



Quicksilver Resources Canada Inc.

Applications for CBM Well and Pipeline Licences
Ghost Pine Field

September 30, 2008

ENERGY RESOURCES CONSERVATION BOARD

Decision 2008-089: Quicksilver Resources Canada Inc., Applications for CBM Well and Pipeline Licences, Ghost Pine Field

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ENERGY RESOURCES CONSERVATION BOARD

Calgary Alberta

**QUICKSILVER RESOURCES CANADA INC.
APPLICATIONS FOR CBM WELL
AND PIPELINE LICENCES
GHOST PINE FIELD**

**Decision 2008-089
Applications No. 1477662, 1477688,
1477700, 1477711, 1477721, 1477768,
1477775, 1483737, 1483742, 1505748,
1505775, 1505801, 1505807, 1507801,
1507803, 1510484, 1510487, 1510791,
1510877, 1513260, and 1529676**

1 DECISION

Having carefully considered all of the evidence, the Energy Resources Conservation Board (ERCB/Board) hereby approves the Quicksilver Canada Inc. (Quicksilver) applications subject to the conditions listed in Appendix 3.

2 INTRODUCTION

2.1 Applications

Quicksilver applied to the ERCB in accordance with Section 2.020 of the *Oil and Gas Conservation Regulations* for licences to drill 16 vertical wells. The purpose of the proposed wells would be to obtain coalbed methane (CBM) from the Horseshoe Canyon Formation. No hydrogen sulphide (H₂S) is expected to be encountered in the wells. The details of the well applications are described in Appendix 1.

Quicksilver also filed 5 pipeline applications pursuant to Part 4 of the *Pipeline Act* for approval to construct and operate 16 pipeline segments. The purpose of the proposed 16 pipeline segments would be to tie in the proposed 16 wells with existing and future wells and pipelines. The pipelines would transport gas with no H₂S. The details of the pipeline applications are also described in Appendix 1.

The project area is within Townships 30, 31, and 32, Ranges 21 and 22, West of the 4th Meridian (W4M). The nearest urban centre is the town of Rowley, about 6.5 kilometres (km) northeast of the project area. Figure 1 shows the proposed locations for the wells and pipelines.

2.2 Interventions

M. Porsche, A. Von Zitzewitz, M. Wirtz, L. Dodd, and R. Dodd, collectively represented by R. Secord and R. Schwab, objected to the applications (the interveners are listed in Appendix 2). The interveners' primary concerns about the applications were the possible effect on groundwater, weed and pest control, the environment, well and pipeline locations, and insurance coverage.

Ms. Porsche, Ms. Von Zitzewitz, and Mr. Wirtz (Schwab clients) are landowners upon whose land some of the proposed developments would be constructed. The Schwab clients all live in Germany and do not have residences on their lands.

L. Dodd and R. Dodd (the Dodds) farm all of the land owned by Ms. Porsche and have been continuously leasing the land from Ms. Porsche since the 1970s. They also own and farm several additional quarter sections of land to the east and southeast of Ms. Porsche's property. R. Dodd operates a livestock feedlot in the southwest quarter of Section 12-32-21W4M and he stated that the feedlot has the capacity to handle up to 1000 head of cattle at any one time.

D. Mueller also registered and participated at the hearing. Mr. Mueller submitted that he owns land at Legal Subdivision (LSD) 5-6-31-20W4M, which is southeast of the proposed development and is not land upon which any of the proposed developments would be constructed. Mr. Mueller's primary concern about the applications was the possible effect on groundwater and weed and pest control.

F. Hugo filed a submission to the Notice of Hearing but did not attend or participate in the hearing.

2.3 Hearing

The Board held a public hearing in Drumheller, Alberta, on July 7 and 8, 2008, before Board Members M. J. Bruni, Q.C. (Presiding Member) and J. D. E. Ebbels, LL.B., and Acting Board Member T. L. Watson, P.Eng. The Board panel and staff conducted a visit of the general area on July 6, 2008, prior to opening the hearing, to view the lands encompassed by the proposed wells and pipelines. Those who participated in the hearing are listed in Appendix 2.

3 BACKGROUND

Quicksilver stated that it has been exploring, developing, and operating in the Horseshoe Canyon CBM areas for a number of years. Quicksilver and its original partner realized commercial production from the CBM reservoirs in 2002. Since then Quicksilver has drilled, completed, and brought on production over 1700 CBM wells in 14 development areas in Alberta. Quicksilver began initiating CBM development in the Ghost Pine area starting in mid-2005. To date, Quicksilver has drilled 76 wells and operates one centrally located compressor in LSD 1-14-31-21W4M and several booster compressors in the Ghost Pine Field. Its reservoir development has been based on two wells per section, even though ERCB regulations allow densities of up to four wells per section from the Horseshoe Canyon Formation.

Quicksilver described the Horseshoe Canyon Formation as existing through a large portion of southern Alberta. The Horseshoe Canyon Formation is divided into the Upper, Middle, and Lower zones. The Upper Horseshoe Canyon contains aquifers, and over 90 per cent of the water supply wells in the Ghost Pine project area are completed in the Upper Horseshoe Canyon zone. Typically Quicksilver targets roughly 24 coal seams for CBM production in the Ghost Pine area at depths ranging from about 130 to 450 metres (m). Quicksilver submitted that the individual coal seams are not productive enough to drill and produce individually, and therefore it commingles the CBM production from as many of the 24 coal seams in the wellbore as possible. The shallowest CBM formations are the Weaver and Garden Plains Formations, which exist at depths from about 130 to 200 m and are part of the middle and lower portion of the Middle Horseshoe Canyon zone. Quicksilver submitted that of the 76 wells that have been drilled in the Ghost Pine area to date, only 14 have been perforated at the 130 to 200 m level in the Weaver and Garden Plains Formations, and the majority of the 76 wells were perforated at depths between 300 and 450 m.

4 ISSUES

The Board considers the issues respecting the applications to be

- need for the wells and pipelines,
- groundwater protection,
- location of wells and pipelines,
- construction techniques of leases and access roads,
- conservation and reclamation plan, clubroot, and weeds,
- insurance coverage, and
- public consultation.

5 NEED FOR THE WELLS AND PIPELINES

5.1 Views of the Applicant

Quicksilver submitted that it believed exploration and development of additional sources of energy were necessary to maintain energy supply and ensure availability for future generations. Quicksilver recognized that exploration and development must proceed in an orderly, economic, and efficient manner and submitted that its applications were in the public interest.

Quicksilver submitted that using appropriate gas prices and typical production rates, the project was expected to produce 4.4 billion cubic feet (Bcf) of gas and generate a half million dollars of royalties and 2.8 million dollars in federal, provincial, and municipal taxes. Other indirect benefits would include increased business activity, employment, and the use of local services. With these direct and indirect benefits to Albertans, Quicksilver strongly believed the project to be in the public interest.

Quicksilver submitted that the economics of the play were not robust, but that the clean and low-risk gas resource was very much worth recovering and could be recovered with limited impact on surface interests. Quicksilver submitted that the 16 applied-for wells were part of a larger CBM development plan in Ghost Pine field, comprising a number of small projects. Combined, these small projects, including the proposed project, were economically viable and in the best interest of Albertans.

5.2 Views of the Interveners

The landowners' counsel acknowledged that there were longstanding instructions from the landowners that there was to be no oil and gas development on the subject lands. The interveners acknowledged that in a broad sense energy development was necessary and in the public interest; however, they did not agree that the wells and pipelines on their lands were necessary for society's welfare and suggested that the applied-for wells would provide little economic return to the province. The interveners estimated that if the 16 wells generated a total of half a million dollars in royalties to the province over a 50-year lifespan, annually they would contribute ten thousand dollars. The interveners questioned whether ten thousand dollars a year in provincial royalties was worth the risk to the landowners in the area. They also argued that Quicksilver had not established a need for the proposed wells and pipelines in the applied-for locations.

5.3 Views of the Board

The Board agrees that Quicksilver needs the proposed wells to capture the CBM reserves and that the pipelines would be required to produce the wells. It also accepts that Quicksilver has the right to explore for and produce the CBM reserves within the Horseshoe Canyon Formation in the applied-for areas.

The Board recognizes that the 16 applied-for wells are part of a larger CBM development plan in the Ghost Pine area and that it must consider the applications in the larger context of the overall CBM development in the area. It must also consider that royalties or returns to the province are only one element in assessing the need and public interest.

The Board agrees that when separated, the economic benefit to the province as a result of these 16 wells may seem minimal; however, the economic benefit of the recovery of the CBM reserves in the context of the overall CBM development in the area constitutes a larger economic benefit to Alberta.

Having satisfied itself that there is a need for the wells and pipelines, the Board addresses the other issues raised by the applications and interventions in the following sections of this report.

6 GROUNDWATER PROTECTION

6.1 Views of the Applicant

Quicksilver presented its belief that a multiple barrier system existed between the shallow aquifers and the CBM reservoirs in the Horseshoe Canyon Formation. It described the Horseshoe Canyon Formation as a layered formation composed of siltstone, sandstone, mudstone, and shale. The siltstone, mudstone, and some bentonitic siltstone and sandstone units formed low hydraulic conductivity layers, or barriers, which limit vertical groundwater flow. Quicksilver argued that its interpretations of geophysical gamma logs confirmed that the Horseshoe Canyon Formation was dominated by lower permeability mudstones and shales.

Generally, water wells in the Ghost Pine area ranged in depth from 20 to 109 m. Quicksilver noted that the shallower aquifers being used for sources of domestic and stock water and the targeted CBM reservoirs in the Horseshoe Canyon were in different pressure regimes and were therefore hydrostatically segregated. Quicksilver indicated that this assertion was supported by the absence of significant quantities of water in the underpressured CBM zones below the shallow water supply aquifers. Quicksilver indicated that 26 of its 76 existing CBM wells had not produced any water and the average production from Quicksilver CBM wells that have produced water was on the order of 0.23 cubic metres (m³) per month. Of those wells that have produced water, Quicksilver had noticed a general decrease in water production over time. In comparison, Quicksilver argued, a sustainable water supply well could generally produce more than 20 m³ per month. Thus, it maintained that isolation existed such that the CBM and water well zones produced independently without affecting each other.

