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Larry Wallace, Chair

Sahtu Land and Water Board

*Delivered via email*

November-22-12

**RE: Application for Land Use Permit (S12X-006), Application for amendments to Land Use Permit (S11A-003) and Water License (S11L1-003) and Application for a Land Use Permit (S12F-007) and Water License (S12L8-007) on exploration license 462 and 463**

Dear Mr. Wallace:

The Sahtu Renewable Resources Board (SRRB) has reviewed the above applications with input from the Pembina Institute and provides the following recommendations and we also take this opportunity to request further information on questions.

### **Application for Land Use Permit (S12X-006)**

#### Parameters

- *Recommendation 1:* A comprehensive baseline water well testing program would include testing of water wells for all parameters that may be introduced into groundwater by oil and gas operations. The parameters to be tested should include methane/ethane/propane.
- *Recommendation 2:* The proponent should indicate which specific parameters it will use to test for frac fluids.
- *Recommendation 3:* Isotopic fingerprint analysis should be conducted for any naturally occurring methane/ethane/propane found in the groundwater. Groundwater can contain naturally occurring methane/ethane/propane but its isotopic fingerprint will be different from gases produced from an oil and gas formation. This information should be made accessible to government and the public.

- *Recommendation 4:* Isotopic fingerprint analysis should be conducted for each gas-bearing zone that is encountered while drilling, as well as the target production zone. If gas or other substances are detected in groundwater in the future the isotopic fingerprint of the gas will allow the proponent/government/public to determine if the contamination is linked to oil and gas activity, or whether it is naturally occurring. This information should be made accessible to government and the public. We refer the SLWB to the attached 2008 Science Review Panel report published by Alberta Environment recommending that Alberta's Energy Resources Conservation Board (ERCB) "develop a complementary or sister database containing the composition and isotopic composition of produced gases, gases in co-produced waters, and surface casing ventflows."
- *Recommendation 5:* The proponent should use the Alberta government's baseline water-well testing protocols (document attached). The Alberta government's baseline water-well testing requirement provides detailed testing protocols that could be applied in this case. It should be noted that at the present time, baseline water-well testing standards only apply to coal bed methane wells completed above the base of groundwater protection (relatively shallow). However, the Alberta government is considering extending the requirement to cover hydraulically fractured wells below the base of groundwater protection.
- *Recommendation 6:* The proponent should clarify under what circumstances baseline water wells will be re-tested, and who can make a request for a re-test. The data and analysis should be made publicly available.

### Waste Management

- *Question 1 for the proponent:* Drill cuttings, produced fresh water, and freshwater clay drilling muds will all be disposed of on site after testing. The produced water will only be discharged if it meets Alberta ERCB Directive 55 (for chloride content, pH, and visible hydrocarbons). When and where will the produced water be released? Pooling water can cause permafrost to melt quicker in those specific areas. What mitigation measures will be in place to prevent water discharge from causing increased permafrost melt?
- *Question 2 for the proponent:* What is the back-up plan for disposal of the dry cuttings / clay mix if the all-weather road application is not approved for this winter?

### **Amendments to Land Use Permit (S11A-003) and Water License (S11L1-003)**

#### Groundwater Monitoring Program

- *Recommendation 1:* Isotopic fingerprint analysis should be conducted for each gas-bearing zone that is encountered while drilling, as well as the target production zone. This information should be made accessible to government and the public. If gas or other substances are detected in groundwater in the future - the isotopic fingerprint of the gas will allow the proponent/government/public to determine if the contamination is linked to oil and gas activity, or whether it is naturally occurring.

- *Recommendation 2:* Husky should revise and clarify its schedules of activities in both S11A-003 and S12X-006 applications, to ensure that groundwater testing is completed **before** well completion activities are carried out. This is an important opportunity to get good baseline information in a relatively pristine area before well completion activities commence.

### Transportation of Waste Fluids

- *Recommendation 3:* Husky should provide calculations of the potential volumes of fluids that will need to be trucked out to Alberta, and estimate how many trucks would be required, the weight of each truck, and how the volume and frequency of traffic may impact the integrity of the winter road. Husky should lay out a back-up plan for what it will do with waste fluids if they cannot safely be trucked out before the end of the winter road season.

### Wildlife Mitigation and Monitoring

The proposed mitigation measures in the application do not seem to reflect any site-specific data on wildlife patterns, for example any data on which areas are frequented by boreal caribou at which times of year, migration patterns, or which areas could be considered ‘critical habitat’.

- *Recommendation 4:* The proponent should cooperate with the RRCs and SRRB in establishing clear monitoring standards and protocols, as part of an adaptive management system. Proposed monitoring methods are vague and it is not clear how exactly data will be collected on observation, or where they will make these observations from. In addition, it is unclear who monitors will be reporting to or how often.

