

ALBERTA ENERGY AND UTILITIES BOARD

**PROCEEDING NO. 1347905
BITUMEN CONSERVATION REQUIREMENTS
ATHABASCA WABISKAW-MCMURRAY
PHASE 3 FINAL PROCEEDING**

SUBMISSION OF CANADIAN NATURAL RESOURCES LIMITED

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Interested Parties

**WELLS IN THE KIRBY UPPER MANNVILLE J & B4B POOLS FOR WHICH
SUBMISSIONS ARE BEING MADE BY CNRL:**

KIRBY UPPER MANNVILLE J	00/10-05-073-07W4/0	Wbsk B Valley Fill	450.6	451.2
KIRBY UPPER MANNVILLE J	00/11-07-073-07W4/0	Wbsk B Valley Fill	449	450
KIRBY UPPER MANNVILLE J	00/07-19-073-07W4/0	Wbsk B Valley Fill	485	486
KIRBY UPPER MANNVILLE J	00/10-03-073-08W4/0	Wbsk B Valley Fill	475.5	476.5
KIRBY UPPER MANNVILLE J	00/10-08-073-08W4/0	Wbsk B Valley Fill	475	476
KIRBY UPPER MANNVILLE J	00/06-09-073-08W4/0	Wbsk B Valley Fill	472	472.5
KIRBY UPPER MANNVILLE J	00/06-10-073-08W4/0	Wbsk B Valley Fill	474.5	475.5
KIRBY UPPER MANNVILLE J	00/10-13-073-08W4/0	Wbsk B Valley Fill	462	463.5
KIRBY UPPER MANNVILLE J	00/11-14-073-08W4/0	Wbsk B Valley Fill	471.6	475.2
KIRBY UPPER MANNVILLE J	00/10-15-073-08W4/0	Wbsk B Valley Fill	479.8	482.2
KIRBY UPPER MANNVILLE J	00/09-17-073-08W4/0	Wbsk B Valley Fill	464	465
KIRBY UPPER MANNVILLE J	00/10-17-073-08W4/0	Wbsk B Valley Fill	462.3	463.2
KIRBY UPPER MANNVILLE J	00/15-18-073-08W4/0	Wbsk B Valley Fill	454	456.3
KIRBY UPPER MANNVILLE J	00/09-19-073-08W4/0	Wbsk B Valley Fill	451.5	453
KIRBY UPPER MANNVILLE J	00/16-20-073-08W4/0	Wbsk B Valley Fill	459	463
KIRBY UPPER MANNVILLE J	00/16-21-073-08W4/0	Wbsk B Valley Fill	485.3	486.7
KIRBY UPPER MANNVILLE J	00/16-22-073-08W4/0	Wbsk B Valley Fill	483.2	484.2
KIRBY UPPER MANNVILLE J	00/16-23-073-08W4/0	Wbsk B Valley Fill	461.2	462.8
KIRBY UPPER MANNVILLE J	00/10-24-073-08W4/0	Wbsk B Valley Fill	456.4	460.5
KIRBY UPPER MANNVILLE J	00/01-25-073-08W4/0	Wbsk B Valley Fill	461.5	463.5
KIRBY UPPER MANNVILLE J	00/11-25-073-08W4/0	Wbsk B Valley Fill	459	460.2
KIRBY UPPER MANNVILLE B4B	00/06-34-073-08W4/0	Wbsk B Valley Fill	467.5	469.5
KIRBY UPPER MANNVILLE B4B	00/09-34-073-08W4/0	Wbsk B Valley Fill	463	467
KIRBY UPPER MANNVILLE B4B	00/10-34-073-08W4/0	Wbsk B Valley Fill	460.7	464.4
KIRBY UPPER MANNVILLE B4B	00/11-34-073-08W4/0	Wbsk B Valley Fill	574	933
KIRBY UPPER MANNVILLE B4B	00/04-03-074-08W4/0	Wbsk B Valley Fill	461	463.2
KIRBY UPPER MANNVILLE B4B	02/07-03-074-08W4/0	Wbsk B Valley Fill	448.2	450
KIRBY UPPER MANNVILLE B4B	00/11-03-074-08W4/0	Wbsk B Valley Fill	452.1	454.4

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PREAMBLE

This evidence has been prepared by or under the supervision of James Waterfield, Geologist and Terry Jocksch, VP Exploitation, whose qualifications are set out in their respective Curriculum Vitae attached hereto. The purpose of this evidence is to have the production status of the Upper Mannville B4B and J Pools changed to allow for production of gas.