Quicksilver presented vertical hydraulic gradient data showing a strong downward groundwater gradient between the shallow aquifers and the CBM zones. This indicated that if a pathway were present, groundwater would have the potential to flow downward, rather than gas flowing upward. Quicksilver noted that since the shallow aquifers and underlying CBM beds had not

equilibrated in pressure since glaciation, strong hydraulic isolation must exist between the two horizons.

Quicksilver questioned the applicability of a groundwater model presented by the interveners that showed simulated changes in water levels due to producing gas from the CBM zones. It suggested that the particular model used did not accurately account for field conditions: the model did not deal with unsaturated or multiphase flow, nor did it adequately account for the heterogeneous layered system present in the Ghost Pine area.

Quicksilver advised that it employed best practices during drilling and completion operations to ensure appropriate groundwater protection. This was mainly achieved by lining the entire wellbore with steel casing (surface and production casing) cemented from the total depth of the well to surface. This cement was the primary tool to prevent vertical movement along the wellbore. Quicksilver indicated that the primary function of the surface casing was to be a means of well control, although it acknowledged that the casing also acted as a barrier for groundwater protection. In the Ghost Pine area, surface casing was generally set to a reduced depth of about 70 m, in compliance with ERCB *Directive 008: Surface Casing Depth Minimum Requirements*, which allowed for surface casing reductions if certain conditions were met. Quicksilver confirmed that a number of water wells in the area were completed at depths greater than 70 m.

Quicksilver acknowledged that of the 76 wells drilled in the Ghost Pine field to date, 14 were completed (perforated and fractured) at depths less than 200 m, with the shallowest completion at about 130 m. It noted that a number of water wells were completed deeper than 100 m, with the deepest known to be about 122 m (depth provided verbally by L. Dodd during hearing proceedings). Quicksilver indicated that if a proposed CBM well was within 200 m lateral distance of a water well, the typical vertical separation between the shallowest completion interval and the base of the water well was 100 m.

It explained that of the 76 wells Quicksilver had previously drilled in the Ghost Pine area, 6 experienced lost circulation events. It said that the main cause for such events was drilling into boulders, gravel seams, or sandstones. While lost circulation events had occurred, Quicksilver argued it had been able to rectify the situations and achieve complete casing cement jobs on both surface and production casing, with cement returns to surface on all 76 wells drilled to date in the Ghost Pine area. Quicksilver stated that cement bond logging was not typically conducted to verify cement quality and noted that it did not practice top-down cementing procedures as a remedial measure if cement did not return to surface.

If there was an issue with cement integrity, Quicksilver asserted that groundwater would most likely flow down the well annulus, as a result of the strong downward hydraulic gradient. While this possibility may result in decreased aquifer productivity, it would likely be noticed by the operator as an increase in water production or reduced gas production due to the water inflow killing the well. With respect to gas migration due to poor cement integrity, Quicksilver did not believe that the potential of gas to flow up the well annulus would overcome the pressure of water flowing downward.

To test wellbore integrity, Quicksilver stated that it completed a surface casing vent flow test after a well was initially completed and before it conducted work on a well after completion. Quicksilver would not conduct gas migration testing outside the wellbore unless an issue was apparent, for example, vegetation stress. In an attempt to identify any issues, Quicksilver would

have operators check the well sites on a monthly basis. In addition, aircraft equipped with infrared cameras would be flown over pipelines and well sites once a year to check for methane leaks.

Quicksilver committed to conduct baseline testing on R. Dodd's water well, located 268 m from the proposed 16-02-032-21W4M CBM well. The testing would include isotopic analyses, if free gas could be collected during the test. As of June 2007, 5 of 37 water wells tested were identified as containing gas. Quicksilver did not plan to conduct a postdrilling test unless Mr. Dodd indicated that some impact had occurred. Quicksilver noted that this procedure was consistent with Alberta Environment's (AENV's) Standard for Baseline Water-Well Testing for Coalbed Methane/Natural Gas in Coal Operations and ERCB *Directive 035: Baseline Water Well Testing Requirement for Coalbed Methane Wells Completed Above the Base of Groundwater Protection*. Quicksilver noted that it was also planning to conduct additional isotopic testing on its CBM wells in the Ghost Pine area.

Quicksilver expressed confidence that isotopic data for carbon-13 (C13) would be useful in distinguishing potential sources of methane gas, although it was not considered a "silver bullet." Consultation with Dr. A. Blyth of the Alberta Research Council supported the assertion that the C13 isotopic signature between water wells and CBM wells would help in assessing the source and origin of methane gas, if necessary. While Quicksilver indicated that isotopic data could be useful, it did not believe that a long-term gas monitoring program would greatly improve the data set already being collected through Quicksilver's baseline water well testing efforts.

In summary, Quicksilver felt that protection for nearby water wells was appropriately considered through existing ERCB requirements, particularly by having properly cemented casings. It maintained that the existing requirements, along with the impermeable barriers within the Horseshoe Canyon Formation, should adequately protect groundwater and water wells. Quicksilver believed that reduced surface casing depths were appropriate as well, since the surface casing's primary function was well control and the production casing would be cemented full length, providing protection to all aquifers above the base of groundwater protection. As such, it felt that a long-term gas sampling program would not be necessary. In the event that a landowner perceived a change in its water well, AENV had an existing process in place to address and evaluate the source of the change.

6.2 Views of the Interveners

The interveners' expert hydrogeologist, Mr. Freeman, stated that as CBM wells and completions got closer and closer to water wells, there was more potential for conflict, whether perceived or real, as far as impact went. He presented carbon isotopic data showing differences between both biogenic gas (produced by bacteria in the subsurface) and thermogenic gas (produced at depth by heat and pressure). The C13 isotopes for these distinct sources of gas are different and can be used to identify the potential source of a gas. However, the interveners argued that as hydrocarbon production occurred from shallower reservoirs, the difference in C13 isotopes became less diagnostic, making it more difficult to distinguish biogenic and thermogenic gases. The interveners' expert acknowledged that it could be difficult to use carbon isotopes alone to determine gas sources; often, when plotted graphically, carbon isotopes from gas in water wells fall somewhere between 100 per cent biogenic and 100 per cent thermogenic gases, making it potentially difficult to resolve future conflicts regarding the source of gas in a water well.

Experts for the interveners proposed a long-term gas sampling program in the Ghost Pine field to monitor residents' water wells into the future. They stated that more data on gas in residents' water wells would make it easier to resolve potential future conflicts and suggested that such a monitoring program would constitute periodic (every two or three years) sampling of water wells known to have gas and analyzing the gas for composition and isotopes.

The interveners introduced a basic two-dimensional computer groundwater model, illustrating predicted declines in water levels resulting from 20 years of CBM production at 10 pounds per square inch (psi) from the Garden Plain zone. The model presented the potential for a 10 m decline in water level for a hypothetical water well completed in the Lower Horseshoe Canyon Formation within 10 to 20 m from the CBM well. In the Middle Horseshoe Canyon Formation, up to 5 m of water level drawdown could be experienced over 20 years of CBM production. While not a substantial decline, the interveners noted that such a drop could equate to a significant reduction in the proportion of available head (and associated productivity) of water in a water well. (The head of water could be as little as 50 m; a 10 per cent decrease in available head/productivity would result from a 5 m decline in water level.)

The interveners acknowledged that the Horseshoe Canyon Formation was composed dominantly of lower permeability units, such as shales and mudstones. However, the two-dimensional model considered those lesser permeability units through application of an anisotropy ratio, assuming a very high ratio of horizontal to vertical flow.

The interveners noted that at least two loss circulation events occurred at depths just below the typical reduced surface casing depth of 70 m while Quicksilver was drilling its initial 76 wells. As a result of the potential for the loss of circulation and depth of water wells in the area, they felt it may be appropriate to increase the surface casing depth.

6.3 Views of the Board

The Board recognizes that protection of present and future groundwater supplies is very important. Several ERCB directives focus on preventing potential impacts and protecting groundwater. An important part of these protective measures is *Directive 009: Casing Cementing Minimum Requirements*. The Board believes that if casing cementing procedures are effectively carried out, all different zones (CBM and other gas-bearing zones, groundwater-bearing zones, etc.) can be effectively isolated from each other in the energy wellbore. Therefore, there would be no potential for upward movement of gas or downward migration of water if a wellbore is effectively cemented.

The Board agrees with both Quicksilver and the interveners about the presence of a strong downward groundwater flow gradient. The implication of such a gradient is that groundwater has the potential to flow downward, possibly leading to a decline in aquifer productivity. If groundwater were to flow downward, it is unlikely that gas will flow upward. Quicksilver noted that it would quickly become aware of this situation, as water flowing down a wellbore would be identified as either increased water production or reduced gas production from a CBM well.

If water volumes of 5 m³/month or greater are produced from any individual well, Quicksilver must comply with *Directive 044: Requirements for the Surveillance, Sampling, and Analysis of Water Production in Oil and Gas Wells Completed Above the Base of Groundwater Protection*

(BGWP). In addition, Quicksilver must ensure that no well that is shut in or suspended allows cross-flow of water above the base of groundwater protection at any time.

The Board acknowledges the interveners' concerns that the proposed CBM wells may be a potential risk to their water wells. The Board is also concerned about Quicksilver's proposal to complete coal seams at depths comparable to the depth of producing water wells in the Ghost Pine area; for example, one of the deepest water wells in the Ghost Pine field to date is 122 m (and there are a few with known depths exceeding 100 m). The Board recognizes that Quicksilver has completed and will continue to complete coal seams as shallow as 130 m.