### Cumulative Impacts

- *Recommendation 5:* As with the MGM and ConocoPhillips applications earlier this year we feel thresholds for levels of impact on wildlife must be established. The potential impacts of the activities could extend beyond the proposed project area; therefore, a cumulative effects assessment should consider an area larger than set out in the application. The SRRB welcomes the opportunity to work with Husky developing a proper cumulative impact assessment framework, since the framework used by Husky does not appear to be adequate. The proponent includes in its list of ‘future actions’ to be considered under cumulative effects assessment “longer term oil and gas development and facilities”. However, no longer term scenarios are actually described or considered in the analysis / evaluation section. As a result, the cumulative effects are deemed to be ‘low’ for all valued components, including wildlife.

## **Application for a Land Use Permit (S12F-007) and Water License (S12L8-007)**

### Wildlife Mitigation

One mitigation measure proposed by Husky is: “Use of the all-weather road and of the airstrip will be limited between the dates of May 1 and July 15, and October 1 and November 30 of each

year in order to avoid important seasonal activities of most resident wildlife and migratory bird species.”

- *Question 1 for the proponent:* What is specifically meant by use being “limited”? The precise dates of calving and rutting seasons may vary year-to-year (and may not necessarily fall between the dates listed above). How will Husky determine when these sensitive times will fall in a given year, and will Husky commit to adjust its activities accordingly?

Another proposed mitigation measure: “Den, dam, lodge, and nest sites will be actively avoided.”

- *Question 2 for the proponent:* How and when will these sites be identified, and how will TEK be incorporated?

Little attention is paid in the Environmental Protection Plan to small furbearers, and potential impacts on trapping, particularly given that construction activities (and proposed activities for the first two applications above) are concentrated between January to March, during prime trapping season.

- *Question 3 for the proponent:* What are potential impacts on furbearers and trapping, and how will these impacts be mitigated?

An additional commitment by the proponent: “On-going wildlife and habitat assessments will be performed by Husky, as conditions and circumstances allow, in order to gain an understanding of the wildlife species utilizing the program area.”

- *Question 4 for the proponent:* What specific kinds of wildlife and habitat assessments will be conducted? What conditions and circumstances would allow these to happen? How will Husky work with the RRCs and the SRRB in conducting these assessments, and how will TEK be incorporated?

### Wildlife Monitoring

Proposed monitoring methods are quite vague – wildlife monitors “will be directed to look for evidence of activity near the work area” and “will be expected to observe and document wildlife and potential wildlife impacts to ensure that environmental protection measures are being implemented as appropriate. The monitor will be expected keep a wildlife log, and will be instructed to collect data on observations, such as: species observed, date, time, location, and animal activity.” It is not clear how exactly monitors will “ensure that environmental protection measures are being implemented as appropriate”, and how monitoring activities are linked to enforcement powers. Details like this could be key to the effectiveness of the monitoring program.

- *Recommendation 1:* The proponent should cooperate with the RRCs and SRRB in establishing clear monitoring standards and protocols, and communication mechanisms, as part of an adaptive management system.

## Cumulative Impacts

- *Recommendation 2:* A regional cumulative impact assessment that takes into account scenarios for projected operations by various companies holding leases in the region should be conducted to establish impact thresholds for wildlife. The proponent assessed cumulative effects on caribou in the RSA to be considered moderately significant due to the year round access creation south of the Mackenzie River, long duration of road use, and potential for future developments within the Husky leases and neighbouring exploration leases. Also as stated in the EPP the current linear corridor density in the RSA is 0.8 km/km<sup>2</sup>. This current linear density is already above the current management threshold of 0.4 km/km<sup>2</sup> suggested by Antoniuk et al. (2009). In the EPP it was concluded that 55% of the RSA is disturbed which is above the 35% threshold suggested for the Northwest Territories range by Environment Canada. A regional cumulative impact assessment would help address such issues and also develop impact thresholds for wildlife.

The SRRB would like to work with the proponent to establish a collaborative adaptive management system / structure. The board would like to have a meeting with the proponent to review the actual results of the mitigation measures and monitoring activities carried out last winter during the initial drilling of the two wells. We would like to discuss how effective were the measures in reducing impacts on wildlife and other renewable resources. If the company does not have any evidence to show how well mitigation worked or didn't work, then it would be wise to review monitoring measures and discuss how they can be improved.