INTRODUCTION

The Kirby Upper Mannville J and B4B pools were recommended for shut in by the Staff Submission Group (SSG) in January of 2004. This recommendation was based on their evaluation of the pool in light of the Regional Geologic Study released on December 31, 2003. CNRL seeks to have the interim shut in of the Kirby Upper Mannville J and B4B pools lifted. CNRL makes this submission on the basis that the shut in is unwarranted because the mapping cutoffs used to evaluate the bitumen resource were inappropriate, and because there are errors in the pool mapping.

In the SSG's submission of January 26, 2004, all of the producers in the Kirby Upper Mannville J and B4B pools were listed for shut in under Cases 3 and 4, as presented in the RGS. Case 4 is defined as "Gas pools within the Wabiskaw D Valley-fill with bitumen in the same unit (RGS Table 1, Pg 138). Case 3 is defined as "Gas pools within the Wabiskaw B or D Valley-fill that are in lateral communication with gas pools in the McMurray Channel or are vertically associated with bitumen in underlying McMurray Channels (RGS Table 1, Pg 138).

When ID-99-1 was issued, the stipulated cutoffs reflected the Boards judgment, based on the available data, on what quality of resource should be protected. At that time the data focused on SAGD performance in the McMurray. In addressing the Case 4 conclusion, CNRL will present data that will show the Wabiskaw B Valley fill, in which these pools are found, is fundamentally different from the McMurray. We will further show these differences result in a bitumen resource that is significantly inferior to the McMurray. As in the case of the Tar – Ells area, where the thickness criterion for the Wabiskaw was increased to 15m, CNRL will make the case that the Board should also apply this cutoff to the Wabiskaw B Valley fill as a minimum, on the basis of reduced potential for commercial bitumen development.

CNRL will also demonstrate that the methodologies employed in the RGS to calculate the bitumen resource in the Wabiskaw B Valley fill are inaccurate and skewed. Specifically, the use of a single log to core transform for both the Wabiskaw and the McMurray, combined with the use of 6 wt % bitumen as a proxy for 50% saturation, which results in the significant overstatement of the resource.

Having demonstrated the inaccuracy of saturation calculation, and shown the bias introduced by the use of the 6 wt % cutoff, CNRL will show that if appropriate cutoffs are applied, and the bitumen resource more accurately assessed, Case 4 does not apply to the Kirby Upper Mannville J and B4B pools. In other words, the bitumen resource within the Wabiskaw B Valley fill does not warrant protection.

The case 3 shut in recommendations were based on one well in each pool which were mapped by the RGS as having no isolation from McMurray Bitumen. CNRL will show that in the Upper Mannville B4B, the regional isolating shale is present in the single problem well, and that the RGS failed to recognize this. In the Upper Mannville J Pool, based on fluid contact differences, CNRL will show that the problem well is not part of

the pool. Since both pools will have been shown to be isolated from McMurray bitumen by regional shales, Case 3 also does not apply.

Having demonstrated that neither Case 3 nor Case 4 is applicable, CNRL will have shown that the Kirby Upper Mannville J and B4B pools are not associated with potentially recoverable bitumen and should be allowed to produce.