The Board notes that Quicksilver has used reduced surface casing depths on existing wells drilled in the Ghost Pine area, due to the particular characteristics of those wells. Quicksilver has also applied for reduced surface casing depths on the proposed wells. The Board notes that Quicksilver's existing surface casing depths are in compliance with *Directive 008*, as they are low-risk, development-type wells and well control was not compromised by such reductions. While an application for a reduction in surface casing depth has been submitted, the Board thinks that it is not appropriate for all cases, particularly when groundwater resources are in close proximity (spatially and vertically) to an energy well.

Quicksilver noted that it has maintained adequate lateral and vertical separation between CBM wells and water wells to date. However, the Board believes it is necessary in this instance to provide additional protection to water wells that will be in close proximity to the 16 proposed CBM wells in the Ghost Pine field by applying the following condition:

For the 16 proposed CBM wells in the Ghost Pine field that are to be completed (perforated and/or fractured) shallower than 200 m and within a lateral distance of 200 m of a water well, Quicksilver is required to set surface casing 25 m below the depth of the deepest nearby water well. If the depth of any water well within the 200 m lateral distance of the CBM well is unknown, the surface casing must be set to a depth of 150 m. All water well locations and depths within 200 m of the 16 proposed wells must be reported to the nearest ERCB Field Centre.

The Board notes that Quicksilver will test water wells in the vicinity of CBM development prior to drilling. The testing would be conducted in accordance with AENV's Standard for Baseline Water-Well Testing for Coalbed Methane/Natural Gas in Coal Operations and *Directive 035*. Further, Quicksilver has committed to sampling the gas (if present) for composition and isotope analysis in R. Dodd's water well located in close proximity to the proposed CBM well at 16-02-032-21W4M.

It is the view of the Board that a long-term gas sampling program in the Ghost Pine field to monitor residents' water wells into the future is not warranted at this time. The Board notes that current ERCB requirements adequately address the potential for CBM activity to impact water wells. In the event that a landowner perceives a change to its water well, AENV has a documented procedure in place. Such an event should be reported to AENV, at which time a water well complaint will be registered and assessed by that organization. Quicksilver would be required to retest the subject water well, in accordance with AENV's Standard for Baseline Water-Well Testing for Coalbed Methane/Natural Gas in Coal Operations. In addition, if there were any indication of an energy well being the potential source of impact, the ERCB would support AENV with the investigation to evaluate the potential of oil and gas operations contributing to the impact on the water well.

7 WELL LOCATIONS: VERTICAL VS. DIRECTIONAL VS. SLANT DRILLING

7.1 Views of the Applicant

Quicksilver submitted that its proposed 16 vertical well locations were chosen based on a statistical method. This resulted in determining optimum locations for accessing the underlying CBM reservoirs and achieving optimum CBM reservoir recovery. Quicksilver explained that in the Ghost Pine area, current ERCB requirements would allow it to drill up to four wells per section per pool, with the potential for increased well density with further approvals. However, Quicksilver's proposed development included two wells per section per pool. In general, Quicksilver proposed vertical well locations within LSDs 6 and/or 16 of a section, which would allow for an optimal interwell distance of about 1130 m for reservoir recovery.

Quicksilver defined the Ghost Pine area as having poorer economics than other CBM projects, due to lower productivities, wider variability of rates, and lower resources in place. Quicksilver believed optimum economic viability to be established when the most known and statistically likely ranges were used. Thus, it felt that vertical wells would be optimum, as they have well-defined costs, statistically defined and understood production variability, and appropriate methods of handling the influences on short- and long-term productivity. Quicksilver acknowledged that its proposed 16 wells would not result in a substantial economic gain for the province. However, it argued that its targeted CBM resource was a clean, low-risk gas resource, which could be recovered with limited impact on surface interests, even with single vertical wells.

Quicksilver acknowledged Mr. Garden's Deadeye Engineering Inc. report, which suggested directional or slant drilling from alternative locations off of landowners' lands. Quicksilver argued that Mr. Garden did not have the appropriate credentials (not being a reservoir engineer or geologist) to provide a review of the proposed well locations, which led to a number of errors in his assessment. He did not take into consideration that each of these wells would be targeting multilayered reservoirs starting at shallow depths, which played a crucial role in the economics and potential recovery of these reserves. Typically each proposed well would target 24 coal zones, ranging from depths of 130 to 415 metres from kelly bushing (mKB). In addition, Mr. Garden did not take into account the optimal interwell distance of 1130 m between wells for reservoir recovery and drainage. Furthermore, Quicksilver pointed out that Mr. Garden's report mistakenly cited holdings in the area and a 200 m buffer zone around each entire section. However, as identified above, the ERCB allows four wells per section per pool in this area, with a 300 m buffer on the west and south boundaries of the section.

Quicksilver discussed the concepts of reach and interwell distance when determining the potential to directionally or slant drill. It defined "reach" as the horizontal distance away from surface at any particular depth and "interwell distance" as the distance between two wellbores at any given depth. The consideration of a directional well profile would result in a reach of only 5 m at the shallowest targeted coal seam and a reach of around 190 m at the deepest targeted coal seam. When Quicksilver compared directional well profiles to a vertical well profile in this area, directional drilling provided very little additional reach, making it physically impossible to hit shallow target zones within the gas target area from the locations suggested by Mr. Garden. In addition, Quicksilver noted that directional drilling would result in other difficulties from a cost and achievable recovery perspective, due to the reduced interwell distance, resulting in drainage reduction.

With respect to slant drilling, Quicksilver acknowledged that the reach of a single pad slant well would result in better reach than that of a directional well profile. A slant well profile would result in a reach of 130 m at the shallowest coal seam and about 450 m at the deepest coal seam. A pad of slant wells could further increase the reach, resulting in a reach of 260 m at the shallowest coal seam and 830 m at the deepest coal seam. However, these options were still reduced from the optimal interwell distance of 1130 m between vertical wells. This ultimately would result in negative impacts on drainage and overall CBM recovery. In addition, Quicksilver stated that slant drilling would greatly increase capital and operating costs. With the potential for decreased reserves and productivity, the economic viability of the Horseshoe Canyon CBM play would be reduced to the point that some of these wells would not be economical to drill.

Quicksilver agreed with Mr. Garden's report that drilling costs for a slant well could be as much as 65 per cent higher than for a vertical well. This was of concern to Quicksilver, considering gas price sensitivity and operating costs to drill slant wells. There would also be a significant potential for operating costs to be higher if a situation were to arise such as directional tools getting stuck downhole or equipment not being available. In addition, Quicksilver expressed concern about low production due to poor completion practices, such as not getting all fluids cleaned out of a slant well during drilling operations.

Quicksilver concluded that drilling slant wells would not be feasible in the Ghost Pine area from an environmental, reservoir, economic, and risk perspective. Slant wells would result in more environmental impact, poorer economic benefits, and potentially reduced reserves and recoveries and they are inherently riskier than vertical wells.

Specific to the applications, Quicksilver noted on several occasions that it sent correspondence through Ms. Schwab regarding the potential to discuss alternative locations with the interveners. However, the interveners provided no response.

At the hearing, Quicksilver discussed in detail the feasibility of slant drilling each of the wells proposed on the lands of M. Porsche, A. Von Zitzewitz, and M. Wirtz. Locations proposed on F. Hugo's land were also discussed, even though alternative locations were not brought forward by the interveners. However, due to the above, Quicksilver stressed that drilling slant wells would not be feasible in the Ghost Pine area from environmental, reservoir, economic, and risk perspectives.

7.2 Views of the Intervenors

Ms. Schwab spoke on behalf of M. Porsche, A. Von Zitzewitz, and M. Wirtz, noting that the law firm's instructions were to preserve the integrity of the lands, as the Schwab clients were not interested in money that could be obtained through oil and gas development. The Schwab clients wanted no development on their lands.

With respect to potential alternative locations, the interveners noted that Quicksilver did not propose any specific alternative locations to them nor did they themselves go to Quicksilver to discuss alternative locations. Ms. Schwab acknowledged that Quicksilver requested information regarding potential alternative surface locations from the interveners, but no response was provided.

The interveners hired Mr. Garden, of Deadeye Engineering Inc., to discuss the feasibility of directional or slant drilling the proposed wells from alternative locations. Mr. Garden reviewed

Quicksilver's wells proposed on the Porsche, Von Zitzewitz, and Wirtz lands. Mr. Garden stated that he did not provide an independent or discrete solution for each of the proposed wells; instead he reviewed the ability to directionally or slant drill.

Mr. Garden determined that each of the proposed wellbores could be candidates for directional or slant drilling from various surface locations. Based on the statistical nature of the reserves, there could also be a large number of bottomhole locations. As a result, he emphasized that the best solution would be the parties coming to an agreement on a surface location.

Mr. Garden suggested that some of the proposed wells could be drilled from existing surface disturbance areas. In the case of the well proposed at LSD 6-9-31-21W4M, Mr. Garden argued that an existing ConocoPhillips well site located at LSD 7-6-31-21W4M could provide a surface to slant/directionally drill from. With respect to the proposed LSD 6-34-30-22W4M well, Mr. Garden identified existing ConocoPhillips well sites at LSDs 11 and 5-34-22W4M, which could be possible locations to slant/directionally drill from.

Mr. Garden acknowledged that he had not spoken to ConocoPhillips regarding the potential to use its existing leases to drill from. However, the interveners noted that ConocoPhillips had been identified as a working interest partner in each of the proposed wells.

Mr. Garden's report used a 200 m buffer zone around the entire section. This suggested that Quicksilver's wells proposed in LSD 16 would be located outside of the gas spacing target. However, with the applicable 300 m buffers only on the west and south boundaries of the section, Mr. Garden agreed that the wells proposed in LSD 16 would be on target. Mr. Garden argued that he based his report on information obtained on the ERCB Web site, where he did not come across any indication that there were no buffer zones on the north and east borders of the section. He acknowledged that with more time and effort he could have determined what the actual holdings and buffers were in the area.