Sincerely,



Deborah Simmons  
Executive Director

**ALBERTA ENIRONMENT STANDARD FOR  
BASELINE WATER WELL TESTING FOR CBM  
OPERATIONS**

**SCIENCE REVIEW PANEL  
FINAL REPORT**



**BASELINE WATER WELL TESTING (BWWT)  
FOR CBM OPERATIONS**

**SCIENCE REVIEW PANEL  
FINAL REPORT**

*Prepared for: Alberta Environment*

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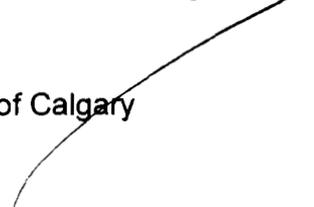
  
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December 5, 2008

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## 1.0 BACKGROUND

The *Baseline Water Well Testing Program* was initiated by Alberta Environment (AENV) as a consequence of the *Coalbed Methane/Natural Gas in Coal Final Report* prepared by the CBM/NGC Multi-Stakeholder Advisory Committee (MAC) in January 2006 (available at [www.energy.gov.ab.ca/245.asp](http://www.energy.gov.ab.ca/245.asp)). Specifically the first two items in Recommendation 3.3.6 of the Final Report stated that “AENV and ERCB should develop a water well testing program, as follows”:

- CBM/NGC operators should be required to offer baseline testing (as described in Recommendation 3.3.5) of all nearby water wells within a specified distance of a proposed CBM/NGC well to be completed above the Base of Groundwater Protection. No consensus was reached on an appropriate distance or depth of completion.
- The information from the baseline testing should be filed by operators in an open, public registry to enhance understanding of Alberta’s groundwater system.

The related points in Recommendation 3.3.5 state that “AENV and the Energy Resources Conservation Board (ERCB) should work with stakeholders, including the environmental service industry, to develop standard procedures and reporting requirements for the sampling, analysis and monitoring of both saline and non-saline water quality and quantity for CBM/NGC wells and potentially affected non-saline water wells. Quality assurance and quality control measures should be developed, as well as a range of tests, depending on the type of water being tested, including:

- Testing for a variety of metals and other impurities, as well as total dissolved solids.
- Testing for the presence of gas in water wells. The presence or lack of gas should be included on the water analysis report or file”.

The ERCB’s Directive 035 “*Baseline Water Well Testing Requirement for Coalbed Methane Wells Completed Above the Base of Groundwater Protection*” (available at [www.ercb.ca/docs/Documents/directives/Directive035.pdf](http://www.ercb.ca/docs/Documents/directives/Directive035.pdf)) made baseline water well testing mandatory for companies initiating CBM development above the base of groundwater protection after May 1, 2006.

Alberta Environment’s “*Standard for Baseline Water-Well Testing for Coalbed Methane/Natural Gas in Coal Operations*” became effective on May 1, 2006. Gas sampling requirements for the Standard were clarified in June 2006, and a revised electronic template for submitting the results of water well testing was made available in February, 2007. The Standard and related documents are available at [www.waterforlife.gov.ab.ca/coal/index.html](http://www.waterforlife.gov.ab.ca/coal/index.html).

A Science Review Panel was struck to evaluate the Baseline Water Well Testing Program with the goal of ensuring that the Standard was effectively obtaining consistent baseline data on groundwater to ensure the protection of groundwater resources and the environment. The Panel’s mandate was to:

- Review collected baseline water well data, research relating to baseline testing, feedback from industry and landowners, and information on baseline testing from other jurisdictions (e.g. Colorado) to evaluate the effectiveness of the Standard.
- Identify information gaps.

- Review the progress and provide recommendations on any enhancements to the Standard or in the manner in which baseline data is collected, stored, and evaluated.

The Panel submitted an interim report to AENV on July 31, 2007. AENV provided a detailed response to the interim report on March 11, 2008 and gave a database demonstration on May 30, 2008. The Panel met on seven different occasions in addition to email and telephone conversations to conduct its task. A review of baseline testing in other jurisdictions was not conducted. This report constitutes the final report of this Panel.

## **2.0 BRIEF UPDATE ON BASELINE WATER WELL TESTING PROGRAM**

As of December 2007, the Baseline Water Well Testing (BWWT) Program database included 4349 entries from water wells located predominantly between Calgary and Edmonton. This region is already heavily drilled for conventional oil and gas wells. The region also has some CBM wells that were completed before the initiation of the BWWT Program on May 1, 2006. Considering this pre-existing resource extraction activity, BWWT samples are not necessarily 'true baseline', or pristine, samples of un-impacted groundwater. In reality the BWWT samples may represent groundwater that has been impacted by previous petroleum exploration and development activities, early CBM activities, and/or other anthropogenic impacts.

Although the 4349 BWWT samples were collected in all seasons by different agencies, and were analysed by different labs, it is worthwhile to broadly summarize the data here. Water quality data were available for about 4181 of the BWWT entries in December 2007. Of these entries, gas compositional data were submitted for 704 (or 17%) of the entries. Of the 704 gas compositional analyses submitted, 671 had detectable methane, 143 had detectable ethane, and 5 had detectable propane. Also, 140 of 4181 well waters had quantitatively reported *E. coli* or fecal coliform, and an additional 240 of the 4181 well waters had detectable *E. coli* or fecal coliform (in the latter case, only presence or absence were reported).

