CCS Corporation

Section 40 Review and Variance of
Application No. 1515213, Class Ib Waste Disposal
Scheme, Well 00/09-01-048-14W5M
Brazeau River

March 24, 2009

Energy Resources Conservation Board

ENERGY RESOURCES CONSERVATION BOARD
Decision 2009-029: CCS Corporation, Section 40 Review and Variance of Application No. 1515213, Class Ib Waste Disposal Scheme, Well 00/09-01-048-14W5M, Brazeau River

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Calgary Alberta

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BRAZEAU RIVER **Application No. 1553726**

1 DECISION

Having carefully considered all of the evidence, the Energy Resources Conservation Board (ERCB/Board) hereby determines that based on its technical merits, Application No. 1553726 can be approved, subject to the conditions listed in Appendix 2 and described in this decision.

The Board will ask Alberta Environment whether or not the application requires ministerial approval under Section 39(2) of the *Oil and Gas Conservation Act* (*OGCA)*. If ministerial approval is required, the application will be referred to Alberta Environment.

2 INTRODUCTION

2.1 Application

CCS Corporation (CCS) applied for and was granted, pursuant to Section 40 of the *Energy Resources Conservation Act*, a review hearing regarding the denial of its Application No. 1515213 by the Alberta Energy and Utilities Board (EUB), predecessor to the ERCB.

2.2 Intervention

Keyera Energy (Keyera) intervened in support of the CCS application for a Class Ib disposal approval for the CCS-operated 00/09-01-048-14W5M (09-01) well. Keyera is a midstream company that needs similar disposal services and may also use the 09-01 well for waste fluid disposal. Keyera currently has other Class Ib applications before the ERCB pending final disposition.

2.3 Hearing

The Board held a public hearing in Calgary, Alberta, on December 17, 2008, before Board Member M. J. Bruni, Q.C., and Acting Board Members T. L. Watson, P. Eng. and R. J. Willard P. Eng. Those who appeared at the hearing are listed in Appendix 1.

At the close of the hearing, CCS was required to complete a number of undertakings. The undertakings were completed on December 24, 2008; therefore, the Board considers the hearing to have been closed on that date.

2.4 Regulatory Framework

Section 39(1)(d) of the *Oil and Gas Conservation Act* (*OGCA)* provides the Board with the authority to approve the storage or disposal of any fluid or other substance to an underground formation through a well. Section 3 of the *Energy Resources Conservation Act (ERCA)* provides the Board with the authority to consider whether the applied-for project is in the public interest, having regard to the social and economic effects of the project and the effects of the project on the environment. The ERCB's application process and technical requirements for converting new or existing wells to disposal operations are clearly described in *Directive 065: Resource Applications for Conventional Oil and Gas Reservoirs* and *Directive 051: Injection and Disposal Wells—Well Classifications, Completions, Logging, and Testing Requirements* respectively.

For greater clarity, Section 39 of the *OGCA* reads in part as follows:

> **39(1)** No scheme for
>
> (d) the storage or disposal of any fluid or other substance to an underground formation through a well,
>
> may be proceeded with unless the Board, by order, has approved the scheme on any terms and conditions that the Board prescribes.
>
> **(2)** Prior to the Board approving a scheme under subsection (1)(d), it shall refer the application to the Minister of Environment for that Minister's approval with respect to the application as it affects matters of the environment.
>
> **(3)** The Minister of Environment may give approval with or without conditions, but when conditions are imposed, the Board shall, if it approves the scheme, make its order subject to the same conditions imposed by the Minister of Environment when that Minister gave approval.
>
> **(4)** Notwithstanding subsection (2), the Minister of Environment may direct that
>
> (a) an application, or
>
> (b) a type of application
>
> for any approval of a scheme or an amendment of an approval specified by that Minister be not referred to that Minister.

In April 2007, the EUB issued *Bulletin 2007-06: Streamlining the Review of Applications for Oilfield or Industrial Waste Fluid (Class I) Disposal Schemes*, which contained a memorandum of understanding (MOU) between the EUB and Alberta Environment on the review of applications for Class 1a and Class 1b disposal schemes.

The purpose of the MOU is to simplify the current administrative review process with respect to the handling of applications for subsurface storage and disposal of fluids into geologic formations through Class 1b wells. The Minister, pursuant to Section 39(4) of the *OGCA*, directed that applications for Class 1b subsurface waste disposal schemes do not need to be referred for Ministerial Approval, as "the EUB's [now the ERCB's] requirements for these applications are protective of groundwater." *Bulletin 2007-06* states that Class 1b well applications will be reviewed solely by the ERCB within the framework of *Directive 051* and the MOU in *Bulletin 2007-06*.

3 BACKGROUND

The 09-01 well is located on Crown land about 76 kilometres west-southwest of Drayton Valley. The well was drilled in 1979 and completed in the Brazeau River Nisku J Pool. It was originally approved in 1990 for gas injection as part of a gas cycling scheme. In 1993, the 09-01 well was put on production to recover gas reserves during blowdown operations.

CCS acquired the 09-01 well in 1999 and converted it to a Nisku Class 1b waste disposal well in March 2000. It operated as a Class 1b disposal well for over five years before being converted to a Class II water disposal well.