Mr. Garden based his report on research of publicly available data from GeoCarta. In the Ghost Pine area, he found that productive intervals were 300 m and deeper. There was no production of any significance from the shallower Garden Plain or the Weaver Formations. Therefore, in determining potential locations in his report, Mr. Garden acknowledged that he did not assess targeting shallower depths. However, he did address shallow production zones at the hearing and agreed that reaching shallow targets would result in less than optimal reach. At a slant of 45 degrees, a depth of 130 m would result in about 130 m of reach, less than the 400 m reach required to target the optimal middle of the quarter section. However, it was noted at a 45 degree slant, the 400 m reach would still be obtainable for the proposed deeper productive zones.

The interveners noted that out of the 76 wells Quicksilver had drilled in the Ghost Pine area, only 14 had been perforated in the 130 to 200 m interval (within the Weaver and Garden Plain Formations). The majority of the 76 wells were perforated at depths between 300 and 480 m. The interveners argued there was no evidence provided to suggest there had been any material production from the 200 m level and above in the Ghost Pine area. Therefore, the interveners believed that the Board was being asked to approve applications with almost no information regarding the productivity of the shallow target formations. The interveners submitted that the appropriate disposition would be to defer a decision until Quicksilver could provide information on the productivity of these shallow zones.

The interveners explained that if Quicksilver did not need to perforate the upper Horseshoe Canyon in the Weaver and Garden Plain, it would be targeting zones at 200 to 480 m in depth. Thus, slant or directional wells could provide a means of targeting the deeper zones. In addition, penetrating a coal zone at a 45 degree angle would result in a larger corresponding productive interval than a true vertical well and could result in obtaining higher production and increase royalties to the province.

Mr. Garden acknowledged that increased costs were associated with drilling deviated wells, noting an incremental drilling cost of about 65 per cent, based on a winter directional drilling program. However, he felt there would be no incremental costs for wellhead and casing design, conditioning the hole, or building up a filter cake.

Mr. Garden believed that changes to the centralization and cementing program would be required in order to obtain the necessary cement job. However, the increased cost of cementing a deviated well compared to a vertical well would be minimal. Fracturing costs would depend on the technique proposed. Mr. Garden did note that increased costs could be associated with the loss of tools, depending on the string of tools and if they were properly insured. He agreed that even after a well was drilled, specialized equipment would be required for the life of the well. However, most of the equipment used would be multipurpose, so the costs associated may be comparable to those for vertical wells. In general, operational costs would be fairly close to those for vertical operations.

The interveners submitted that the current applications were based on two wells per pool per section, but there was potential for four or eight wells per section in the future. Currently, two wells per section would mean two leases at 80 by 100 m, two access roads, and associated pipeline infrastructure. Increasing development to four wells per section would mean four leases, four access roads, and four pipelines per section of land. The interveners argued that this was not orderly and efficient development and suggested that centrally located pad sites would minimize surface disturbance and the cost of pipeline infrastructure.

With respect to pad sites, R. Dodd spoke specifically to the well site proposed at 16-2-32-21W4M. In his opinion, it had been proposed too close to his feedlot operation and existing water well. He noted that he would prefer the well to be directionally drilled from a pad site farther in the middle of Section 2, reducing the impacts on his operations. R. Dodd identified an existing road running east-west for about one mile down the middle of Section 2, providing access to the area.

The interveners maintained that if these wells were not drilled, the reserves would not be lost, and another company could drill wells to recover the reserves. In terms of royalties, \$10 000 per year would be in return for risks to landowners and conflict between landowners and Quicksilver.

7.3 Views of the Board

With respect to well locations, the Board understands that in some situations a company may have more flexibility in the placement of a surface and/or bottomhole location of a well. However, at times the underlying geology and reservoir potential of an area can be limiting factors that could dictate well placement.

The Board is of the view Quicksilver provided compelling evidence to substantiate that its proposed vertical well locations are appropriate to obtain the underlying CBM reserves. The Board believes that Quicksilver thoroughly evaluated the potential to directional and/or slant drill its proposed wells and provided significant evidence regarding the negative impacts on reaching its shallow target formations, reservoir drainage, and economics.

Although the Board understands it may be technically feasible to directional or slant drill wells off of the interveners' lands, the Board notes that Mr. Garden did not use accurate and/or comprehensive information in making his assessments. As such, he underestimated the implications of deviated drilling on accessing and recovering the targeted CBM reserves. Based on Quicksilver's intent to target multiple zones from 130 to 415 m in depth, directional or slant drilling from locations off of the interveners' lands will not allow Quicksilver to reach all of its target formations, which the Board believes reduces the potential for orderly and efficient recovery of these reserves.

With respect to the shallow CBM reservoir production in the area, the Board is of the view that the potential for shallow production may be different for each proposed well. Production from a single zone in one well may not necessarily dictate potential production from another. Therefore, the nature of the CBM reserves is such that wells need to be drilled in order to evaluate CBM production from the shallower formations.

The Board acknowledges the statistical nature of these reserves, but believes that the specific economics of this area make accessing these reserves challenging. It is apparent to the Board that increased costs from directional and slant drilling may result in these wells being uneconomical to drill and that they therefore would be dropped from Quicksilver's drilling program. This may result in the reserves not being developed for the province.

8 FULL BUILD VS. MINIMAL DISTURBANCE LEASES

8.1 Views of the Applicant

Quicksilver noted that all 16 of its proposed vertical wells would be minimal disturbance leases. This means its well sites and access roads would not be stripped of topsoil or subsoil prior to drilling. Quicksilver committed to conducting its drilling operations during dry or frozen conditions, negating the need to conduct soil stripping. Once drilled and completed, each well site would be partially reclaimed to its previous agricultural land, resulting in a small teardrop shape around the wellhead, minimizing the surface disturbance associated with the drilling and operation of its proposed wells.

Quicksilver believed that the potential need for a full build lease would be greater for single slant wells than vertical wells. This was mainly attributed to the need to achieve rig stability. Slant wells would require a rig to face the exact direction in which it needed to drill, reducing the flexibility for rig placement and increasing the likelihood of requiring surface disturbance to provide a stable site, whereas vertical wells would allow more flexibility in rig movement, increasing the likelihood of finding a stable position on the lease without increased surface disturbance.

In addition to rig stability, Quicksilver noted that a shallow vertical well in this area would take about 1.5 days to drill, whereas a slant well could take up to 3 days. The longer the drilling rig would be on the lease, the greater the possibility of more surface impact.

Quicksilver acknowledged that there was less proliferation of surface leases when multiple wells were drilled from one pad site. However, it emphasized that pad sites resulted in negative impacts associated with increased drilling time and increased likelihood of requiring full build leases. For full build leases, a two-well pad would require a lease size of about 100 m by 120 m and a four-well pad would require about 130 m by 120 m. In comparison, a typical single vertical well lease would require 80 m by 100 m, which would be further reduced with minimal disturbance leases. Regardless of the reduced size associated with minimal disturbance leases, Quicksilver noted that compensation would be paid as if the entire lease and access road were not accessible.

Quicksilver argued that in its experience landowners preferred minimum disturbance locations because they could farm over access roads and only have to farm around a small portion surrounding the wellhead.

8.2 Views of the Interveners

Mr. Garden was of the view that in dry or frozen conditions, full build leases would not be required for slant drilling regardless if a single well or multiple wells from a single pad would be drilled. This could be done by the use of rig matting or drilling one well at a time during optimal frozen conditions.

He agreed that slant wells required drilling rigs to be set up in the exact direction to drill the wellbore, but noted that most of the slant rigs available were able to self-level by the use of hydraulics. Mr. Garden further noted that rig stability would be required regardless of whether a company were drilling a slant/directional or vertical well.

The Dodds did not agree that minimal disturbance leases were necessarily the best thing in agricultural lands. They stated that impacts on their farming operations were not associated so much with the size of an obstacle to farm around as with the number of obstacles they would have to farm around. If given the choice, they would prefer one larger obstacle as opposed to multiple smaller ones. The Dodds believed that if they farmed right up to the wellhead, it would be at their own risk, requiring them to spend money on seeding land that they may or may not obtain crop from. They added that there was the possibility that the company could require use of the seeded area and access the site, with its equipment flattening the crops.

Although the Dodds expressed concerns about minimal build leases, they were not able to provide a response as to whether they would prefer full build leases. They said that it would depend on each specific location and each specific site setup. L. Dodd spoke about the well proposed in the middle of his farming property and noted that a minimal disturbance access road in the middle of a field could increase weeds, while a full build lease and access road could result in increased water erosion and culverts that could cut up his farm field. The Dodds noted that they would be amicable to working with the company to determine what solution would be the most appropriate for them.

8.3 Views of the Board

Minimal disturbance development is increasingly used by industry in an effort to reduce the surface impacts associated with oil and gas development. Under appropriate conditions, this approach can be an effective way of reducing the surface impacts of a proposed development.

When a proponent is given a licence to drill a well on privately held lands, its survey plan represents the maximum approved extent of the lease and access road. In this case, Quicksilver's proposed minimal disturbance development would result in it not using the entire approved lease and access areas. However, Quicksilver would compensate the private landowner for potential impacts resulting from the maximum extent represented.

With respect to the properties farmed by the Dodds, it appears to the Board that minimal disturbance development may not be the best approach to this development. The Board believes that there is an opportunity for the parties to work together to achieve an amicable resolution regarding full build or minimal disturbance at each location. The Board fully supports meaningful communication between the parties and believes that it would create an opportunity for the parties to maintain effective and ongoing communication through the life of the project.

The Board expects Quicksilver to abide by its commitment to conduct its operations during dry or frozen conditions. The Board also notes that in the event minimal disturbance leases are agreed upon, Quicksilver would be required to ensure that changes in ground, weather, or operating conditions would not adversely impact the land or negate the benefits of its proposed minimal disturbance operations. The Board notes that it is Quicksilver's responsibility to make reasonable efforts to delay, modify, or suspend its operations when conditions indicate that an adverse impact is likely to occur.