Overall the Panel is pleased that AENV has successfully initiated the Baseline Water Well Testing Program. The major AENV contribution to this effort has been data collation and input into an appropriate database. This database is now substantially up-to-date, and the database contents and structure appear to be suitable for scientific investigation, public distribution, and use by regulators. Although this report recommends some further refinements to the gas sampling Standard and database management, on the whole, the Panel is satisfied with the progress to date.

## **3.0 RECOMMENDATIONS**

1. ***The ERCB and AENV need to develop an audit process to ensure all tests committed to in the D035 process are conducted and the results submitted to AENV.*** This recommendation was included in the interim report, and is re-emphasized here because a cursory audit of isotopic analyses conducted by one of the university labs showed that 13 of 37 samples analysed did not appear in the BWWT database. This is thus an

important issue. The need for an audit process, and the perception by the public of regulatory rigour, is self-evident.

2. ***The ERCB must develop a complementary or sister database containing the composition and isotopic composition of produced gases, gases in co-produced waters, and surface casing vent flows.*** This would permit direct comparison of water well gases to CBM well gases, allowing regulators to be proactive, rather than reactive, to well complaints. These samples could be collected inexpensively during drilling (e.g., by degassing canistered coal chips recovered while drilling), and/or from vent gases.

The Panel understands that the ERCB requires that at least one “Control Well” be drilled in each township that is subject to CBM exploration or development. Thus, the Panel recommends that such samples must be collected from every “Control Well” drilled. The samples must be in sufficient vertical detail as to quantify the compositional and isotopic characteristics of gas from each major coal seam within that township (e.g. Carbon Thompson, Weaver, Garden Plains, Drumheller, etc).

The Panel is also of the opinion that there is merit to requiring that CBM companies also submit periodic compositional and isotopic data for gases producing wells (possibly including mixed wells). Existing wells should have isolated samples taken if the company involved sets packers across a section for any reason. If not, co-mingled sampling would be better than none, particularly if a spinner log is also done.

3. ***A consistent approach to free gas sampling is needed.*** There is a clear discrepancy in the fraction of wells sampled that produce free gas between different environmental consulting firms conducting the BWWTs. For instance, as of December 2007, the firm that conducted the largest number of BWWTs (979 tests) found free gas in 24% of the wells sampled. Other firms report even higher fractions. In contrast, the firm that conducted the second largest number (892 tests) of BWWTs found free gas in only 2% of wells sampled. (Note that AENV has notified the latter firm about this observation, and the matter is being dealt with). The Panel notes that many of the samples were collected in overlapping geographic areas and therefore such a large difference in the fraction of wells producing free gas is unlikely to be due to chance. This suggests that the type of gas separator/sampler and/or pressure settings used by different consultants may have a significant effect on whether or not free gas is observed and subsequently analyzed.

The Panel would prefer to not prescribe a particular sampling technique. However, the Panel strongly recommends that AENV invite consultants to collaboratively develop a standard gas sampling technique that consistently yields representative gas samples from water wells. AENV should facilitate this process by having consultants demonstrate the ability of different sample collection methods to capture representative free gas samples.

4. ***In the absence of observed free gas, no characterization of dissolved gases is recommended.*** The Panel believes widespread dissolved gas sampling is an unnecessary procedure and expense at this point. Although there may be dissolved methane and other gases present in well waters, the primary concern of landowners is the presence or absence of free gas in their water wells. If free gas occurs in a well that did not yield

free gas in the initial BWWT, the Panel recognizes that there would be no information about prior dissolved gas concentrations or isotopic composition available for comparison.

5. ***Data quality assurance and quality control measures (QA/QC) need to be incorporated into the field sample collection procedure to ensure a robust database.*** The Panel recommends that each energy company conducting baseline water well testing should ensure that a reasonable fraction (10% is usual) of wells sampled should have field duplicate, blanks, and/or spike samples with blind submission to the analytical laboratories for each type of analysis for which samples are submitted (e.g. water and gas analyses and isotopic composition). The responsibility for reviewing the QA/QC data should be clearly assigned (i.e. either to the industry or the regulators) and reporting required. Tests that fail to meet QA/QC criteria should be re-sampled in accordance with appropriate due diligence.

QA/QC is explicitly recommended in Section 3.35 of the 2006 Multi-Stakeholder Advisory Council report, and currently not being conducted. Appropriate QA/QC is a particular issue with isotopic compositions in samples with low concentrations of gases (see below), and is compounded by the free gas sampling issues described above. One simple cross-check for free gas analyses is to ensure that there is not significant oxygen in free gases collected from groundwater with low field-measured dissolved oxygen (as is typical in Alberta groundwater).