On July 12, 2007, CCS applied to the EUB to convert its Class II water disposal well back to a Class 1b waste disposal well. That application was registered as No. 1515213 and was denied by the EUB on November 22, 2007.

On December 21, 2007, CCS submitted a request for a review of the EUB's decision, and on March 20, 2008, the ERCB granted that request.

On July 10, 2008, the Board sent a letter to Alberta Environment requesting Alberta Environment's view on the MOU as it relates to the CCS application and its comments on the need for and timing of a ministerial approval. On July 28, 2008, Alberta Environment responded to the Board's letter, stating that it did not support approval of the application, as the well did not meet current standards, specifically that the well lacked cemented casing across the full groundwater protection interval.

4 ISSUES

The Board considers the issues respecting Application No. 1553726 to be

- requirements for a Class 1b waste disposal well,
- Nisku disposal zone suitability for disposal,
- groundwater protection,
- monitoring program as an effective means of groundwater protection,
- remedial cementing for groundwater protection, and
- alternatives to waste disposal at the 09-01 well.

In reaching the determinations contained in this decision, the Board has considered all relevant materials constituting the record of this proceeding, including the evidence and argument provided by each party. Accordingly, references in this decision to specific parts of the record are intended to assist the reader in understanding the Board's reasoning relating to a particular matter and should not be taken as an indication that the Board did not consider all relevant portions of the record with respect to that matter.

5 REQUIREMENTS FOR A CLASS 1B WASTE DISPOSAL WELL

5.1 Views of the Applicant

CCS took the position that *Directive 051* contained the requirements necessary to obtain approval of a Class Ib waste disposal well and the directive did not require cemented surface casing from 25 metres (m) below the base of groundwater to surface when an existing well was being converted to disposal service. CCS maintained that the requirement for an appropriate combination of surface, intermediate, or production casing cement from the base of groundwater protection (BGWP)[1] to surface pertained to new wells and that other options could be considered for converting existing wells, provided the outcome of groundwater protection was achieved.

CCS stated that the ERCB's regulatory process includes alternative provisions in the absence of full cemented casing and found the Board's decision on Application No. 1515213 to be inconsistent with documented requirements.

In the view of CCS, *Bulletin 2007-06* and the MOU did not amend the terms of any ERCB directives. Instead, the bulletin announced an administrative change, removing the need in the future of obtaining Alberta Environment approval for Class 1b disposal wells. CCS maintained that *Bulletin 2007-06* explained that Alberta Environment recognized the ERCB requirements as protective of groundwater and permitted the ERCB to be the sole arbiter in a decision to approve a Class 1b disposal well. CCS acknowledged that the MOU attempted to summarize ERCB requirements in *Directive 051* but argued that in hindsight the bulletin might have done an inadequate job by not addressing all the requirements in the directive in more depth. CCS noted that while the MOU was silent on the issue of monitoring with respect to conversion of existing wells to Class Ib disposal, CCS viewed this silence as an omission, not as an amendment to the requirements in *Directive 051*.

CCS noted that it operated 57 disposal and cavern wells in Alberta, including 26 Class 1b disposal wells, and that not all of its wells had full cemented casing across the groundwater interval. CCS believed that its alternative measure of using a monitoring program provided equivalent, if not superior, groundwater protection and that it was in the public interest, having regard to economic and environmental impacts.

CCS took the position that by citing *Directives 051* and *065*, the bulletin and MOU indicated that the ERCB would continue to review disposal well applications as it had in the past. Thus, CCS believed that the ERCB could review and approve an application based on its merits without referral to Alberta Environment. In these cases, the applicant would have to demonstrate that groundwater would be adequately protected by means other than cement across the full BGWP interval.

[1] The BGWP is the depth at which groundwater is anticipated to change from non-saline (above) to saline (below). Alberta Environment's *Water Act* defines saline water as water having a total dissolved solids (TDS) content of greater than 4000 milligrams per litre (mg/L). Non-saline groundwater (sometimes termed "useable") has a TDS content of less than or equal to 4000 mg/L. If the BGWP is found to be greater than 600 m below GL, it may be defaulted to 600 m.

5.2 Views of the Intervener

Keyera stated that ERCB cementing and casing requirements for a disposal well were described in Part 4 of *Directive 051*, which stated that the fundamental requirement was hydraulic isolation of the injection zone, as well as isolation of non-saline groundwater from cross-flow with the injected fluid.

In Keyera's view, *Directive 051* made a clear distinction between the requirements for a new well and for a conversion well. Keyera pointed out that *Directive 051* stated: "All new wells drilled for the purpose of injection or disposal shall ensure useable water-bearing zones are isolated with the appropriate combination of surface, intermediate or production casing cemented to surface from a minimum of 25 meters below the lowest usable groundwater zone." Keyera further cited the directive's statement that "Conversion of existing wells to injection or disposal service where this criterion is not met may be denied or made subject to testing, monitoring or evaluation in addition to the requirements indicated in this guide." As a result, Keyera suggested that the standard for new wells was different from that for existing wells.

Keyera argued that this distinction was made because many suitable disposal zones might be accessed by existing wells that may not have cemented casing over the full BGWP interval. Keyera believed that to arbitrarily require an existing well to have casing cemented across the BGWP interval in order to use it for disposal would result in the exclusion or disqualification of a large number of wells currently being used for disposal.