9 CONSERVATION AND RECLAMATION PLAN, CLUBROOT, AND WEEDS

9.1 Views of the Applicant

Quicksilver stated that all pipeline segments proposed under Applications No. 1529676, 1507803, 1507801, and 1483742 required an amendment to its existing Ghost Pine West Conservation and Reclamation Plan (C & R) previously approved by AENV (Approval No. 222055-00-00), whereas all pipeline segments proposed under Application No. 1483737 were proposed in the Ghost Pine East area and did not require a C & R or amendment.

Quicksilver acknowledged that new C & Rs, as well as amendments to existing ones, should be filed with AENV prior to submitting a pipeline application to the ERCB and admitted that it was Quicksilver's oversight in this case. Quicksilver identified that as of March 27, 2008, it had filed an amendment to its Ghost Pine West C & R with AENV and that no statements of concern had been received.

Recognizing that the amendment was not complete at the time it was filed, Quicksilver acknowledged that the required field studies, such as soil, wildlife, vegetation, and wetland assessments, etc., had not been conducted. The reason Quicksilver did not conduct its field work was explained in terms of economies of scale. Although it had been granted access to lands owned by the Schwab clients in February 2008, Quicksilver argued that it did not have access to the Hugo land and would prefer to perform as many activities in a given area at a single time, as

opposed to conducting multiple field events. Quicksilver noted that AENV agreed with this approach, as it would avoid having piecemeal field studies submitted. Quicksilver stressed that all of the environmental work it would be completing in the future would be scrutinized by AENV and that ultimately AENV would have to determine its completeness.

Notwithstanding that there was no requirement for a C & R, Quicksilver confirmed that it would be preparing an environmental protection plan (EPP) for the pipeline segments proposed under Application No. 1483737. Such a plan would include the same baseline environmental information and construction and mitigation plans as those associated with a C & R.

Quicksilver noted that as part of its corporate policy, it undertook to follow all environmental regulations. Quicksilver further noted that it had experience with C & R approvals and EPPs and hired qualified environmental personnel to execute them. In addition, Quicksilver stated that it had experience and infrastructure specifically in the Ghost Pine area, emphasizing that this area was not unknown to the company.

As a result of not accessing the Schwab clients' and F. Hugo lands, Quicksilver stated that its proposed pipeline routes were determined using aerial photography and that they would require field testing and ground truthing to be confirmed. Consequently, Quicksilver agreed that there was a possibility that routes might be subject to change, pending completion of its field work. Quicksilver understood that future applications would be required to amend any of its proposed pipeline routes should they change. However, it pointed out that the majority of lands where pipeline development had been proposed were cultivated and, therefore, it did not foresee many changes, if any, being required.

In response to the interveners' concerns about surface impacts resulting from activities during wet conditions, Quicksilver committed to conducting drilling, servicing, and other operations in dry or frozen conditions. Quicksilver further noted that it would be installing self-contained automated data acquisition (SCADA) units for each of its proposed wells. This would enable remote data collection and result in operators not having to access the sites to collect daily production data.

To address the interveners' concerns about weeds and clubroot, Quicksilver stated that it had a weed management plan and submitted its "Clubroot Best Management Practices" as evidence during the hearing process. In addition, Quicksilver stated it had worked with Alberta Agriculture on a committee to help develop Alberta Agriculture's clubroot policy and was one of four companies helping to develop the Canadian Association of Petroleum Producers' Clubroot Management Plan.

Specific to its proposed development in the Ghost Pine area, Quicksilver noted that it had had discussions with municipal agricultural field men in the area and that both Ghost Pine East and West are deemed to be clubroot free at this time.

9.2 Views of the Intervenors

Ms. Schwab spoke on behalf of her clients, noting that the law firm's instructions were to preserve the integrity of the land, as the Schwab clients were not interested in money that could be obtained through oil and gas development. With respect to the Porsche lands, the firm was instructed to maintain a long-term working relationship with the occupants, the Dodd family, which had farmed the Porsche lands since the 1970s. Ideally, the Schwab clients wanted no

development; however, if the Board decided this development was in the public interest, they believed it should be carried out in a manner that would minimize the impact on the land.

The Schwab clients expressed concerns regarding Quicksilver's environmental due diligence, noting that the company did not provide complete answers the Board's questions regarding the C & R plan and additional environmental aspects of its proposed development. The interveners felt that Quicksilver's argument concerning land access meant Quicksilver could not conduct basic environmental due diligence until it knew if its proposed development would be approved. From the interveners' perspective, this meant that they would never be entitled to such information as appropriate mitigation protocols until after oil companies were already on their lands. The interveners were of the view that the information requested by the Board should be a precondition to the Board's consideration of the proposed applications and should not be a discretionary exercise to be completed in the event that the Board were to approve Quicksilver's applications.

The Schwab clients submitted e-mail correspondence dated February 11, 2008, in which they had given Quicksilver permission to access the lands in order to conduct its soil sampling program. They could not understand why they were forced to await access being granted to the Hugo properties, as their lands were not continuous with the Hugo's. The interveners requested that any approval the Board may issue be conditional upon Quicksilver completing its soil sampling program and conducting its environmental due diligence.

The Dodds expressed specific concerns about the impact on soils from construction and operations during wet conditions and the potential to introduce weeds and Clubroot.

They agreed that Quicksilver's commitment to drilling, servicing, and other operations in dry or frozen conditions could help alleviate some of their concerns. However, they questioned the feasibility of Quicksilver achieving this, as the area remained frozen only for short periods during the year and it rained often. The Dodds noted that in general during drilling operations, companies did not seem to be willing to stop when it rained. They further explained that drilling operations were not limited to a drilling rig on the lease, but also included additional equipment, such as water and mud spraying trucks and perforating and fracturing trucks etc. that can tear up fields by driving in and out of the lease during wet conditions.

In the event that Quicksilver's applications were approved, the interveners sought the ability to ensure that Quicksilver's impacts would be minimal. As such, they requested conditioning any approval to include the hiring of an independent third party as a "watch person" to oversee Quicksilver's drilling and pipeline operations. The interveners further requested restriction of mobilization during wet conditions and specific notifications when any equipment, such as service rigs, completions trucks, fracturing equipment, etc., would be mobilized to the sites.

When questioned regarding specific conditions on the Porsche lands, the Dodds agreed that the lands were for the most part flat farm land and stated that they were not aware of any environmental constraints where the pipeline routes were proposed.

The interveners defined clubroot as a debilitating and long-lasting soil-borne pest that blights canola crops. The Dodds stated that clubroot spores were transmitted by physical contact and transportation from one field to another, often on farm or oil company equipment. In an attempt to reduce the risk of clubroot infestation, the Dodds said they currently used a closed farming

system, using only dedicated farm equipment. As such, no additional or foreign earth-moving equipment or traffic accessed the Dodds' farm fields and the Dodds did not transport their equipment to and from other properties. The Dodds noted that their farm lands were presently free of Clubroot and stressed that Quicksilver should be responsible for ensuring that all equipment, whether owned and operated by Quicksilver or its subcontractors, be sterilized each time it was transported to or entered upon their lands.

With respect to weeds, the Dodds noted that there were various hard-to-control weeds around the county that they did not have on their farmed properties. The Dodds emphasized that once weeds started growing in an area, they were generally hard to eliminate. The Dodds also noted that in their experience, weeds were harder to control on minimal disturbance roads as opposed to full built roads. Fully constructed roads were easily visible and the farmer could see weeds establishing at early stages. With minimal disturbance roads, weeds could be hidden within the crops and were generally not visible until they already seeded and germinated. Thus, the Dodds stated that Quicksilver should pay close attention during the construction and operational phases to prevent the introduction of new weeds.

The Dodds acknowledged that Quicksilver had a weed management plan and best management practices in place for mitigating the potential for weed and/or clubroot infestations. However, they expressed concern regarding the logistics of enforcing such practices and felt that the onus of ensuring adherence to such practices would ultimately lie with them and not Quicksilver.

9.3 Views of the Board

When considering any application for oil and gas facilities proposed on privately held lands, the Board must balance the rights of the surface holder with the rights of the mineral holder and account for the public interest associated with the economic development of Alberta's energy resources. The Board expects the applicant to consider all available options in establishing that the location proposed is the most appropriate, having regard for the social, economic, and environmental circumstances. If a surface holder has legitimate concerns regarding potential impacts of the proposed development, the Board expects that the applicant will take reasonable steps to mitigate impacts.

The Board understands that there may have been some clarity required when determining AENV's requirements for filing the C & R amendment associated with Quicksilver's proposed pipeline applications. However, the Board is of the view it is the proponent's responsibility to determine and meet all requirements when it is proposing potential development in Alberta. As such, the Board would have expected Quicksilver to determine the requirements for its C & R amendments with AENV during its planning stages, specifically prior to putting forth its applications to the ERCB. Future applications should include this determination during the planning stages.

In view of the fact that AENV is in agreement, the Board accepts the argument of Quicksilver that its field surveys, specific to completion of its C & R, would be conducted at one time on all affected lands once access was granted. The Board, however, does not accept this argument with respect to the pipeline application proposed on the Porsche lands. It is the Board's understanding that the pipeline segments under Application No. 1483737, proposed on the Porsche lands, are not subject to a C & R. Although not required for the ERCB, Quicksilver submitted that it would be conducting similar environmental field work on this property. Given that completion of the

required C & R amendment is not contingent upon environmental information collected from these lands, that these lands are not spatially connected to those requiring a C & R, and that the occupants and landowners expressed concerns regarding environmental issues, the Board would have expected Quicksilver to at least initiate its identified environmental studies on these lands. The Board is of the view that just because the work can be done at a later date at the convenience of the applicant, that may not be the most appropriate method of addressing interveners' concerns.