WABISKAW B VALLEY FILL CUTOFFS

CNRL, as both a significant producer of bitumen, and a major gas operator in the Athabasca Oil Sands is clearly in both camps on GOB issues. We are in agreement with the conclusion reached following the EUB's Inquiry into Gas/Bitumen Production in Oil Sands Areas (Mar 1998) that "some regulatory involvement is warranted" (Pg. vi). During the course of that original inquiry, both gas and bitumen producers made their cases using SAGD performance models for the McMurray alone. The models were based on the extrapolation of experience at the Underground Test Facility (EUB Inquiry, Gas/Bitumen Production in Oil Sands Areas, March 1998, Pg.V). As the Board must often do, it used its judgment on this very limited data to formulate the criteria outlined in ID-99-1. In decision 2004-045 the Board again, when presented with sufficient data, judged that the criteria of ID-99-1 should be altered in the Tar - Ells area. CNRL believes that the data presented in the following paragraphs is sufficiently compelling that the Board should again alter the ID-99-1 criteria for the Wabiskaw B Valley fill.

Historically, the bitumen evaluation cutoffs applied to the Wabiskaw have been identical to those of the McMurray. As the 1998 inquiry focused on SAGD performance in the McMurray, no evaluation of SAGD performance in the Wabiskaw had been made prior to ID-99-1. The performance of SAGD in the Wabiskaw has not been addressed in any of the subsequent hearings leaving open the question of whether the cutoffs applied to the McMurray, whatever they may be, should also be applied to the Wabiskaw? A comparison of the characteristics of the McMurray and the Wabiskaw B Valley fill clearly demonstrates that they should not.

The McMurray is a complex heterogeneous formation composed of fluvial and estuarine channels, overbank, sand or mud flat deposits, and thin marginal marine cycles. Correlations over even short distances are difficult. In contrast, the Wabiskaw B Valley fill is lithologically extremely homogeneous despite spanning 10 townships. It consists of an upward cleaning muddy sand which varies only in thickness across the region (Fig 1). This contrast is clearly illustrated in published core studies. In the AOSTRA Technical Publication # 10, three cores were examined in detail in the Kirby area (11-22-73-6W4, 10-23-72-7W4 & 12-14-75-8W4). This study identified between 6 and 8 different depositional facies in the McMurray. Despite the extent and thickness of the unit, the Wabiskaw B Valley fill was described as a single facies, with the generic description of estuarine valley fill (AOSTRA # 10, Pg. 71). This uniformity extends down even to the level of the cement streaks, which in much of the deposit, is arguably a correlatable unit.

The heterogeneity of the McMurray is reflected in the bitumen resources distribution. The best resource is confined to the fluvial and estuarine channel deposits. These are most attractive because of their superior resource quality and thickness. In contrast, the resource quality varies little in the Wabiskaw, with the most attractive resource simply being that which is thickest.

Petrologically the two formations differ as well. The McMurray sands have highly variable grain size while the Wabiskaw B Valley fill sands are uniformly fine to very fine. The sand mineralogy of the McMurray is characterized as a subarkose and sublitharenites composed of 86% quartz, 8% feldspar and 6% rock fragments. The Wabiskaw B Valley fill in contrast, are lithic, consisting of only 68% quartz, 8% feldspar, and 24% rock fragments (AOSTRA #10, pg 125). Clay mineralogy analysis from the same report shows the McMurray to be dominated by Kaolinite, while the Wabiskaw B Valley fill is dominated by swelling clays and Illite (ibid).

Further contrasts are apparent when core analysis data from the Wabiskaw B Valley fill and underlying McMurray are compared. Figure 2 is a map showing wells where digital core analysis is available between the top and base of the Wabiskaw B Valley fill as picked in the RGS. Figure 3 shows the availability of digital core analysis in the same region for the McMurray.

