# SYNOPSIS OF THE REPORT "RECOMMENDED SAMPLING, ANALYSIS, AND REPORTING PROTOCOLS FOR BASELINE GROUNDWATER SAMPLING IN ADVANCE OF COALBED GAS DEVELOPMENT IN THE TELKWA COALFIELD, BRITISH COLUMBIA"

*Susan Chaytor[1] and Rachel Shaw[2]*

## ABSTRACT

*This synopsis provides a summary of the key points from the report, "Recommended sampling, analysis, and reporting protocols for baseline groundwater sampling in advance of coalbed gas development in the Telkwa Coalfield, British Columbia" (the Protocols Report) by Dr. Tony Gorody of Universal Geoscience Consulting, Inc.*

*The advent of baseline groundwater sampling, analysis, and monitoring in the oil and gas industry in advance of drilling new wells is a relatively new concept; however, the protocols recommended in the Protocols Report have been gradually developed and successfully tested for 15 years. These include protocols for field sampling, sample analysis, data documentation, and quality control/quality assurance procedures. By using the consistent procedures outlined in the Protocols Report, the quality of groundwater data collected may be improved, and this can help stakeholders reliably evaluate whether groundwater in a producing basin is being adversely affected by oil and gas operations.*

Chaytor, S. and Shaw, R., (2008), Synopsis of the report "Recommended Sampling, Analysis, and Reporting Protocols for Baseline Groundwater Sampling in Advance of Coalbed Gas Development in the Telkwa Coalfield, British Columbia;" in Geoscience Reports 2008, *BC Ministry of Energy, Mines and Petroleum Resources*, pages 9-11.

[1]Resource Development and Geoscience Branch, BC Ministry of Energy, Mines and Petroleum Resources; 250-953-3800; Susan.Chaytor@gov.bc.ca
[2] Resource Development and Geoscience Branch, BC Ministry of Energy, Mines and Petroleum Resources; 250-387-1667; Rachel.Shaw@gov.bc.ca

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## INTRODUCTION

The report, "Recommended sampling, analysis, and reporting protocols for baseline groundwater sampling in advance of coalbed gas development in the Telkwa Coalfield, British Columbia" (the Protocols Report) was prepared for the Ministry of Energy, Mines and Petroleum Resources (the Ministry) by Dr. Tony Gorody of Universal Geoscience Consulting, Inc. This synopsis was written to provide a summary of the key points; interested parties are encouraged to contact the Ministry for a copy of the full-length report.

The objective of the Protocols Report is to recommend standardized baseline groundwater sampling, analysis, and reporting protocols in advance of coalbed gas (CBG) development in the Telkwa Coalfield tenure area. As applied in the report, baseline sampling is intended to provide the foundations for additional groundwater monitoring during future CBG exploration and development activities. Such monitoring would provide a valuable screening tool for evaluating whether CBG activities are affecting groundwater either tapped by domestic wells or issuing from springs.

The approach proposed in the Protocols Report is to sample and test for the most direct, abundant, and obvious signs of groundwater contaminants potentially related to CBG development; this would require analyzing and comparing data derived from sampling groundwater in coalbed gas reservoirs as well as springs and sources designated for domestic use. Sample selection criteria are not addressed in the Protocols Report.

Recommendations presented in the report address the two major environmental concerns related to the potential impact of CBG development on potable groundwater resources. These are 1) contamination of aquifers with migrated hydrocarbon gas and 2) declining aquifer yield resulting from drawdown associated with CBG water production. Consistent baseline sampling and analysis protocols will make it possible to reliably assess potential impacts to

the groundwater environment. Although emphasis in the Protocols Report is placed on sampling cased and completed water wells, similarly rigorous protocols would apply to the sampling of open wells, springs, and surface water resources.

Recommendations presented in the Protocols Report include the following:

- Standard field sampling protocols to ensure consistent analytical results;
- Standard analyses to evaluate the origin of naturally occurring gas in water resources;
- Standard data maintenance and recording practices and;
- Selected quality assurance and control considerations that allow the information collected to withstand public and scientific scrutiny.

To keep the Protocols Report reasonably brief, established conventional surface water and groundwater sampling protocols are not repeated.

## DISCUSSION: FIELD SAMPLING

Field sampling protocols recommended in the Protocols Report focus on the collection and documentation of information resulting from many sources, including interviews of water users; observations of surroundings, water sources, hydrologic setting, and mechanical well components; and a hazard assessment of the site, including confined space protocols if necessary. Techniques for decontamination of sampling equipment, recording static water levels, and purging wells are detailed, as are recommendations on which samples should be filtered in the field.