Further, the Board notes that Quicksilver runs the risk of its proposed pipeline routes requiring change after the field work and ground truthing have been completed. These applications would be subject to the ERCB's facilities application process. The Board is of the view that Quicksilver could have reduced this risk by completing a portion of the ground truthing, specifically on the lands it was granted access to.

The Board does not find it necessary for an independent third party to oversee Quicksilver's operations. The Board expects Quicksilver to use qualified environmental personnel to conduct its operations. Further, as noted in Section 8.3, the Board expects Quicksilver to abide by its commitment to conduct its operations during dry or frozen conditions. Quicksilver would be required to ensure that changes in ground, weather or operating conditions would not adversely impact the land or negate the benefits of its proposed minimal disturbance operations. The Board notes that it is Quicksilver's responsibility to make reasonable efforts to delay, modify, or suspend any of its operations when conditions indicate that an adverse impact is likely to occur.

With respect to clubroot, the Board notes that in April 2007 it was declared a pest under Alberta's *Agricultural Pests Act*. The Minister of Alberta Agriculture and Rural Development is responsible for the act, while municipalities are responsible for enforcing it. A landowner and/or occupant is responsible for taking reasonable measures to prevent the establishment of any pest on the land. The Board is of the view that prevention and mitigation are a shared responsibility between the landowners/occupants and Quicksilver and any other user of the land. The Board acknowledges the efforts of the Dodds in attempting to prevent the establishment of clubroot on the properties on which they farm.

Specific to Quicksilver's proposed development, the Board notes that Quicksilver has corporate Best Management Practices for Clubroot, which includes conducting an environmental overview to determine specific weed and pest issues, identification of fields with clubroot through consultation with municipal agricultural field men, equipment cleaning, and testing introduced soils for weeds and pests.

The Board expects Quicksilver to abide by its best management practices during all aspects of its proposed development. The Board notes that it would be prudent for Quicksilver and the Dodds to maintain communication with agricultural field men and local municipalities regarding the issue of clubroot in the area to allow each party to take appropriate precautions and mitigation measures through the entire life of the proposed project.

The Board accepts that if these measures are successfully implemented, the risks associated with the establishment of clubroot as a result of Quicksilver's proposed activity could be effectively mitigated.

10 INSURANCE

The interveners raised the issue of the sufficiency of the insurance program maintained by the applicant, and submitted that the types of coverage, limits on coverage, exclusions, and warranties contained in policies left the applicant in a position where it may not be able to answer for damages caused by possible untoward events such as blowouts, loss of well control, discharge of contaminants, damage to property, and damage to aquifers.

10.1 Views of the Applicant

Quicksilver submitted evidence in two subject areas. The first was testimony about its size and activities, from which a picture of its financial viability could be gleaned. The second area of evidence was contained in an expert report prepared and filed by the insurance industry representatives that obtain and maintain the insurance coverage of Quicksilver.

Regarding its activities and size and that of its American parent corporation, Quicksilver Resources Inc., the applicant submitted that the American parent corporation, a publicly traded corporation, is roughly a \$6 billion company based in Fort Worth, Texas, with annual revenues of \$561 million over the last decade.

The applicant advised that it originated as MGV Energy Inc. and became a subsidiary of Quicksilver Resources Inc. in 1999, headquartered in Calgary, Alberta. It conducts the Canadian operations, with main project areas including the South Central Horseshoe Canyon area between Calgary and Camrose.

In 2007, the applicant had revenues of \$147 million and a net income after tax of \$44 million.

The combined production of the parent corporation and its Canadian subsidiary was said by Mr. Morris on behalf of Quicksilver to be about 10 000 barrels of oil equivalent per day.

Quicksilver noted that pursuant to *Directive 006: Licensee Liability Rating (LLR) Program and Licence Transfer Process*, its ERCB licensee liability rating (LLR) which is a ratio of Alberta cash flow over projected abandonment liabilities, is 6.68 and that security on hand with the ERCB, as a result, is zero dollars.

In addition to providing a certificate of insurance for policy periods from May 1, 2008, through May 1, 2009, the applicant filed an expert report dated July 1, 2008, prepared by P. W. Johnston, an insurance executive in Houston, Texas, and by K. Letourneau, an insurance executive in Edmonton, Alberta. The report was filed to rebut the expert reports filed on behalf of the interveners, which are described below.

The report filed by the applicant contended that the types of coverage, limits of coverage, exceptions or exclusions, and warranty requirements were all in accordance with industry norms and provided adequate insurance coverage for the types of activities proposed by Quicksilver.

Also, Quicksilver contended that hearings on specific applications were not the appropriate juncture or forum at which to review the insurance policies of an applicant. The scrutiny of a licensee's insurance coverage was, it was argued, to take place at the time the licensee sought a business code allowing it to apply for ERCB licences, pursuant to *Directive 067: Applying for Approval to Hold [ERCB] Licences*.

Quicksilver's expert report highlighted the difficulties in assessing the complete adequacy of an insurance program in advance of the events that might give rise to losses or liabilities, stating that "...we cannot certify the extent of coverage provided under QRCI's [Quicksilver Resources Canada Inc.] policies without first knowing the fact circumstances of a given claim to apply to the respective policy language."

In specific response to some of the conclusions offered by the interveners' expert, Quicksilver's expert report noted the following:

- The catastrophic blowout or loss of control events and resultant losses cited as examples by the interveners' expert report were not analogous to the possible types of blowouts or loss of control events that could be anticipated in CBM drilling operations contemplated by the applicant. The interveners' examples were in instances having risk profiles that were much more hazardous than those contemplated by the applicant.
- In response to the assertion that there was either no pollution coverage or inadequate pollution coverage and even then only for aboveground damage, the expert rebuttal report of the applicant opined that the limit of the applicant's coverage was \$25 000 000.00, not \$1 000 000.00, that it covered pollution risks, and that underground third-party damages were in fact covered.
- By basing limits of coverage on the magnitude of a particular authorization for expenditure (AFE) for a given well (for example, \$3 000 000.00 for a well with an AFE of \$1 000 000.00 or less), the applicant was following an industry norm and that levels of loss of control coverage would be adequate.

10.2 Views of the Intervenors

Ms. E. Schwab, legal counsel for the Schwab clients, stated that her clients wished to see evidence that Quicksilver either had the financial wherewithal to answer established claims for damages or had a program of insurance that would be responsive to and sufficient to satisfy damage claims if an unanticipated and undesirable event were to occur, causing damage to their lands. Upon examination, she indicated that she understood that should an untoward event occur, such as a blowout, loss of well control, release of contaminant, damage to the aquifer, or property damage, in order to access insurance coverage, liability would have to be first imposed upon the applicant before insurance coverage could be accessed.

The intervenors stated that prior to the hearing, they were granted access to Quicksilver's insurance policies for their expert, Mr. R. D. Farries. He prepared two reports dated October 31, 2007, and June 4, 2008, which were adduced in evidence. The reports were critical of Quicksilver's insurance program and the types of coverage, limits on coverage, exclusions or exceptions to coverage, and warranties contained therein. The reports concluded that the insurance maintained by Quicksilver was inadequate to protect third-party claimants in the event that they suffered damages as a result of the company's activities.

Some of the intervenor's expert's main conclusions were as follows:

- There was either no pollution coverage for significant portions of Quicksilver's operating activities or limits on coverage were too low and did not cover loss or damage below the surface of the ground.

- Control of well policy provisions and limits were not sufficient to meet historical Canadian losses, and examples of well-known and significant loss of control events were listed, including the Lodgepole sour gas event of 1982.
- The insurance program was devoid of coverage for damage to underground property.

Counsel for the interveners did not cross-examine Quicksilver's insurance experts on their report.

The interveners sought a number of conditions to be imposed upon Quicksilver in the event that the applications were approved, as follows:

- 1) The interveners be entitled to review Quicksilver's insurance policies on an annual basis.
- 2) Quicksilver be required to obtain and maintain insurance coverage in compliance with the recommendations of the interveners' consultants.
- 3) Quicksilver's insurance policies be provided to the interveners on the anniversary of every policy renewal for so long as the well sites and pipelines exist on the landowners' lands.
- 4) The interveners' experts be able to review the policy produced by Quicksilver on the eve of the hearing and report to the Board on the interveners' analysis of the adequacy of that policy.

10.3 Views of the Board

The Board does wish to gain an understanding of the financial viability of applicants for oil and gas development to have confidence in the ability of the applicant to prudently and safely operate and to answer its obligations and potential liabilities. There are also some statutorily provided safeguards in place should an applicant fail or neglect to abandon and remediate its projects.

There are at least two requirements pursuant to directives of the ERCB dealing with the financial health of an operator:

- 1) The requirement that an ERCB licensee receive a Business Associate (BA) Code, during the course of which insurance coverage is assessed pursuant to *Directive 067: Applying for Approval to Hold [ERCB] Licences*; and
- 2) The potential requirement for an operator to post security pursuant to *Directive 006: Licensee Liability Rating (LLR) Program and Licence Transfer Process*.

These are discussed in turn.

Pursuant to Section 3.4 of *Directive 067*, an ERCB licensee must have reasonable and appropriate insurance coverage (and maintain the insurance coverage) for the size of the company and the type of operation that the company carries out. The insurance policy must be issued from a company registered in Alberta to provide insurance in Alberta. Proof of the insurance must be provided to the ERCB.

This is the first step or requirement in an operator establishing to the ERCB's satisfaction the reasonable corporate health of a licensee.

The second and ongoing requirement is under the Licensee Liability Rating Program (LLR Program) set forth in *Directive 006*. The purpose of this program is to minimize the risk to the Orphan Fund, about which more is said later, posed by unfunded well, facility, and pipeline abandonment and reclamation liabilities. The LLR Program applies to all upstream oil and gas facilities included within the scope of the Orphan Fund.