Although measured porosity values of sands in the McMurray and Wabiskaw B Valley fill are similar (Figure 4), there is a tremendous contrast in permeability between the two. Figure 5 is a plot of Core K-Max from 231.35m of analyzed McMurray core, and 219.79m of Wabiskaw B Valley fill. It is clear from this chart, the McMurray is far more permeable than the Wabiskaw. Ignoring the very high values at the far right in both data sets (probably bad data), it can be seen that the median permeability of the McMurray is about 5 darcies, whereas the Wabiskaw B Valley fill averages around 1 darcy. The graph also shows the heterogeneity of the data, with the broader distribution of the McMurray data indicating more variability in permeability than in the Wabiskaw B Valley fill. As these cores represent a random sampling of all analyzed McMurray sands, it would be very likely that the permeability of a commercially attractive McMurray channel sand would be found on the right of the plot (6 darcies +). The uniformity of the Wabiskaw means that the permeability encountered in any development is likely to be less than 2 darcies.

A comparison of analyzed bitumen saturations from sands with measured saturations greater than zero (shale, water sands & lost core removed) also shows a stark contrast. Figure 6 shows the thickness weighted average saturation of 1735.55m of Wabiskaw B Valley fill core, and 2285.05m of McMurray core. This plot clearly demonstrates that the McMurray has a much higher average saturation than the Wabiskaw B Valley fill. Again, since the data includes a variety of McMurray sands. A commercially attractive McMurray Channel sand would be expected to have a higher average (70 to 80%, Figure 6). The Wabiskaw, being more uniform, is likely to average 50-60% saturation almost everywhere

In the previous paragraphs, CNRL has shown that the characteristics of the Wabiskaw B Valley fill differ from those of the McMurray in many ways. From this, it would be unreasonable to conclude that SAGD would behave the same in both units. It is clear that these two formations should not have the same cutoffs applied to them. Furthermore, the contrast in characteristics shows that the Wabiskaw B Valley fill is not only different from, but also a far poorer bitumen reservoir than the McMurray.

How much poorer can be clearly demonstrated by using the parameters described above and comparing the theoretical performance of SAGD in the McMurray and Wabiskaw B Valley fill. In the example presented here, porosity, permeability and saturation data were extracted from the core analysis described above, and used in the classic empirical SAGD calculations developed by Dr. Roger Butler. For both formations, the 75th percentile value for porosity, permeability and saturation was used. A summary of these, and other parameters used in the calculations are summarized in Table 1. Figures 7, 8 and 9 show the calculated performance of a 700m long SAGD pair operated at 2000kpa in 10m of McMurray compared to a similar well in 10m of Wabiskaw.

Although these types of calculations are approximate, they are certainly sufficient to show the relative theoretical performance of SAGD in these two units. In this example, using real core data, the SAGD oil rate of the Wabiskaw is about half that of an equivalent McMurray reservoir. In a 10m reservoir, the same barrel of oil recovered by SAGD from the Wabiskaw requires about 50% more steam than the equivalent thickness of McMurray. Furthermore, these calculations do not take into account several features of the Wabiskaw which are detrimental to SAGD. For example, with steam injection, the reactive mineral in the Wabiskaw reservoir will further reduce its already low permeability. This makes the Wabiskaw reservoir extremely challenging for thermal processes. The Wabiskaw also has a high probability of containing extensive cemented streaks. These may inhibit vertical steam chamber growth, a challenge not common in the McMurray. Additionally, since SAGD utilizes gravity drainage, the coarsening upward nature of the Wabiskaw forces operators to place producing wells in the poorest quality reservoir. This is in contrast to the McMurray Channels where reservoir quality is generally highest at the base. In short, the Wabiskaw B Valley fill is fundamentally an inferior bitumen resource.

CNRL submits that the low quality of the Wabiskaw B Valley fill resource must be reflected in the bitumen cutoff criteria that are to be utilized in determining whether any bitumen present is worthy of protection. The criteria selected are to ensure that potentially recoverable bitumen is protected, while allowing the production of gas where there is no bitumen present or the bitumen is insufficient to make recovery a viable option. In the Wabiskaw, the use of the 10m cutoff will shut in gas production where no corresponding potentially recoverable bitumen resource exists. This rationale has been invoked in decision 2004-045 where the thickness cutoff in the Wabiskaw was increased to 15m at Tar - Ells.