6. ***The database should include carbon isotopic compositions of samples with low (e.g. less than 500 ppm of methane, or less than 150 ppm of ethane) concentrations. These data should be flagged, and refer to a footnote that the isotopic values are not precise at low concentrations unless gases are sampled carefully in duplicate, and stored and handled with a 'research level' of care.*** Given the decreasing isotopic precision with decreasing concentration, there is some concern that the isotopic composition could be incorrectly interpreted as thermogenic gas. Experience in the lab shows that in most cases the errors introduced by poor sample handling and/or container integrity lead to bias the isotopic data towards  $^{13}\text{C}$  enrichment (e.g. increasing  $\delta^{13}\text{C}$  values), most notably in methane as well as the other homologues. The Panel does not recommend editing the data out of the database in the interest of transparency, but wants database users to be appropriately informed.
7. ***The accuracy and precision of gas sample concentration analyses conducted to date need to be assessed.*** The gas concentrations currently being measured at commercial labs may be using instrumentation designed to measure the heating value of gases for the oil and gas industry, not trace levels of C1 to C4 gases. The Panel suspects that the accuracy and precision of some reported measurements are questionable for the BWWT purposes. The environmental laboratory industry should be subjected to a controlled inter-laboratory 'ring test' to evaluate the QA/QC of gas compositions.
8. ***Appropriate gas sample collection containers should be used and duplicate samples taken.*** Acceptable free gas sample container types could include electro-polished stainless steel air sampling canisters (most ideal) or FlexFoil grab bags or tedlar bags

(Hirsche and Mayer, 2007). Ideally duplicate gas samples should be collected since occasional leaks are readily identifiable due to atmospheric contamination.

9. **Gas analyses should:**

- a. **Be reported in consistent units (e.g. ppm, or milligrams of gas per litre of water).** Since the environmental consulting industry is not particularly familiar with gas analyses and concentrations, a fact sheet should be created to clarify conversion between different reporting units.
- b. **Have specified maximum detection limits, which should be noted in the reporting.** The maximum detection limits for most hydrocarbons, including methane, should be 10 ppm.
- c. **Have concentrations reported “as sampled” and not “air corrected”.**

10. **The inclusion of argon in the gas analyte list should be considered.** Argon is a useful gas for understanding groundwater flow systems and gas-related geochemistry. Depending on the separation and detection methods being conducted, it may be relatively simple to report Ar concentrations. This possibility should be evaluated.
11. **The Panel does not see any reason to include further analytes (e.g. metals or additional hydrocarbons (e.g. BTEX, F1/F2)) in the BWWT Standard.** They do not directly address the issue of CBM impacts on well water quality.
12. **Pathogen indicators should continue to be included in the BWWT and E. coli should be used exclusively as a pathogen indicator.** This recommendation is consistent with an increasing number of agencies, including major municipalities supplying water, and the Provincial Lab (where pathogen indicator analyses for rural residents are conducted). The rationale for moving towards *E. coli* rather than total or fecal coliform as pathogen indicators is that many total, and some fecal, coliform can have non-fecal sources, making their presence in water misleading.

The rationale for including *E. coli* in the Standard even though it is unlikely to be directly related to CBM activities is that *E. coli* tends to be common in poorly maintained or poorly constructed water wells, which may be related to well functioning and water quality.

13. **The current requirement that domestic wells within a 600 m radius of a proposed or new CBM well (or the nearest well within 800 m if no wells exist within 600 m) should be maintained.** Although the 600m distance is somewhat arbitrary, there is no compelling reason to make the radius smaller or larger based on our current scientific understanding of the issues.
14. **The type of work conducted during Baseline Water Well Testing is specific to, and should be supervised exclusively by, Professional Geologists or Professional Engineers from APEGGA.** The Panel recognizes that there are some groundwater-related activities conducted by professionals regulated by other agencies (e.g., those permitted under Joint Practice Standard in Completion of Reclamation and Remediation Work in Alberta (Sept 2007)). However, sampling and pump testing of water wells is

typically more specialized than reclamation and remediation, and should be conducted by APEGGA members with appropriate training.

15. ***The requirement for a water well pumping test should be maintained.*** The Panel recognizes that pumping tests are expensive, but recommends that they continue to be required. The Panel notes that the wells should be pumped significantly prior to water sampling and the collection of free gas. Even limited pumping test data are better than none in terms of understanding future changes in well condition and/or production. Two hours of pumping, followed by appropriate of sufficient recovery data (i.e. recovery of 90% of drawdown), is appropriate.
16. ***The BWWT reporting template should include a:***
  - a. checkbox to verify that the landowners were notified of any health or safety concerns, or that they declined a test;
  - b. required unique identification that links the water well to the associated ERCB license application and energy wells (see item 1 above) included to ensure effective audits can be conducted;
  - c. calculated ion charge balance (i.e., without estimating any ion concentrations by difference). The BWWT laboratory reports should be rejected when ion balances are poor (larger than  $\pm 10\%$ ), the source(s) of error evaluated, and the BWWT sampling conducted again.