On a monthly basis, this program assesses a licensee's ability to address its abandonment and reclamation liabilities. The assessment is a comparison or ratio of a licensee's deemed assets to its deemed liabilities. A producer licensee's deemed asset is its cash flow from oil and gas production reported to the Petroleum Registry of Alberta and a nonproducer licensee's deemed asset is its cash flow from midstream activities. The deemed liabilities of both producer and nonproducer licensees is the cost to abandon and reclaim its wells and facilities included within the scope of the LLR Program.

Any licensee whose deemed liabilities exceed its deemed assets (i.e., an LLR below 1.0) is required to place a security deposit with the ERCB equal to the difference between those assets and liabilities.

This is the second step in the ERCB's efforts to ensure ongoing financial health of oil and gas operators.

The Board also considered all of the evidence and argument about Quicksilver's insurance program.

Ultimately in the case of an operator or working interest participant failing financially, defaulting or neglecting to perform its abandonment and reclamation obligations, resort may be had to the Orphan Fund governed by Part 11 of the *Oil and Gas Conservation Act (OGCA)*. Sections 68 through 77 of the *OGCA* provide for the purpose, the funding of, *inter alia*, the suspension, abandonment, and reclamation of facilities, the designation of orphan wells and facilities, levies, appeals of levies, and the effect of payment from the fund for abandonment and reclamation. The Board stresses that upfront efforts in assessing the financial wherewithal of licensees and applicants is preferable to reliance upon the Orphan Fund.

The Board agrees with Quicksilver that an assessment of whether or not a licensee's insurance coverage is reasonable occurs at the time the operator applies to become a Business Associate with a Business Code, pursuant to Section 3.4 of *Directive 067*.

Of the expert reports of the parties, the Board accepts that of the applicant over those of the interveners. Messrs. Letourneau and Johnston are closer to Quicksilver and its insurance needs. The experience of Mr. Johnston appears to be more closely tied to the energy industry than that of the interveners' expert. Finally, the rebuttal report was not the subject of cross-examination and the Board accepts the views put forward in that rebuttal report.

In conclusion, the Board finds that Quicksilver's insurance program is reasonably adequate for the activities the applicant is proposing to engage in were the applications to be approved.

Because of the satisfactory picture of the applicant's corporate health and viability and the foregoing views, the Board declines to impose the conditions sought by the interveners.

11 PUBLIC CONSULTATION

11.1 Views of the Applicant

Quicksilver submitted that its public consultation had been proactive. It recognized that a unique and innovative approach was required when drilling multiple CBM development wells in higher density settings than conventional wells. It submitted that in its initial development phases, it had held two open houses in February 2005 and August 2005 to provide information and solicit feedback from interested stakeholders. Quicksilver also submitted that it believed it had a history of successful consultation and negotiations with the large majority of the landowners and occupants in the Ghost Pine area.

Quicksilver stated that after initially learning there were concerns, it embarked upon exhaustive efforts to resolve the concerns raised by Ms. Porsche, Ms. Von Zitzewitz, and Mr. Wirtz in 2005. Quicksilver noted that because the landowners had counsel from the start, counsel-to-counsel communication was prevalent from the early stages of the consultation and application processes. Quicksilver submitted that it had provided the landowners with a great deal of information and thoroughly responded to questions and concerns in an effort to involve the landowners in its project, alleviate their concerns, and ultimately develop its project with the landowners' support. It believed that the consultation efforts were hampered as a result of the landowners' longstanding instructions to their counsel that there was simply to be no oil and gas development on the subject lands. Quicksilver expressed frustration over the fact that the landowners withdrew from the appropriate dispute resolution (ADR) process on the basis that Quicksilver was not prepared to provide a copy of its insurance policies, even though those policies were, in the end, provided for review. Quicksilver also submitted that a copy of the area development was provided to the landowners as early as September 2005 and again in August 2007.

Quicksilver submitted that one of its representatives, no longer employed by Quicksilver, met with the Dodds on a couple of occasions to discuss preferred locations and lease configurations on lands they farmed.

With respect to the Hugo family, Quicksilver submitted that despite being told by the Hugos numerous times that they were not willing to participate in the consultation process unless their discussion agreements were executed and monies were paid, Quicksilver continued to make efforts to communicate with them. Quicksilver submitted that it did everything it could to try to engage the Hugos in meaningful consultation and that the process was meant to be a two-way street, with the expectation that intervening parties also need to take part. It felt that in this case some responsibility for the process failing should be borne by the Hugos.

11.2 Views of the Intervenors

Counsel for the Schwab clients described their participation in the consultation process as being one conference call with Quicksilver, their counsel, and the son of Ms. Porsche. Counsel submitted that a number of issues arose that were never addressed to the satisfaction of the landowners, to the point where the landowners felt that there would be no purpose served to

attend the second step of the planned mediation because of Quicksilver's failure to produce certain requested materials. Those materials included Quicksilver's insurance policy and Quicksilver's long-term development plans for the area. The interveners argued that it was very hard for the landowners to make suggestions with respect to drilling the wells from alternative locations using directional drilling techniques when they did not know the totality of the reasonably foreseeable well and pipeline applications.

The Dodds did not dispute or criticize any of the notification or consultation material or procedures described by Quicksilver.

11.3 Views of the Board

The Board is satisfied that Quicksilver carried out all of the notification and consultation requirements as set out in *Directive 056: Energy Development Applications and Schedules* for the proposed wells and pipelines. With regard to the consultation efforts made with the Hugos, the Board believes Quicksilver when it says that it did everything it could to try to engage the Hugos in meaningful consultation. The Board also agrees with Quicksilver's comment that the consultation and ADR processes are meant to be a two-way street, with the expectation that intervening parties also need to take part in the process in order to try to find effective solutions to concerns that they may have.

Dated in Calgary, Alberta, on September 30, 2008.

ENERGY RESOURCES CONSERVATION BOARD

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

J. D. Ebbels, LL.B.
Board Member

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

APPENDIX 1 DESCRIPTION OF EACH OF THE PROPOSED WELL AND PIPELINE APPLICATIONS

Application No.	Description and Location of Application
1477662	Well, 6-34-30-22W4M, total depth 443 m, surface casing to 70 m
1477688	Well, 6-11-32-21W4M, total depth 433 m, surface casing to 70 m
1477700	Well, 16-11-32-21W4M, total depth 438 m, surface casing to 70 m
1477711	Well, 6-11-31-22W4M, total depth 453 m, surface casing to 70 m
1477721	Well, 16-3-32-21W4M, total depth 409 m, surface casing to 70 m
1477768	Well, 16-2-32-21W4M, total depth 427 m, surface casing to 70 m
1477775	Well, 16-16-31-22W4M, total depth 446 m, surface casing to 70 m
1505748	Well, 6-9-31-21W4M, total depth 411 m, surface casing to 70 m
1505775	Well, 6-5-31-21W4M, total depth 434 m, surface casing to 70 m
1505801	Well, 16-10-32-21W4M, total depth 465 m, surface casing to 70 m
1505807	Well, 16-35-31-21W4M, total depth 422 m, surface casing to 70 m
1510484	Well, 16-1-32-22W4M, total depth 465 m, surface casing to 75 m
1510487	Well, 16-2-32-22W4M, total depth 486 m, surface casing to 75 m
1510791	Well, 6-19-31-21W4M, total depth 464 m, surface casing to 70 m
1510877	Well, 16-35-31-22W4M, total depth 498 m, surface casing to 75 m
1513260	Well, 6-1-32-22W4M, total depth 496 m, surface casing to 75 m
1483737	<p>Pipeline, five segments:</p> <p>Line No. 6 from the proposed well at LSD 16-11-32-21W4M to the proposed pipeline at LSD 14-11-32-21W4M. The proposed pipeline would be 0.63 km in length, with a maximum outside diameter (OD) of 88.9 millimetres (mm).</p> <p>Line No. 7 from the proposed well at LSD 14-11-32-21W4M to the proposed pipeline at LSD 6-11-32-21W4M. The proposed pipeline would be 0.82 km in length, with a maximum OD of 168.3 mm.</p> <p>Line No. 8 from the proposed well at LSD 6-11-32-21W4M to the proposed pipeline at LSD 8-2-32-21W4M. The proposed pipeline would be 2.46 km in length, with a maximum OD of 219.1 mm.</p> <p>Line No. 9 from the proposed well at LSD 8-2-32-21W4M to the existing pipeline at LSD 15-36-31-21W4M. The proposed pipeline would be 1.82 km in length, with a maximum OD of 323.9 mm.</p> <p>Line No. 10 from the proposed well at LSD 16-3-32-21W4M to the proposed pipeline at LSD 14-2-32-21W4M. The proposed pipeline would be 0.82 km in length, with a maximum OD of 88.9 mm.</p>
1483742	<p>Pipeline, four segments:</p> <p>Line No. 36 from the proposed well at LSD 6-11-31-22W4M to the proposed pipeline at LSD 8-11-31-22W4M. The proposed pipeline would be 0.65 km in length, with a maximum OD of 88.9 mm.</p> <p>Line No. 37 from the proposed well at LSD 8-11-31-22W4M to the existing pipeline at LSD 16-2-31-22W4M. The proposed pipeline would be 0.82 km in length, with a maximum OD of 88.9 mm.</p> <p>Line No. 38 from the proposed well at LSD 16-16-31-22W4M to the existing pipeline at LSD 1-21-31-22W4M. The proposed pipeline would be 0.13 km in length, with a maximum OD of 114.3 mm.</p> <p>Line No. 39 from the proposed well at LSD 6-34-30-22W4M to the existing pipeline at LSD 16-34-30-22W4M. The proposed pipeline would be 1.44 km in length, with a maximum OD of 88.9 mm.</p>
1507801	<p>Pipeline, one segment: from the proposed well at LSD 6-1-32-22W4M to the proposed pipeline at LSD 8-1-32-22W4M. The proposed pipeline would be 0.61 km in length, with a maximum OD of 88.9 mm.</p>