“the potential for the development of commercial projects may be reduced in this type of reservoir” (Decision 2004-045, Pg 5).

While that decision is interim, CNRL submits that the reasoning is sound, and should be confirmed in this proceeding and applied to the Wabiskaw B Valley fill. It is clear from the data presented above that it is extremely unlikely that commercial development of bitumen in the Wabiskaw B Valley fill would ever be viable. CNRL believes that at a minimum, cutoffs applied to this unit should be raised at least to a similar value (15m).

In considering the alteration of cutoff criteria for the Wabiskaw B Valley fill, the Board needs to consider whether the change is warranted. The answer to this is clearly yes. As CNRL has shown, the original ID-99-1 cutoffs did not consider the difference between the McMurray and the Wabiskaw. As has been shown, the Wabiskaw B Valley fill is clearly an inferior bitumen resource. The cutoffs applied to this unit should reflect this.

PAY MAPPING ISSUES OF THE WABISKAW

If the Board accepts CNRLs contention that the bitumen thickness cutoff should be raised, like the Wabiskaw at Tar, to a minimum of 15m, it must then apply this cutoff to the net pay maps for the Wabiskaw at Kirby. CNRL believes that the mapped pay from the RGS is incorrect, due to flaws and bias in the methodologies employed. In the following sections CNRL will describe the issues with the methods employed. It will further present data from the Kirby Upper Mannville J gas pool showing these flaws introduce errors that are both significant, and skewed toward overstatement of bitumen pay.

The first issue with methodology is related to the log derived net pay. The method for calculating net pay is outlined on Pg. 97 of the RGS. It describes a process where a computer algorithm is used to calculate saturations between the top of the Wabiskaw and the base of the McMurray. The resulting analysis is compared to core where available, and adjustments of input parameters are made to match the core.

CNRLs concern with this approach is the entire Wabiskaw / McMurray interval is evaluated together, with a single set of input parameters used for both formations. As demonstrated in the previous section, the Wabiskaw differs significantly from the McMurray in permeability, saturation, mineralogy, and depositional morphology. Further, the use of a common input parameter such as R_w for both formations is a concern. Salinities in the area vary substantially. In Rio Alto Exploration's application for its Kirby SAGD project reported DST salinities (TDS) for the Wabiskaw and McMurray in the area range from 4000 to nearly 18000 (Rio Alto Exploration Ltd Kirby Project Application April 2002, Vol 4-86). Salinities are also known to vary vertically, such that R_w can change within the McMurray interval of a single well. Given this variability, salinities are very likely to differ between formations. By treating the two formations as a single entity in the log analysis, these differences cannot be recognized. Instead a blended parameter set and results are produced. Since the Wabiskaw interval is thinner than the McMurray, the blended parameters and results will be biased toward the McMurray. This mixing of the higher quality McMurray resource with the poorer quality Wabiskaw is also likely to produce a skew in the error in which the Wabiskaw saturation is overstated.

A further issue is the use of a 6 weight % cutoff as a proxy for the 50% saturation cutoff stipulated in ID-99-1. Although this approach was done "because of the ease of calibrating core analysis to log results" (RGS pg 97), it does introduce a bias. The Board, in decision 2004-045 stated:

"The Board recognizes that 6 weight per cent bitumen is equal to 50 per cent pore volume saturation at 27 percent porosity and that, as the porosity increases, 6 weight per cent represents bitumen saturations less than 50 per cent."

It went on to state:

“this calculation has the potential to overstate the volume of potentially recoverable bitumen in both the Wabiskaw and the McMurray.”

The Board went on to discount this issue based on a re mapping of three test areas where limited change to the 10m cutoff was identified. It should be noted that none of the three test areas (Tar Wabiskaw P gas pool, Leismer McMurray ZZ gas pool and Hardy Wabiskaw McMurray A gas pool) include the Wabiskaw B Valley fill. As such this issue has not been fully addressed.