#### **4.0 THE PATH FORWARD: ISSUES RAISED BY THE PANEL THAT ARE NOT WITHIN ORIGINAL SCOPE**

1. ***The utility of hydrogen isotope ratios of methane in groundwater, and produced gases, gases in co-produced (or formation) waters, and surface casing vent flows to discriminate between different sources and processes (e.g. methane oxidation from CO<sub>2</sub> reduction or from fermentation processes) should be evaluated.*** Preliminary data suggesting that such measurements are useful should be carefully considered. One must note however, that hydrogen isotope analyses of water itself must also be conducted to benefit from the hydrogen isotope analyses of the methane. The Panel notes that Alberta isotope labs are not currently set up to process significant numbers of hydrogen isotope ratio analyses on methane samples, but they are available out-of-province.
2. ***The extent of seasonal and temporal variability of free gas concentrations and isotopic compositions in both deep and shallow domestic wells should be characterized, including the relationship between free gas production in a water well, the volume of groundwater pumped, groundwater levels, etc.*** If seasonal and/or temporal variations are significant, the utility of the database may be questioned. The Panel strongly recommends that the seasonal and temporal variability of concentrations and isotope compositions of free gas in water wells must be investigated.
3. ***As a complement to the Baseline Water Well Testing, at least a limited subset of AENV's Groundwater Observation Well Network (as opposed to domestic wells)***

*should also be sampled and monitored for the seasonal and temporal variability of groundwater gas concentrations and isotopic compositions.* Domestic wells have long screens and are typically subjected to regular pumping and thus continued local degassing. Unless groundwater monitoring wells are used, it may be difficult to sort out natural processes affecting groundwater gas compositions from the effects of regular water well pumping.

When sampling monitoring wells for gas concentrations, total dissolved gas pressures should be measured during monitoring. Total dissolved gas pressure is directly related to in situ gas concentration. Preliminary data from the Rosebud, Alberta area suggest groundwater gas concentrations are being underestimated by a factor of three when TDGP is not measured (Roy et al., 2008). Although TDGP cannot be easily measured on water wells, it should be considered in groundwater monitoring well sampling programs. TDGP probes are commercially available from a number of suppliers. There may also be an opportunity to evaluate some other groundwater gas sampling devices for monitoring wells.

### **3.0 LITERATURE CITED**

- Hirsche, T. and B. Mayer, 2007. A comprehensive literature review on the applicability of free and dissolved gas sampling for Baseline Water Well Testing. Prepared for Alberta Environment.
- Roy, J., M.C. Ryan, J. Randell, and J. MacNeil, 2008. Measurements of elevated total dissolved gas pressure in an Albertan groundwater monitoring well. Ninth Joint CGS/IAH-CNC Groundwater Conference (GeoEdmonton, 2008); Edmonton, Sept 21-24, 2008

**Standard for Baseline Water-Well Testing for  
Coalbed Methane/Natural Gas in Coal Operations**

**April 2006**

# STANDARD FOR BASELINE WATER-WELL TESTING FOR COALBED METHANE /NATURAL GAS IN COAL OPERATIONS

## INTRODUCTION

Coalbed Methane (CBM)<sup>1</sup>, also known as Natural Gas in Coal, is in the early stages of development in Alberta and has significant growth potential. With this potential for development, it is necessary to obtain consistent baseline data on groundwater to ensure the protection of groundwater resources and the environment. While many oil and gas companies have adopted the practice of gathering baseline water quantity and quality data from nearby water wells prior to drilling energy wells, this testing has been voluntary. Broader application of groundwater testing will also support Alberta Environment's (AENV) goal of mapping all groundwater resources in Alberta. To ensure all CBM developers collect representative baseline data prior to CBM development, AENV has introduced the *Standard for Baseline Water-well Testing for Coalbed Methane/Natural Gas in Coal Operations* to make baseline testing a mandatory regulatory requirement. Data collected will be submitted to AENV and will be made publicly available.

This Standard was developed by AENV and is in addition to *Alberta Environment Guidelines for Groundwater Diversion for Coalbed Methane/Natural Gas in Coal Development* (April 2004)<sup>2</sup>. The Standard will be implemented and enforced by the Energy and Utilities Board (EUB).

## OUTCOMES

As part of AENV's integrated policy framework to ensure that CBM development is balanced with environmental protection, the *Standard for Baseline Water-Well Testing for CBM Operations* will contribute to achieving the following outcomes:

- Continued protection of provincial groundwater resources and Albertans' groundwater supplies,
- Facilitation of responsible CBM development, and
- Consistency with the government's *Water for Life* strategy.

The *Standard for Baseline Water-well Testing for CBM Operations* provides:

- Consistent protocols for testing, sampling and analyzing groundwater,
- Scientific information to support achievement of the outcomes, and
- A regulatory basis for water well testing and baseline data collection prior to CBM development.

## REVIEW OF THE BASELINE TESTING DATA

Data collected from baseline water-well testing will be submitted to AENV and the landowner/occupant. Six months after the effective date, AENV will conduct a preliminary review of all data collected, followed by a comprehensive review after 12 months. AENV will review the data to determine if the outcomes listed above are achieved, and will prepare a report within 18 months summarizing the results, and conclusions and recommendations from the review. The data will also be used to determine the need to improve the Standard.