Keyera further argued that the intent of the MOU was to require cemented casing across non-saline groundwater intervals only in all new wells. Specifically, Keyera pointed to the stated purpose of the MOU, which was "to simplify the current administrative review process with respect to the handling of applications." Keyera contended that the MOU did not indicate or imply intent to change the substantive requirements for such applications as they currently existed. Keyera added that the Minister of Environment acknowledged in the MOU that ERCB requirements were protective of groundwater.

Keyera concluded that for existing wells, there was no absolute requirement for cemented casing across the full BGWP interval and that it was within the Board's discretion and judgement to determine whether the unique and particular circumstances of an individual case would be protective of non-saline groundwater.

5.3 Findings of the Board

The Board believes that *Bulletin 2007-06* and the MOU have not changed the technical requirements and options under *Directive 051*. The MOU notes the ERCB's commitment to continue to require groundwater protection measures under *Directive 051*. For the majority of expected disposal cases, the Board believes this will involve new wells or existing wells that include cemented casing across the full BGWP interval. However, *Directive 051* also includes a provision to convert existing wells that may be lacking some portion of cemented casing above the BGWP to disposal, if it can be shown that non-saline groundwater has equivalent or better protection from injected or disposed fluids through different means. The Board believes that such consideration would be the exception and that the normal standard is fully cemented casing to below the BGWP. It also notes that any such ERCB approval would also require effective monitoring by the company and an effective surveillance program by ERCB staff.

The Board accepts and emphasizes the view that conversion of an existing well to a disposal well that may not comply fully with the normal technical standards may in some cases aid in achieving other legislative objectives. These include good land-use practices, minimizing environmental footprints and public impacts, avoiding other risks due to long-distance trucking of waste, having access to drilled and tested subsurface zones with superior containment properties, and avoiding economic waste. Some of these objectives are discussed in later sections.

Accordingly, the Board agrees with CCS and Keyera that regulatory consideration can be given to wells proposed to be converted to disposal that do not have the normal standard of a combination of surface, intermediate, or production casing cemented to surface from a minimum of 25 m below the base of groundwater.

The Board has reviewed the subject application and is of the view that the application falls within the scope and processes contemplated by *Bulletin 2007-06* and the MOU. However, there is the potential that Alberta Environment may have a different interpretation of the MOU. Accordingly, the Board determines that Application No. 1553726 can be approved based on its merits and will, in this case, refer the application to Alberta Environment to decide whether a ministerial approval is required, in accordance with Section 39(2) of the *OGCA*, or whether the subject application falls within the processes and approvals contemplated by the MOU and a ministerial approval is not needed. If a ministerial approval is not required, the Board will then issue a Waste Disposal Approval to CCS. If Alberta Environment determines that a ministerial approval is required, the Board will await the results of Alberta Environment's review of the application, as outlined under Section 39(2).

In any event, given the potential for differing interpretations of the MOU, the panel recommends that the ERCB engage in consultation with Alberta Environment to clarify the MOU.

6 NISKU DISPOSAL ZONE SUITABILITY FOR DISPOSAL

6.1 Views of the Applicant

CCS determined that the Nisku reservoir encountered by the 09-01 well was an isolated pinnacle reef situated in a shale basin surrounded laterally by shale and tight argillaceous carbonates of the Upper Nisku off-reef facies. CCS stated that the Nisku interval was about 42 m thick, with an average porosity of 11 per cent and an average permeability of 1812 millidarcies. CCS explained that the Nisku disposal zone took fluid on vacuum, further indicating that it was an ideal disposal zone, and that the highly porous and permeable Nisku Formation was an excellent reservoir for waste disposal. CCS used drill stem testing data to confirm that the Nisku was depleted of hydrocarbons.

CCS noted that there was an uncemented interval originally reported between the base of intermediate casing at 2989 metres kelly bushing (mKB) and the top of the cement behind the production casing at 3005 mKB. However, CCS said that its review of the 09-01 well logs showed the cement top was at 2925 mKB, above the shoe of the intermediate casing at 2989 mKB. In addition, no apparent porosity existed from 2989.0 to 3018.0 mKB. Therefore, CCS maintained that there was no risk from contamination to intervals behind the production casing.

6.2 Views of the Intervener

The intervener had no comments on this issue.

6.3 Findings of the Board

Based on the evidence, the Board agrees with CCS that the Nisku pool in the 09-01 well is an excellent waste disposal zone. The Board believes that the Nisku is highly porous and permeable, with ideal zonal containment capacity, as shown by its ability to accept fluid on vacuum. The Board finds that it would be unlikely for waste fluids to migrate behind casing through the cement from the disposal zone to another zone.

Furthermore, the Board accepts the bond log interpretation indicating that the production casing is cemented above the intermediate casing shoe and that zones between 3005 mKB and the intermediate casing shoe are tight and non-permeable. Therefore, the Board finds there is minimal risk from contamination of disposal fluids within this interval.

