration of 10,000 ppm (1%) methane in air was used for field screening where gas occurrences were found at higher-span concentrations, typically greater than 1%.

During the investigation, the FID was employed to collect

Over 600 observation well locations were considered as a part of this investigation (Table 1). Since many of the well locations were not a part of the contemporary monitoring array, it was anticipated that many of the well locations might not be in existence as they have likely been abandoned or destroyed because of disuse over time. Of the well locations considered, over 200 wells were not locatable in the field and are presumed abandoned or destroyed. Over 300 wells were field screened for shallow gas.

Several well locations were not visited during the investigations due simply to access issues and/or time and weather constraints.



Figure 2. Field screening for shallow gas (methane) occurrence in a shallow ground-water observation well in Emmons County during the fall of 2006. The author is shown field screening a well with an FID at the observation well top of casing or TOC.

Table 1. Summary of Shallow Gas Field Screening Results in Eastern North Dakota.

County	No. of Wells Investigated	No. of Wells Field Screened	No. of Wells with a positive FID response	No. of Wells with no FID response	Range of FID Instrument Response (ppm as CH ₄ in air)	No. of Wells Not Visited
SE Steele	21	9	3	6	2.0 – 146.3	11
Bottineau	110	33	11	22	2.4 - 30,362	10
Renville	34	8	3	5	20.6 – 28,000	6
Emmons	109	92	12	38	1.6 - 775	17
Stutsman	170	106	21	86	0.4 - 182	40
Rolette	114	52	10	42	0.6 – 15.2	16
Towner	78	31	6	25	0.2 – 32.8	4
Totals	636	331	66	224	0.2 – 30,362	104

Historic and Recent Field Screening Results for Bottineau County

The first county selected for FID field screening was Bottineau, primarily because of the relative abundance of historical gas shows in water wells (fig. 3) that were documented in the early 1900s.

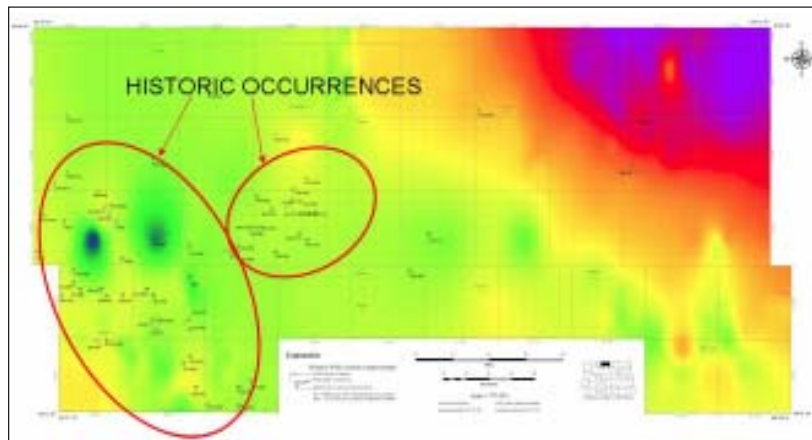


Figure 3. Location of Historic Shallow Gas Occurrences (ca. 1920s) and Relationship of Bedrock Topographic Surface in Bottineau County, North Dakota.

During the field work in Bottineau County, one well located at T.162 N., R.83 W., Sec. 15, SW1/4, SW1/4, SW1/4 (162-83-15CCC) was found to be flowing at the wellhead with gas bubbling up through the water column (fig. 4).

Field screening of the gas bubbles emanating from the water column resulted in an FID response of 236 ppm (as methane). Additional groundwater analysis indicated a concentration of methane in groundwater of 8.3 mg/L. Continued fieldwork in the county revealed several other well

locations with contemporary shallow gas occurrences (fig. 5). It is interesting to note that the majority of detected shallow gas in the county corresponds quite well with the area of historic shallow gas occurrence in and around the early 1900s.

Recommendations for Further Work

It is well understood that field screening alone cannot be used for quantitative analysis of shallow gas occurrence nor should it be used solely for resource assessment purposes. Subsequent air column sampling and gas composition analysis must be performed to quantify the types and amounts of compounds present. Field screening does provide a first look at an area of interest and can help to focus further field investigative efforts. Additional air column and groundwater sampling should be performed in these areas to better characterize the nature of these shallow natural gas occurrences.

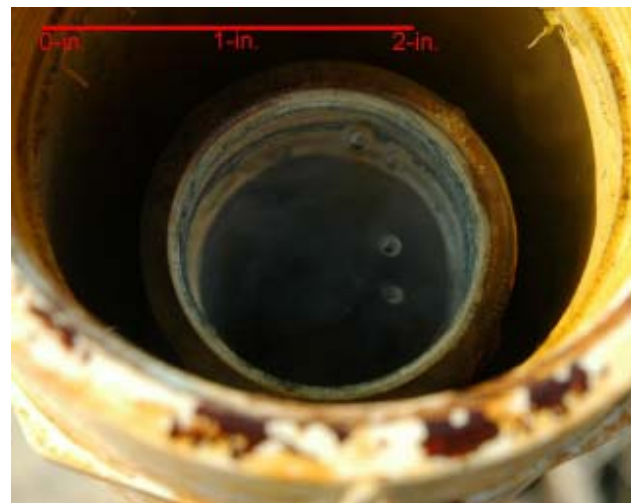


Figure 4. Gas bubbles rising through the water column of a flowing-head observation well located in eastern Bottineau County in T.162 N., R.83 W., Sec. 15, SW1/4, SW1/4, SW1/4 (162-83-15CCC).