## WATER WELL COMPLAINTS

If a landowner/occupant perceives a change in well water quantity or quality after CBM development, then CBM developers must retest the water well. The retesting program should be designed to address the landowner/occupant's concerns. The landowner/occupant must register his/her complaint with AENV at 1-800-222-6514 prior to retesting.

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<sup>1</sup> For the purpose of this Standard, CBM is used as the acronym for Coalbed Methane or Natural Gas in Coal

<sup>2</sup> [www.gov.ab.ca/env/water/Legislation/Guidelines/groundwaterdiversionguidelines-methgasnatgasincoal.pdf](http://www.gov.ab.ca/env/water/Legislation/Guidelines/groundwaterdiversionguidelines-methgasnatgasincoal.pdf)

## STANDARD FOR BASELINE WATER-WELL TESTING FOR COALBED METHANE /NATURAL GAS IN COAL OPERATIONS

Effective May 1, 2006:

- Coalbed Methane (CBM) developers must test all active water wells either flowing or equipped with a pump, and observation wells in the provincial Groundwater Observation Network<sup>3</sup> within a minimum 600 metre radius of a proposed CBM well prior to drilling a new CBM well or re-completing an existing well for CBM production where the completion will be at a depth above the Base of Groundwater Protection.
- If no water wells are found within the 600 metre radius, testing must be conducted at the nearest water well within a 600-800 meter radius.
- AENV and the EUB expect industry to identify those situations where unique geological or topographical conditions, or landowner concern warrant testing at greater distances or more than one well in the 600-800 metre radius.
- Testing procedures must comply with the requirements in Attachment A.
- If the water well has been tested within the previous two years, and if the landowner/occupant or AENV can provide a copy of the test to the CBM company representative, and the testing conforms to the described protocols in Attachment A, testing is not required unless requested by the landowner.
- Landowner/occupant's permission must be obtained prior to testing. If permission is refused, testing is not required at that well.
- If a landowner/occupant does not want his/her water well tested, the company must obtain written confirmation from the landowner/occupant that testing is not required. If written confirmation is refused, a company representative must diarize landowner/occupant's refusal and the CBM developer must deliver to the landowner/occupant, and retain a copy of, a notice describing this protocol.
- CBM developers must retest water wells after drilling is completed, if requested by the landowner/occupant in response to any changes in quantity or quality of water observed by the landowner/occupant. The landowner/occupant must register his/her complaint with AENV at 1-800-222-6514 prior to retesting. The retesting program should be designed to address the landowner/occupant's concerns.
- CBM developers are responsible for the water-well testing, and for submission of all testing data and analyses to AENV within 2 months of sampling.
- CBM developers must provide AENV and the landowner/occupant with copies of all tests and analysis within 2 months of testing. If the information cannot be provided within 2 months, the CBM developer must advise the landowner/occupant of the reason for the delay.

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<sup>3</sup> Information on and locations of wells in the provincial Groundwater Observation Well Network can be found at <http://www.gov.ab.ca/env/water/gwsw/quantity/waterdata/gwdatafront.asp>

## **ATTACHMENT A: TESTING REQUIREMENTS**

This testing protocol was developed for use in collecting representative baseline quantity and quality data from water wells. The testing methods should be used for collecting data prior to, and following (if necessary), the drilling and completion of CBM wells to ensure the results are comparable.

This program must be carried out under the direction of a professional registered with APEGGA.

Available information regarding the age, depth, completion, well use, expected yield, and condition of the water well should be recorded prior to commencement of any testing. Collection of additional information about the water well, such as well maintenance/service events, landowner/occupant's testimonials, and historic groundwater analytical information is encouraged.

Modifications to the recommended water quantity testing procedures may be warranted in older or small diameter wells to avoid damage to the water well. The landowner/occupant or AENV's Groundwater Information Centre may have a record of the water well drilling report, available on the web at [www3.gov.ab.ca/env/water/groundwater/index.html](http://www3.gov.ab.ca/env/water/groundwater/index.html) or phone (780) 427-2770.

If testing or sampling methodology differs from this protocol, due to case-specific circumstances, appropriate supporting documentation justifying the change(s) must be submitted to Alberta Environment with the test results.

All monitoring, purging and sampling methods, as well as testing equipment must be selected based on the parameters being monitored, and the expected yield of the water well being tested. All equipment (e.g. water level sounder, pump, tubing, etc.) must be cleaned to prevent introducing contaminants into the well.

CBM developers are responsible for ensuring a copy of all test data are provided to the landowner and to:

Alberta Environment  
Monitoring and Evaluation Branch  
11<sup>th</sup> Floor, 9820 106 Street  
Edmonton, Alberta T5K 2J6  
Fax: (780) 427-1214.