7 GROUNDWATER PROTECTION

7.1 Views of the Applicant

CCS accepted that the ERCB Base of Groundwater Protection database provided a BGWP depth of 600 m below ground level (GL) for the 09-01 well and that cementing for new wells was required from surface to 25 m below the base of groundwater. CCS noted that in the 09-01 well, cement was present from surface to the base of surface casing at 373 mKB. CCS acknowledged that from 373 mKB to 25 m below the base of groundwater (600 m GL) there was no combination of surface, intermediate, or production casing cemented across the groundwater zone (see Figure 1). CCS identified four potential porous and permeable sands from 388 mKB to 650 mKB, which CCS interpreted to be within the Edmonton Formation. Using the Canadian Well Logging Society Water Catalog for the Edmonton Formation, CCS determined the four sands in the 09-01 well from 388 mKB to 650 mKB have a water resistivity of about 0.25 ohm m at 25 degrees Celsius, which equates to 25 000 parts per million sodium chloride. Using core cut in the Edmonton Formation in the similar 10-28-45-14W5M well, CCS interpreted the permeability of the sands to range from 1 to 5 millidarcies.

CCS submitted that the intermediate casing was present from surface to a depth of 2989 mKB, but the cement top behind the intermediate casing was at 1352 mKB. CCS determined this cement top using volumetric calculations, since a cement bond log had not been run on the intermediate casing. From its review of the 09-01 well logs, CCS determined that there were no obvious hydrocarbon-bearing formations in the interval from surface casing setting depth to 1351 mKB.

With respect to the production casing, CCS submitted that it was present in the wellbore in two portions of different sizes: the upper portion was located from surface to 2639 mKB, and the lower portion was located from 2639 mKB to 3480 mKB. From its recent analysis of a cement bond log that was run in 1980, CCS determined that the cement top behind the production casing was at 2925 mKB, contrary to the field interpretation in 1980 that had identified the cement top to be at 3005 mKB. CCS stated that the Nisku J perforations were from 3365 mKB to 3395 mKB

and that there was a permanent packer set at 3335 mKB. Therefore, CCS concluded that there was hydraulic isolation between the Nisku J disposal zone and the rest of the wellbore.

CCS noted that the intermediate and production casing strings had been cathodically protected since 1988 and that both the production-intermediate casing annulus and the tubing-production casing annulus were filled with inhibited fluid. CCS also noted that in 1999, when it acquired the well, a temperature log was run to prove zonal isolation and that the well had been a Class Ib or Class II disposal well since that time. CCS believed that wellbore conditions above the packer had not changed significantly, since the annulus was protected by corrosion-inhibited fluid and the casing was cathodically protected. In addition, CCS indicated that it had never experienced an isolation packer failure on the 09-01 well.

CCS stated that a wellbore leak, whereby injection fluid would come into contact with groundwater resources, would require three simultaneous failures: a failure of the primary containment system, consisting of the wellhead, tubing, and packer; a failure of the production casing; and a failure of the intermediate casing. CCS submitted that the likelihood of any of these potential failures occurring was minimal, especially a casing failure, as the casing had never been exposed to the injected fluids. CCS stated that the likelihood of all three potential failures occurring simultaneously was extremely remote. If those failures did all occur at the same time, CCS indicated that contamination of the groundwater resources above the BGWP was unlikely, as these zones were some 400 to 1000 times less permeable than the disposal zone and the disposal zone accepted fluid on vacuum. CCS stated that any released fluids would not have the ability to get to the zones above the BGWP.

CCS submitted that a casing inspection log run in 1999 indicated little or no wall loss in the production casing in the 20-year life of the well. Based on this negligible corrosion rate and the fact that the casing had never been exposed to injected fluid, CCS concluded that the casing remained in good condition.

7.2 Views of the Intervener

Keyera submitted that an absolute prohibition against all Class 1b waste disposal through existing wells that do not have casing cemented across the groundwater interval is neither reasonable, nor required to assure groundwater protection in every circumstance. Keyera provided what it said were “actual examples” (at unidentified locations) of situations where it believed it was not essential to have non-saline groundwater protected by cemented casing, as the exposed groundwater was at no risk for cross-flow with the injected fluid. Through examples cited, Keyera asserted that there was not a reasonable possibility that the injected disposal fluids would affect groundwater. For two examples, this assertion was based on the known bottomhole pressures, which was converted to an equivalent hydrostatic pressure or fluid level in the borehole. In the provided examples, the equivalent fluid level in the boreholes was below the BGWP, indicating that the groundwater intervals above the BGWP could not be impacted by the injected fluid. In a third example, Keyera suggested that remedial cement squeezed into the interval below the BGWP but above the production casing cement top could effectively ensure no aquifer cross-flow or migration of injected fluid to the BGWP. Keyera contended that the CCS application fell within the range of cases presenting no risk.

Keyera further asserted that the establishment of groundwater protection on the basis of purely arbitrary criteria will lead to economic waste and incremental environmental disturbance.

7.3 Findings of the Board

The Board notes that while cemented surface casing in the 09-01 well is set to 373 mKB, far below most domestic water wells, it does not cover to the BGWP, which is set at 600 m at this location. Based on the description of the Paskapoo/Scollard boundary from the *Geological Atlas of the Western Canada Sedimentary Basin*, the Board acknowledges that the four sands identified by CCS from 388 mKB to 650 mKB in the 09-01 well are within the Paskapoo Formation, not the Edmonton Formation. The Board does not find Edmonton salinity and permeability data to be applicable to the Paskapoo Formation sands in the 09-01 well. In the absence of conclusive data to accurately determine the salinity of the four sands in the 09-01 well, the Board accepts the current BGWP depth of 600 mGL at the 09-01 well site.