Detailed rationale and sample-collection procedures are presented for

- alkalinity;
- free and dissolved hydrocarbon gas concentration measurements;
- stable isotopic and chromatographic analysis of free and dissolved gas;
- volatile organic compounds;
- Biologic Activity Reaction Test (BART™) screening; and
- tests for dissolved sulfide.

Procedures are given for conditions of both effervescent and non-effervescent water.

## DISCUSSION: SAMPLE ANALYSIS

The Protocols Report specifies the following analytical procedures:

- *Routine analyses for dissolved inorganic constituents and physical properties (including general water quality parameters, major ions, halides, trace metals, and nutrients)*: Repeated sampling and analysis of the major ions can be used to establish the presence of multiple aquifers, to observe differences in aquifer mixing rates that influence dissolved gas concentrations, to document seasonal changes in precipitation rates, recharge rates, and discharge rates, and to document the influence of irrigation.
- *Measurement of dissolved atmospheric and hydrocarbon gases in the $C_1$-$C_4$ range*: Measuring gas component ratios at either a contaminant or pollutant site can also help establish the role that hydrocarbon-oxidizing bacteria play in altering the original source-gas composition. Repeated, temporal analysis of dissolved gas composition at a contaminant or pollutant site will reveal the rate at which the source gas is consumed.
- *Measurement of volatile organic compounds (VOCs), including total extractable petroleum hydrocarbons*: Measurement of volatile organic compounds can help differentiate a naturally occurring gas-pollutant source from a refined-product pollutant source.
- *Biological Activity Reaction Test (BART™)*: This protocol suggests measuring for specific bacteria that are the most common indicators of potential bacteria-related water well problems.
- *Stable isotopes of the gas (if either thermogenic gas components are detected or dissolved methane concentrations exceed 2 mg/L)*: Stable carbon and deuterium isotopes of methane provide an independent means to determine the origin of gases and are conventionally used to differentiate between biogenic and thermogenic methane sources. Both chromatographic composition and isotope ratios are used to differentiate naturally occurring gas sources.
- *Stable isotopes of δD and δ18O in water (if dissolved methane concentrations exceed 2 mg/L)*: The stable isotopic content of water is routinely used to establish water provenance, mixing between aquifers, and brine contamination from either natural contaminant or pollutant sources. The deuterium data are also used to differentiate the reaction pathways that generate bacterial methane (fermentation vs. $CO_2$ reduction), and to determine whether bacterial methane is generated in-situ or migrated from another source.

## DISCUSSION: DATA DOCUMENTATION

The Protocols Report offers recommendations for documenting a large variety of data and illustrates with examples what types of data table structures can be used to store the many field observations, field data, photographs, and lab data collected. A relational database structure is recommended. Examples of table structure are given for tables that can be queried to generate formatted data useful for spreadsheet analysis, plotting data on GIS maps, and other reports.

## DISCUSSION: QUALITY ASSURANCE / QUALITY CONTROL

Quality control measures and protocols for environmental sampling are too extensive to be covered in great detail here. Essentially, the Protocols Report suggests that every sampling program should make provisions to document the protocols required for checking data quality:

- Checklists are to include calibration checks, lists of interview questions to ask property owners, lists of field parameters to record, and a list of materials, equipment, and supplies needed for sampling.
- Records should be kept of field instrument calibration (minimum daily, using appropriate fresh standards).
- Submissions for laboratory analysis should include at least one blind sample duplicate for every twenty samples (i.e., 5% of samples).
- Records should indicate whether split duplicate or consecutive paired sample collection was used.
- The use of trip and equipment blanks should be anticipated and collected.
- The quality of laboratory results should be evaluated.

## CONCLUSION

The advent of baseline groundwater sampling, analysis, and monitoring in the oil and gas industry in advance of drilling new wells is a relatively new concept; however, the protocols recommended in the Protocols Report have been gradually developed and successfully tested for 15 years. Observing consistent sampling and analysis protocols will minimize natural variability that can sometimes be mistaken for trends of either decreasing or increasing contaminant concentrations in groundwater. Observing a consistent set of analytical measurements will facilitate the forensic analysis required to reliably determine whether a contaminant plume is increasing or decreasing in intensity. Maintaining a consistent and standardized data-reporting format will allow all stakeholders to compare results obtained by different service providers and operating companies. This will make it easier for all stakeholders to reliably evaluate whether groundwater in a producing basin is being adversely affected by oil and gas operations. And finally, maintaining consistent quality control and assurance practices will ensure that available data are defensible when subjected to public or scientific scrutiny.

Interested parties are welcome to contact the Resource Development and Geoscience Branch for a copy of the full-length report.