CBM developers must also retain a copy of all testing and sampling data, in addition to any supporting documentation to address future concerns.

## Water Well Capacity

A yield test must be performed to determine the capacity of the well. During the test, water must be discharged from the well without going through the pressure system unless there is no practical alternative possible. If the test is run through the pressure system, water should not be used during the test. The yield test must be performed using the following procedure:

1. Measure the non-pumping water level (npwl) prior to the start of the test. This level should be recorded after the water level in the well has been allowed to fully recover, and before the pump is turned on. It may be necessary for the well to remain unused for a period of time prior to the test in order to obtain a true npwl. If testing a large-diameter bored or dug well, also measure the total depth of the well.
2. The pumping rate for the yield test must reflect the capability of the well without drawing the water level down to the pump intake too quickly. The pumping rate should be determined in consultation with the landowner and be consistent with the recommended pumping rate on the water well drilling report form, if available. If a safe pumping rate cannot be established using these methods, then it should be established by conducting a step drawdown test.
3. The pump should be disconnected from the distribution system while conducting the yield test, to ensure the pumping rate is held constant during the test and to prevent any unwanted fluctuations in the drawdown of the water in the well.
4. Pump the well at a constant rate (+/- 5%) for two hours and measure the drawdown of the water level at the following time intervals: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 50, 60, 70, 80, 90, 100 and 120 minutes. If pumping cannot be sustained, provide an explanation, allow the water level to recover to the non-pumping level and repeat the test at a lower pumping rate. If testing a large diameter bored or dug well, carefully monitor the drawdown of the water level during pumping to ensure it is not drawn down so far as to leave the landowner with insufficient water. Bear in mind that recovery rates in large diameter bored or dug wells can be extremely slow.
5. After pumping is completed, measure the recovery of the water level at the same time intervals as described for the pumping portion of the test, or until the water level recovers to at least 90% of the non-pumping water level.
6. Record the following information upon completion of the yield test:
  - a. Name, address, and qualification of person conducting the test
  - b. Date and time of test
  - c. Details of well construction such as age, diameter, total depth, screen interval, well ID number
  - d. Description of test equipment used
  - e. Non-pumping, static water level
  - f. Pumping rate during test
  - g. Reference point from where water level measurements were taken (e.g. from top of casing (TOC) and distance from TOC to ground level)
  - h. Drawdown and recovery measurements of the water level
  - i. Any general observations of the water being discharged during the test, such as the presence of silt, colour, odour, sheen or gas.

## Water Quality Data

Water quality data is to be collected to evaluate the water quality prior to the CBM drilling and operation.

If possible water and gas samples must be collected at a location prior to the pressure system. The sampling point must be recorded. Samples must be preserved and filtered as required. Water samples must be stored at 4 °C, gas samples must be stored and transported to an accredited laboratory according to laboratory specifications within appropriate sample holding times. A documented chain of custody must be maintained for all samples.

Water quality samples can be collected during the yield test. Water quality samples must be collected when the field parameters have stabilized, indicating the well is producing formation water.

Water and gas samples collected from water wells must be delivered to a laboratory accredited for the following analyses:

### 1. Routine Potability

Analysis for common water quality parameters, including major ionic constituents and water quality standards, which must include the following parameters:

Bicarbonate (HCO <sub>3</sub> )	Nitrite + Nitrate (NO <sub>2</sub> + NO <sub>3</sub> )
Calcium (Ca)	pH
Carbonate (CO <sub>3</sub> )	Potassium (K)
Chloride (Cl)	Sodium (Na)
Fluoride (F)	Sulphate (SO <sub>4</sub> )
Iron (Fe) - <i>Dissolved &amp; Total</i> *	Total Dissolved Solids
Magnesium (Mg)	Total Alkalinity
Manganese (Mn)*	Total Hardness

*\* Note: Accurate iron and manganese analysis requires proper preservation of the sample*

Additional constituents may be analyzed as deemed necessary.

### 2. Bacteriological Analysis

Analysis for aesthetic and pathogenic bacteriological constituents present in the water supply, which must include the following parameters:

Iron bacteria  
Sulphate-reducing bacteria  
Total and fecal coliform bacteria

### 3. Presence and Analysis of Gas

A flow-through cell must be used to evaluate the presence or absence of gas during the yield test. Water must not be heated in the determination of the presence of gas, nor to obtain gas samples. If free gas is present, gas samples must be collected and delivered to a laboratory accredited for compositional analysis. Gas and water samples must be collected from a representative number of wells with free gas and submitted for isotopic analyses. Volume of gas per flow-through volume of water must be recorded. It is recognized that the volume and composition of gas may vary seasonally and with well use.

If free gas becomes present or apparent after offset energy drilling, a sample of the gas must be collected and delivered to a laboratory that is accredited for the analysis, and the situation must be identified to the appropriate AENV Regional Office.