The Board notes that the intermediate casing string was not cemented full length; the interval from 373 to 1352 mKB has no cement coverage. The next casing string (production casing) was not cemented full length and has a cement top at 2925 mKB, above the intermediate casing shoe. There is tubing and a packer at 3224.54 mKB.

The Board has reviewed the existing wellbore configuration and agrees with CCS that the configuration provides a high degree of assurance that non-saline groundwater will not be contaminated by Class Ib waste fluids and is equivalent to if not better than the level of security provided by cement alone, subject to an effective program of monitoring by CCS and surveillance by ERCB staff, as discussed in Section 8. Simultaneous failures of the primary containment system (consisting of the wellhead, tubing, and packer), the production casing and intermediate casing would need to occur for the injected fluid to come into contact with the uncemented interval of the production casing. A failure of the production casing would need to occur for the injected fluid to come into contact with the uncemented interval above the BGWP. The Board further acknowledges the preventive corrosion measures that CCS has implemented to ensure casing integrity, such as the corrosion-inhibiting fluid in the annuli and cathodically protecting the casing.

The Board also finds that in the unlikely event of multiple tubing and casing failures, the nature of the Nisku Formation, having high permeability and porosity and being underpressured such that fluids are injected on vacuum, would make the possibility of injected fluids contaminating zones above the BGWP highly unlikely.

The Board notes that the cement bond log is 29 years old and the casing inspection and temperature logs are 10 years old. Furthermore, the Board acknowledges CCS's argument that wellbore conditions do not suggest a reason for deterioration from initial test results. The Board notes that CCS agreed to conduct these tests again at a time coinciding with a future workover to minimize costs. However, the Board believes that the expanding interest in ensuring protection of groundwater resources requires a high level of diligence, especially where the ERCB is reviewing wells not conforming to normal standards and a stricter schedule to reconfirm integrity is necessary. Accordingly, as a condition of the approval of this application, the Board requires that these logs, which would otherwise be required for a disposal well conversion, be run and submitted to the ERCB for its acceptance in writing prior to using the well as a Class 1b disposal well. The logging requirements set out in *Directive 051* include determining the cement top if the production casing is not cemented to surface or cement returns to surface were not obtained and maintained during setting, ensuring hydraulic isolation by running a temperature log and one additional hydraulic isolation log, and ensuring casing integrity by running a casing inspection

log that can verify if maximum burst resistance of the casing is 1.3 times that of the maximum wellhead injection pressure. CCS is encouraged to choose a casing inspection log capable of identifying both internal and external corrosion. Guidelines for running these logs and ERCB expectations in obtaining satisfactory logs are outlined in Appendix 2 of *Directive 051*.

The Board cannot comment on the "actual examples" provided in Keyera's submission without having location information and specific details for the examples provided.

The Board notes that the BGWP is not based on arbitrary criteria. The Alberta Geological Society updated and completed *ST55-2007: Alberta's Base of Groundwater Protection Information* using geostatistical mapping processing with stratigraphic information as the basis for the interpretation. Mapping on a regional level may cause the BGWP in specific wells to vary from the 15 m below the base of the deepest protected geological unit.

8 MONITORING PROGRAM AS AN EFFECTIVE MEANS OF GROUNDWATER PROTECTION

8.1 Views of the Applicant

CCS proposed continuous monitoring of the tubing-production casing and production-intermediate casing annuli. Electronic gauges would monitor any pressure change on either annulus and automatically shut in the well. CCS indicated that an alarm would most likely be set to activate if a 100 kilopascal (kPa) pressure drop or a 1400 kPa pressure increase occurred. Each annulus could also have a positive pressure of 500 kPa applied on the annuli between the tubing-production casing and production-intermediate casing to increase the monitor's sensitivity, as the most likely alarm situation would be a pressure drop. The pressure transmission of both these annuli would be relayed back to the facility supervisory control and data acquisition (SCADA) screen. CCS said that it currently monitored these annular spaces and recorded the pressure on a daily basis.

CCS stated that to date there had been no failures of these annuli in terms of pressure changes. However, if an alarm condition were triggered due to a pressure change, it would activate a call-out system, whereby the operator on shift would close a master block valve that would stop injection. Accordingly, CCS viewed the monitoring program as a means of protecting groundwater from contamination by the injected fluid equivalent to cemented casing.

CCS noted that the switches would be installed in such a way as to permit quarterly on-line isolation and functional testing. The on-line testing would simulate alarm conditions to ensure that the system was operating correctly.

CCS commented on what it considered should be part of an ERCB surveillance or oversight program. It suggested that if its monitoring program triggered an alert, the ERCB should be notified immediately or within 24 hours. As part of the audit program, CCS suggested a program similar to that currently used for packer isolation tests. CCS explained that it could simulate a pressure drop in its electronic system to check its monitoring system and confirm company staff response to an alert. It welcomed the suggestion that ERCB field staff witness an exercise.