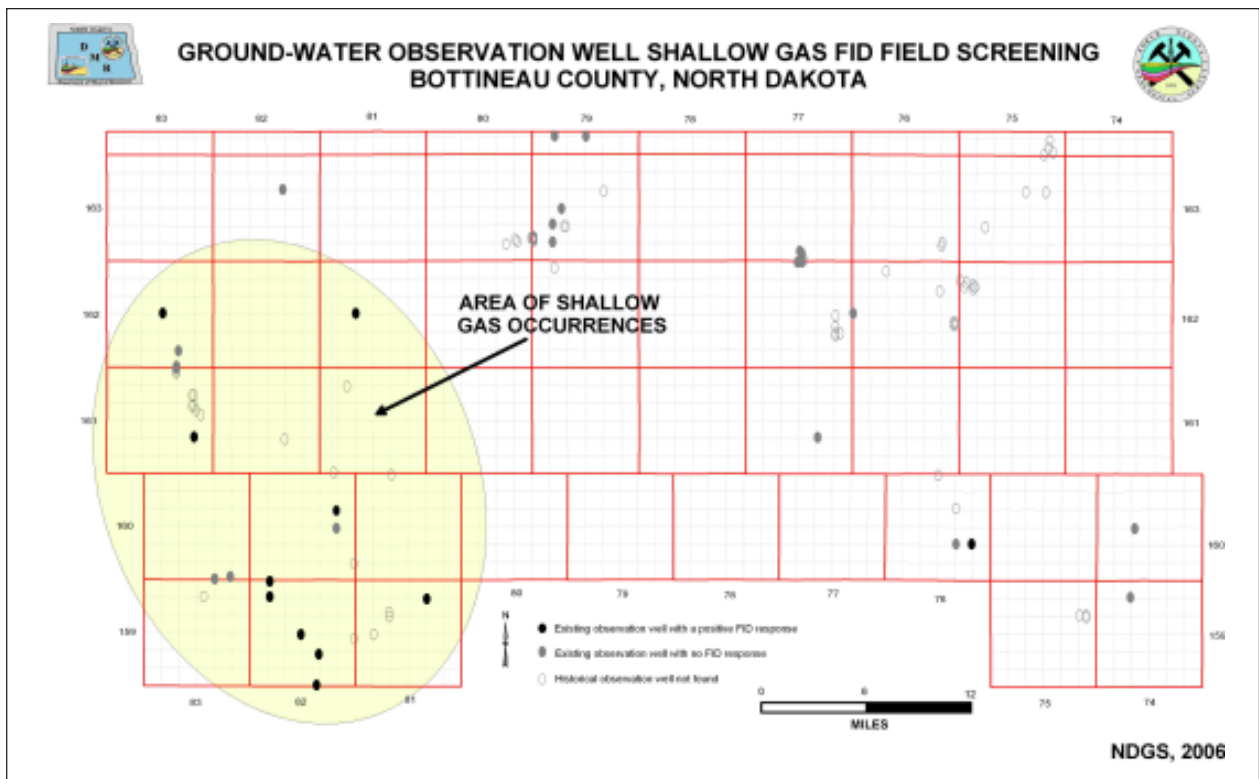


Figure 5. Location and summary diagram of the distribution of wells and FID field screening results for shallow gas (methane) in Bottineau County, North Dakota.

Detailed maps displaying the results of this investigation have been published in the Survey Geological Investigation (GI) series.

Recent NDGS Geological Investigations (GI) and 100K Maps of Interest Related to Shallow Gas in North Dakota

GI-28 Anderson, F.J., 2006, Historical Shallow Natural Gas Occurrences in Wells in Bottineau County, North Dakota. Available in map format (\$10.00) and on CD (\$5.00).

GI-29 Anderson, F.J., 2006, Shallow Gas Field Screening in Emmons County, North Dakota. Available in map format (\$10.00) and on CD (\$5.00).

GI-30 Anderson, F.J., 2006, Shallow Gas Field Screening in Southeastern Steele County, North Dakota. Available in map format (\$10.00) and on CD (\$5.00).

GI-31 Anderson, F.J. and Juenker, B.J., 2006, Preliminary Structure Contour Map on the Cretaceous Greenhorn Formation in North Dakota. Available in map format (\$10.00) and on CD (\$5.00).

GI-32 Anderson, F.J., 2006, Assessment of the Shallow Natural Gas Resource Potential of North Dakota. PowerPoint presentation. Available on-line only.

GI-33 Anderson, F.J., Shurr, G.W, and Fischer, D.W., 2006, History, Geology, and Potential Hydrogeochemical Indicators of Natural Gas Occurrence and Production from Quaternary Glacial Drift and Upper-Cretaceous Sedimentary Bedrock in North-Central North Dakota. PowerPoint presentation. Available on-line only.

GI-34 Anderson, F.J., 2006, Shallow Gas Field Screening in Stutsman County, North Dakota. Available in map format (\$10.00) and on CD (\$5.00).

GI-35 Anderson, F.J., 2006, Shallow Gas Field Screening in Rolette County, North Dakota. Available in map format (\$10.00) and on CD (\$5.00).

GI-36 Anderson, F.J., 2006, Shallow Gas Field Screening in Towner County, North Dakota. Available in map format (\$10.00) and on CD (\$5.00).

Anderson, F.J., 2006, Shallow Gas Field Screening: Bottineau 100k sheet, North Dakota Geological Survey, 100k Btnu-gs, 1:100,000 scale. Available in map format (\$10.00) and on CD (\$5.00).

Anderson, F.J., 2006, Shallow Gas Field Screening: Mohall 100k sheet, North Dakota Geological Survey, 100k Mhll-gs, 1:100,000 scale. Available in map format (\$10.00) and on CD (\$5.00).