1507803	<p>Pipeline, five segments:</p> <p>Line No. 25 from the proposed well at LSD 16-2-32-22W4M to the proposed pipeline at LSD 6-2-32-22W4M. The proposed pipeline would be 1.28 km in length, with a maximum OD of 88.9 mm.</p> <p>Line No. 26 from the proposed well at LSD 6-19-31-21W4M to the existing pipeline at LSD 14-18-31-21W4M. The proposed pipeline would be 0.79 km in length, with a maximum OD of 88.9 mm.</p> <p>Line No. 27 from the proposed well at LSD 16-35-31-22W4M to the existing pipeline at LSD 14-35-31-22W4M. The proposed pipeline would be 0.8 km in length, with a maximum OD of 88.9 mm.</p> <p>Line No. 28 from the proposed well at LSD 16-1-32-22W4M to the proposed pipeline at LSD 16-36-31-22W4M. The proposed pipeline would be 1.41 km in length, with a maximum OD of 88.9 mm.</p> <p>Line No. 29 from the proposed well at LSD 16-36-31-22W4M to the proposed pipeline at LSD 6-31-31-21W4M. The proposed pipeline would be 1.59 km in length, with a maximum OD of 114.3 mm.</p>
1529676	<p>Pipeline, one segment from the proposed well at LSD 6-9-31-21W4M to the proposed pipeline at LSD 8-9-31-21W4M. The proposed pipeline would be 0.74 km in length, with a maximum OD of 88.9 mm.</p>

APPENDIX 2 HEARING PARTICIPANTS

Principals and Representatives
 (Abbreviations used in report)

Witnesses

Quicksilver Resources Canada Inc. (Quicksilver)

D. K. Naffin
S. M. Munro

J. Gouw
D. Morris
K. Letourneau,
of Phoenix Group Risk Management
P. Johnston,
of John L. Wortham & Sons
K. Longmuir, P.Eng.
S. Goodfellow, C.E.T.
H. Morris, C.E.T.
D. Rempel, P.Eng.
D. David, P.Geol., P.Geo.,
of Waterline Resources
M. Somerwil, P.Geol.
R. Fluter, C.E.T.
K. Mouser

M. Porsche, A. Von Zitzewitz, M. Wirtz (Schwab clients)

L. Dodd and R. Dodd (the Dodds)
R. Secord
R. Schwab
E. Chipiuk

L. Dodd
R. Dodd
E. Schwab,
of Schwab, Schwab & Schwab
R. Farries,
of Robert-McClure Insurance Services Ltd.
J. Garden, P.Eng.,
of Deadeye Engineering Inc.
J. Freeman,
of Matrix Solutions Inc.

D. Mueller
Energy Resources Conservation Board staff

K. Stilwell, Board Counsel
G. McLean, C.E.T.
R. Connery, T.T.
T. Novotny, AIT
M. Bevan, P.Geol.
A. Smandych, P.Eng.
L. Jonker, C.E.T.
S. McDonald

APPENDIX 3 SUMMARY OF COMMITMENTS AND CONDITIONS

The Board notes throughout the decision report that Quicksilver has undertaken to conduct certain activities in connection with its operations that are not strictly required by the ERCB's regulations or guidelines. These undertakings are described as commitments and are summarized below. It is the Board's view that when a company makes commitments of this nature, it has satisfied itself that these activities will benefit both the project and the public, and the Board takes these commitments into account when arriving at its decision. The Board expects the applicant, having made the commitments, to fully carry out the undertaking or advise the ERCB if, for whatever reasons, it cannot fulfill a commitment. The ERCB would then assess whether the circumstances regarding the failed commitment warrant a review of the original approval. The Board also notes that the affected parties also have the right to request a review of the original approval if commitments made by the applicant remain unfulfilled.

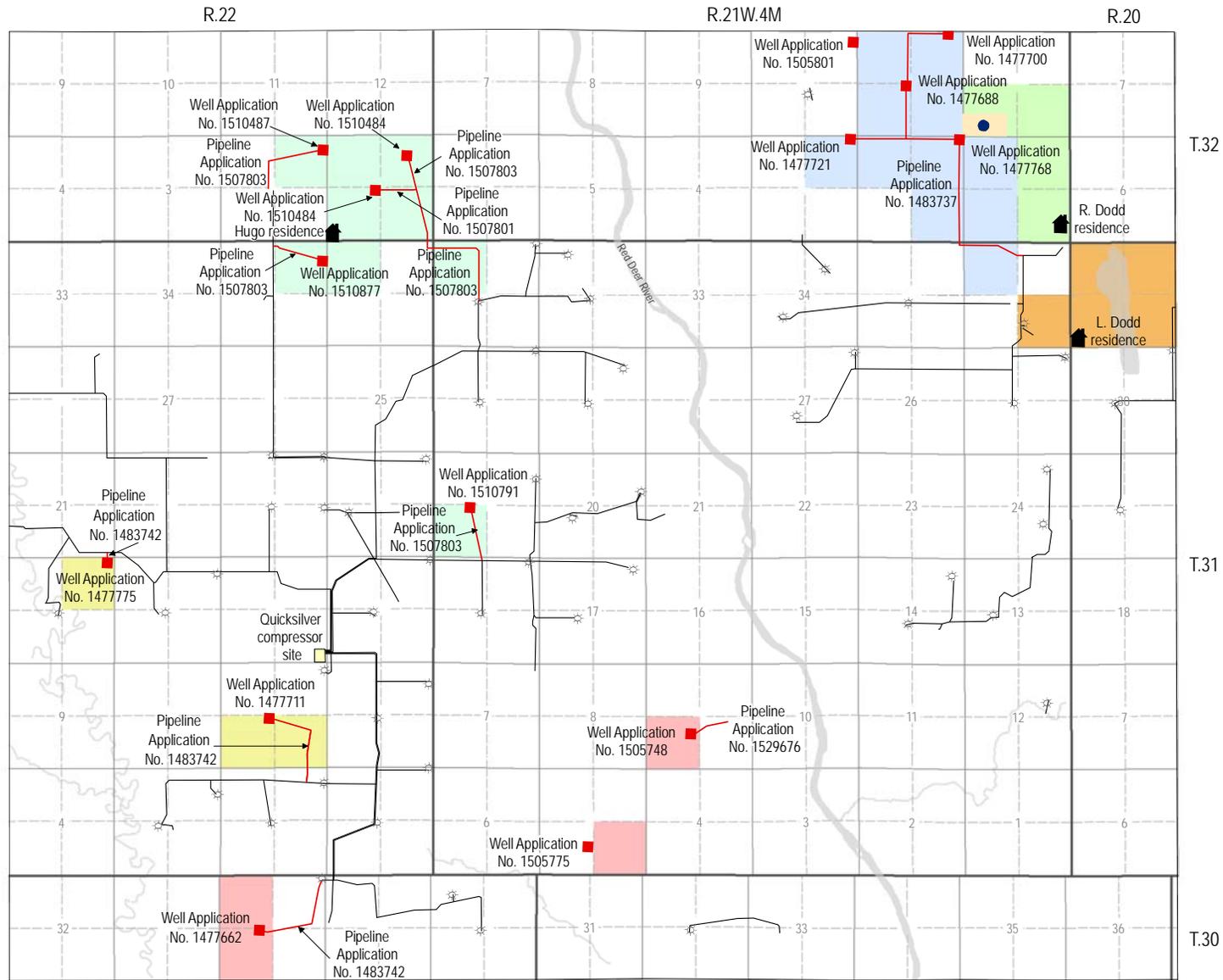
Conditions generally are requirements in addition to or otherwise expanding upon existing regulations and guidelines. An applicant must comply with conditions or it is in breach of its approval and subject to enforcement action by the ERCB. Enforcement of an approval includes enforcement of the conditions attached to that licence. 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 licence are summarized below.

COMMITMENTS BY QUICKSILVER

- Test water wells in the vicinity of CBM development prior to drilling. The testing will be conducted in accordance with AENV's Standard for Baseline Water-Well Testing for Coalbed Methane/Natural Gas in Coal Operations and ERCB *Directive 035: Baseline Water Well Testing Requirement of Coalbed Methane Wells Completed Above the Base of Groundwater Protection*. Conduct baseline testing on R. Dodd's water well, located 268 m from the proposed 16-02-032-21W4M CBM well. The testing will include isotopic analyses, if free gas can be collected during the test.
- Conduct lease construction, drilling, and servicing operations only when the land is either dry or under frozen conditions.
- Prepare an environmental protection plan for the pipeline segments proposed under Application No. 1483737. Such a plan would include the same baseline environmental information and construction and mitigation plans as those associated with a conservation and reclamation plan.

CONDITIONS

- For the 16 proposed CBM wells in the Ghost Pine field that are to be completed (perforated and/or fractured) shallower than 200 m and within a lateral distance of 200 m of a water well, Quicksilver is required to set surface casing 25 m below the depth of the deepest nearby water well. If the depth of any water well within the 200 m lateral distance of the CBM well is unknown, the surface casing must be set to a depth of 150 m. All water well locations and depths within 200 m of the 16 proposed wells must be reported to the nearest ERCB Field Centre.
- Quicksilver must ensure that no well that is shut in or suspended allows cross-flow of water above the base of groundwater protection at any time.



Legend

- | | | | | |
|----------------------------------|--------------------------------------|--------------------|-----------|--------------|
| ■ Proposed wells | — Quicksilver existing CBM pipelines | Landowners | | |
| — Proposed pipelines | ■ R. Dodd feedlot | ■ A. Von Zitzewitz | ■ L. Dodd | ■ M. Porsche |
| ⊗ Quicksilver existing CBM wells | ● R. Dodd water well | ■ R. Dodd | ■ F. Hugo | ■ M. Wirtz |

Figure 1. Project area