8.2 Views of the Intervener

Keyera stated that a good monitoring program would be designed to secure expected results. The monitoring program would have to be tailored to unique situations. For instance, a well having positive pressure would be monitored for a pressure drop.

Keyera noted that it had applications for conversion of existing wells to disposal and that in most cases the surface casing did not cover to below the BGWP or the next casing string was not cemented to surface. It stated that these wells would be potential candidates for a monitoring program.

8.3 Findings of the Board

The Board acknowledges that the monitoring program for the 09-01 well would be continuous and is tied into a SCADA system capable of notifying CCS operations of a potential casing failure and that CCS operations would then take immediate action to stop further disposal. This level of monitoring exceeds the standard practice for wells lacking full cement coverage, where there are only on-site checks. Also, this particular case involves not one but two separate annuli triggers. Accordingly, the Board supports CCS's view that the monitoring program supports multiple layers of protection in the 09-01 well and provides equivalent or better protection of non-saline groundwater from contamination by the injected fluid as would cemented casing alone.

Interim Directive (ID) 2003-01: 1)Isolation Packer Testing, Reporting, and Repair Requirements, 2) Surface Casing Vent Flow/Gas Migration Testing, Reporting, and Repair Requirements, 3) Casing Failure Reporting and Repair Requirements requires that during the annual packer isolation test, the tubing-production casing annulus is required to be pressure tested to 1400 kPa and the test results reported to the ERCB.

The Board sees benefit in a cooperative effort between ERCB staff and CCS to initiate a compliance assurance program. Therefore, the Board requires that CCS work with ERCB staff to initiate such a program with respect to its proposed monitoring program of the 09-01 well.

9 REMEDIAL CEMENTING FOR GROUNDWATER PROTECTION

9.1 Views of the Applicant

CCS explained that it was not able to recement the intermediate casing in the 09-01 well because it did not consider perforating and cementing through two casing strings to be feasible or desirable. However, CCS explained that it could fill the production-intermediate casing annulus with cement, which would address the letter of the standard for new wells. CCS submitted that such administrative compliance would eliminate its ability to monitor that annulus for leaks. CCS stated that it preferred its monitoring program over attempts to conduct remedial cementing, as the monitoring program could immediately indicate when a problem occurred and then the well would be automatically shut in.

CCS added that if the BGWP interval was poorly cemented, which was possible due to the number of variables involved during remedial cementing operations, and if the annulus was

subsequently unable to be monitored, it was possible that a failure could occur behind cemented casing that would remain undetected for quite some time. Additionally, CCS stated that perforations in casing increased the risk of casing failure and the potential for groundwater contamination.

CCS argued that a decision requiring cement across the BGWP interval in existing wells being converted to Class 1b waste disposal would have negative economic impacts. CCS submitted that there was a cost to industry for remedial cementing and a risk of lost invested capital if the remedial work failed. Unsuccessful remedial cementing across the BGWP interval could result in abandoning an asset and lead to an unnecessary proliferation of well sites. CCS stated that where strict adherence to the groundwater protection interval on a given well from 25 m below the base of groundwater up to surface was required, the cost of remedial cementing would become a line item in the economic analysis of whether or not to convert a well or drill a new well. CCS explained that strictly requiring cement from 25 m below the base of groundwater on a well meant that either a company had to take a risk and spend the money or it had to move on, adding that it costs much more money to develop another well.

CCS acknowledged that it was aware of the requirements in *Directive 020: Well Abandonment Guide*, which included isolation of non-saline groundwater units upon abandonment of a well.

9.2 Views of the Intervener

Keyera stated that remedial cementing was not always successful. It noted that attempts to place cement at the BGWP depth to prevent cross-flow from below left holes in the production casing, which after a cement squeeze might not pass the pressure test to ensure casing integrity. Keyera argued that perforating created weakness in the integrity of the production casing, which was the primary containment chamber, adding that annual packer isolation test failures were the only indication of an isolation problem in the future.

Keyera noted that there were a number of scenarios that the Board could safely and reasonably conclude should be approved where there was no cemented casing across the non-saline groundwater zone. In these cases, Keyera believed it would be redundant, unnecessary, and potentially hazardous to require remedial cementing.

Keyera concluded that the CCS application did meet one of those tests with its proposed monitoring program and, on that basis, submitted that it was equivalent to cemented casing over the BGWP interval.

9.3 Findings of the Board

The Board notes that remedial cementing is a common practice to achieve the normal standard of fully cemented casing above the BGWP. At the time of abandonment, licensees of any wells constructed prior to the requirement to cover all non-saline groundwater intervals with cement must ensure that those non-saline groundwater intervals are covered. The Board also acknowledges that problems occurring from poor remedial cementing may result in the inability to detect wellbore integrity loss early, as is the case with monitoring.

The Board believes that remedial cementing on the intermediate casing (through two casing strings) is possible, but is not the best option for protecting non-saline groundwater from Class Ib

waste fluids in this case. The Board acknowledges that perforating the casing may impact casing integrity and may result in a new pathway for injected fluids to travel into the protected non-saline groundwater zone. Furthermore, remedial cementing prevents monitoring of the annulus and may hinder cementing operations of the well at the time of abandonment.

Accordingly, the Board concludes that remedial cementing is not the best option for groundwater protection for the 09-01 well prior to abandonment. The Board notes that if the well were not being converted to class 1b disposal, full groundwater protection would not be required until the well is abandoned.

10 ALTERNATIVES TO WASTE DISPOSAL AT THE 09-01 WELL

10.1 Views of the Applicant

CCS argued that if the subject well were not approved to be converted to a Class 1b disposal well, the trucking of fluids to alternate disposal sites would not be ideal due to environmental and social impacts. CCS stated that it currently disposed of Class 1b fluids from the area at another CCS facility closer to Drayton Valley and at a competitor facility northeast of the 09-01 well, pointing out that these disposal locations were 30- to 60-minute drives away. CCS believed that it was critical to both industry and the public to have a Class 1b well in the area to provide a greater level of protection to the public and support industry activities, such as gas plant operations and well completions.

CCS stated that it was in the overall public interest to promote the conversion of existing wells for waste disposal and the ERCB, where possible, should avoid implementing requirements that would render conversions of existing wells less economically viable. CCS submitted that the ERCB should have the discretion to consider case-specific proposals as a means of protecting groundwater, rather than a rigid policy of mandatory cementing, which might result in unnecessary proliferation of wells and the associated incremental impacts.

CCS submitted that the cost to drill and complete a new Class 1b waste disposal well in this area was about $4 million to $6 million. CCS stressed that there were additional environmental impacts from the drilling of a new well, such as clearing the land, surface disturbance, water crossings, road construction, and disposal of drilling fluids.

10.2 Views of the Intervener

Keyera argued that there were a number of cases and exceptions for which cemented casing across all non-saline groundwater intervals, if required by the ERCB, would simply be redundant and unnecessary. Keyera also argued that there would be consequences resulting from insisting on cemented casing over the groundwater interval in all cases, such as the drilling of new wells and trucking fluids to another location, which would lead to adverse economic, environmental, and social impacts.

Keyera stated that by using existing wells and infrastructure, there was a potential to realize economic, environmental, and social benefits. Keyera believed that drilling new wells to facilitate water disposal service had economic impacts, as well as incremental environmental and social impacts. Keyera was of the view that trucking the waste, as an alternative, would pose a

risk to the environment and public safety, regardless of the fluid, as well as having associated impacts on the community.

10.3 Findings of the Board

The Board agrees with CCS's and Keyera's determination of the risks and impacts associated with continued trucking of waste and/or the drilling of new wells. The Board attempts to achieve a balancing of risk factors to meet a series of legislative objectives and the protection of groundwater. Although the protection of groundwater is an essential and important objective, it is not the only objective. The Board's decision also considers the broader perspective of the economic, environmental, and social impacts of trucking waste and/or drilling of new wells to facilitate waste disposal, as well as whether the project provides for the economic, orderly, and efficient development in the public interest of the oil and gas resources of Alberta.

11 CONCLUSION

The Board finds that in this instance, the well configuration, along with the logging requirements and monitoring, will effectively protect non-saline groundwater from the injected fluids.

Dated in Calgary, Alberta, on March 24, 2009.

ENERGY RESOURCES CONSERVATION BOARD

<original signed by>

M. J. Bruni, Q.C.
Board Member

<original signed by>

T. L. Watson, P.Eng.
Acting Board Member

<original signed by>

R. J. Willard, P.Eng.
Acting Board Member

APPENDIX 1 HEARING PARTICIPANTS

Principals and Representatives (Abbreviations used in report)	Witnesses
CCS Corporation (CCS) A. M. Sears, LL.B. D. K. Naffin, LL.B.	D. Adamowicz, B.Sc. D. Baker, C.E.T. G. Dickie, C.E.T. D. Burkard, C.E.T.
Keyera Energy (Keyera) A. L. McLarty, Q.C.	R. Sikora, P.Eng. H. Henrichs, P.Eng.
Energy Resources Conservation Board staff B. Kapel Holden, Board Counsel M. Bevan, P.Geol. K. Bieber, P.Geol. P. Gigantelli, P.Geol. A. Lewis, P.Eng. R. Parkyn, C.E.T. E. Zimmerman, Geol.I.T.	

APPENDIX 2 SUMMARY OF CONDITIONS

Conditions generally are requirements in addition to or otherwise expanding upon existing regulations and guidelines. An applicant must comply with conditions or it is in breach of its approval and subject to enforcement action by the ERCB. Enforcement of an approval includes enforcement of the conditions attached to that approval. Sanctions imposed for the breach of such conditions may include the suspension of the approval, resulting in the shut-in of a facility. The conditions imposed on the waste disposal approval are summarized below.

Logging

CCS is required to run the following logs in the 09-01 well, in accordance with the logging requirements of *Directive 051* and as discussed in Section 7.3.

- Cementing top location: A cement top locating log must be run if the production casing is not cemented to surface or cement returns to surface were not obtained and maintained during setting.
- Hydraulic isolation: The minimum logging requirements for a Class Ib well to evaluate hydraulic isolation of the disposal or injection include running a temperature survey and one of the following: radioactive tracer survey, oxygen activation log, or cement integrity log. All required logs must be submitted, accompanied by a detailed interpretation of the log against its specific objective.
- Casing integrity: A full-length casing inspection log must be run on any existing well being converted to injection or disposal service. When a casing inspection log is used to assess the casing integrity and condition, the maximum burst resistance, based on the least wall thickness and minimal yield strength of the casing, must be greater than 1.3 times the maximum allowable wellhead injection pressure (see Section 1.0 of *Directive 051*). CCS is encouraged to run exterior corrosion logs to optimize its evaluation of the wellbore condition.

Monitoring Program

The CCS monitoring program must consist of the following:

- Continuously monitoring the tubing-production casing and production-intermediate casing annuli. This includes monitoring any pressure change of both annuli 24 hours a day, seven days a week, 365 days a year. The pressure transmission of both these annuli would be relayed back to the facility SCADA screen. If an alarm condition is triggered, it would activate a call-out system. The monitoring program would be able to signal a process alarm to the operator on shift and at the same time close in a master block valve that would stop injection should the automation detect a pressure change. At that time, CCS would assess and find the reason for the alarm.
- Maintain a positive pressure on the annuli between the tubing-production casing and production-intermediate casing. This includes alarming on high and low pressures to be determined by operating performance and switch performance.
- CCS must work with ERCB staff to initiate a compliance assurance program with respect to its proposed monitoring program of the 09-01 well.

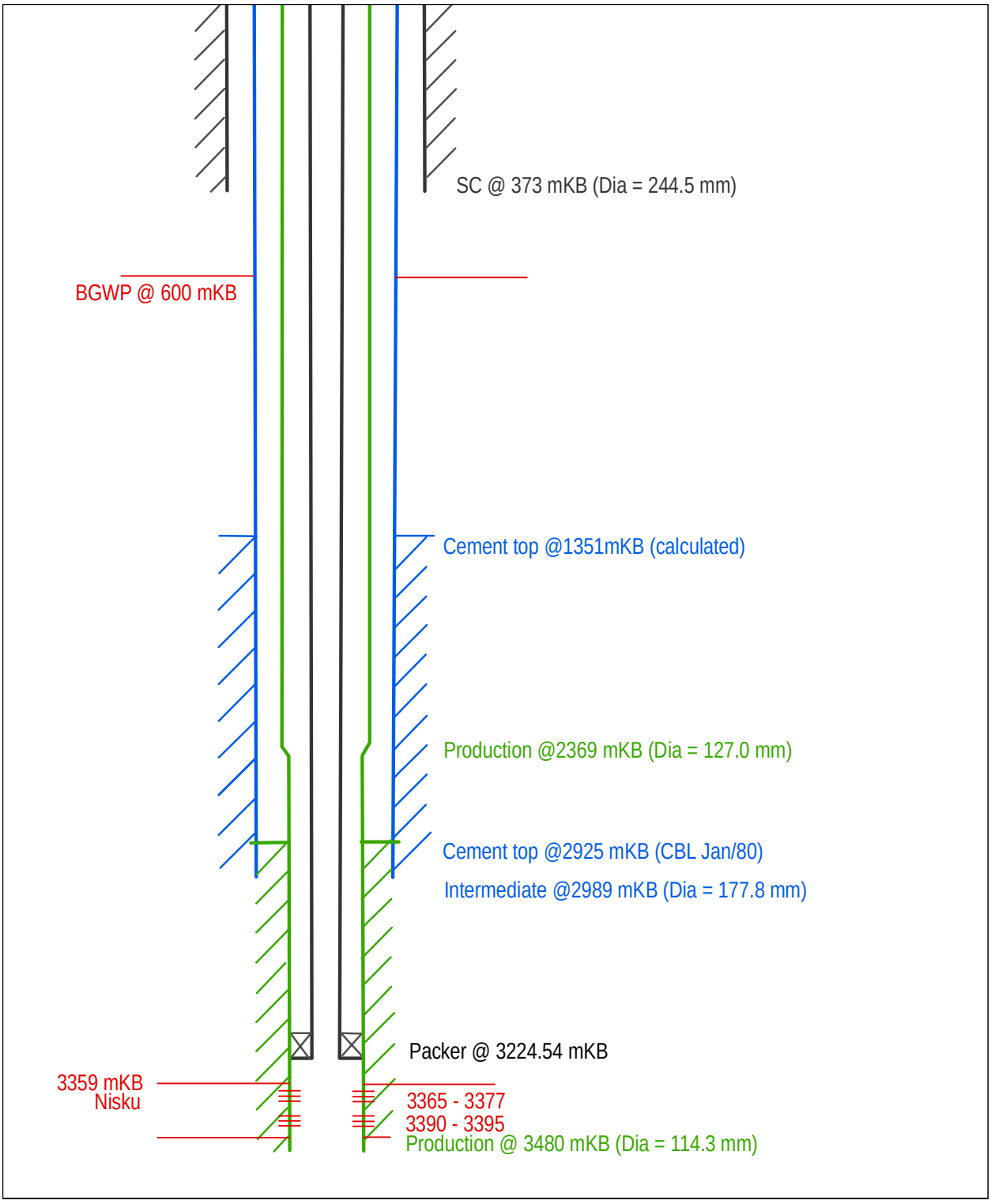

Figure 1. Wellbore schematic (well 00/09-01-048-14W5M)