CNRL submits that this issue is very significant in the Kirby Wabiskaw B Valley fill due to the nature of the unit. Firstly, the examination of the core analysis outlined in the previous section (Figure 4) shows almost 95% of the analyzed Wabiskaw B Valley fill has a porosity greater than 27%. With a median value of about 34%, the log analysis will certainly include bitumen saturations less than 50%. This is also true for the McMurray which has a similar porosity distribution. This bias will however more strongly impact bitumen estimates in the Wabiskaw because of the distribution of saturation it exhibits. The core analysis described in the previous sections showed the measured Wabiskaw saturations are concentrated nearer the 50% cutoff than the McMurray. This means, in the critical 40-50% saturation range, there will be significantly more of the Wabiskaw than the McMurray incorrectly counted as pay. Figure 6, shows almost 20% of the analyzed Wabiskaw B Valley fill falls in this range, whereas less than 10% of the analyzed McMurray analysis falls in this category. As a result, net pay overestimation will more strongly influence the Wabiskaw pay calculations.

In summary, by analyzing the Wabiskaw - McMurray interval as a single entity the RGS will generate results that are both inaccurate and skewed to overestimation. This issue is further compounded by the use of a 6 wt% cutoff instead of the prescribed 50% saturation. Finally, the nature of the saturation distribution in the Wabiskaw means the inherent bias in the methodology will have a significantly greater impact on the Wabiskaw than on the McMurray.

As part of CNRL's examination of the Kirby Upper Mannville J Gas Pool, a comparison was made between net bitumen pay values from core and the log derived pay in the RGS. This comparison strongly suggests errors described above result in Wabiskaw B Valley fill bitumen pays that are both seriously inaccurate and optimistic.

In the Kirby Upper Mannville J Gas Pool, 9 of the 21 wells have core from the Wabiskaw B Valley fill. Of these, 5 have recovered a sufficient interval where direct comparisons of core and log derived pay estimates can be made. To derive a net pay value from core, the top and base depth of the gross bitumen interval in the Wabiskaw B Valley fill were taken from the bitumen evaluation spreadsheet of the RGS. Core analysis data from this interval was then evaluated to determine the maximum net pay from core. This was done by subtracting the cumulative non-pay thickness from the gross interval. The resultant

value is called the maximum net pay because this method assumes any lost core is pay. Non-pay consists of the cumulative thickness of all tight intervals not analyzed (cemented sands, shales & silts), plus the cumulative thickness of all measured saturations below the 50% bitumen saturation cutoff.

When this exercise was carried out on the 5 complete cores in the Upper Mannville J pool (table 2 & Appendix A), all log derived pay was found to be overestimated. The overstatement of pay ranges from 0.92m to 5.26m, or 8 to 281%. The fact the net pays are consistently overestimated, and the error so large, demonstrates that the concerns outlined in the previous paragraphs are valid. Also since the issues raised are common to the entire Wabiskaw B Valley fill, these errors will be widespread. This data proves that the algorithm used in the RGS is insufficient to accurately and properly assess the net pay in the Wabiskaw B Valley fill.

A further issue concerns the apparent double counting of some intervals as both gas and bitumen pay. In Report 2003-A, gas pay intervals for every well and every zone are presented in the Gas Evaluation and Delineation Data spreadsheet. In the Bitumen Evaluation Data, bitumen intervals with net and gross pay values are also presented. A comparison of the gas intervals and the Bitumen intervals show that 9 of the 21 wells listed in the pool have overlapping intervals (Table 2). This overlap means that in 9 wells, some portion of the zone is considered to be both gas pay, and oil pay. The overlap ranges from a minimum of 5cm, to a maximum of 1.35m. Although small, the fact that almost half the wells in this pool have this error suggests that the error could be widespread.

All these issues are significant to the evaluation of the Kirby Upper Mannville J Gas Pool. The RGS identifies 3 wells in the pool which would exceed the proposed CNRL cutoff of 15m. The largest of these are 16-23-73-8W4 & 1-25-73-8W4, both of which have no core, but have been ascribed a log net pay of 15.9m. The pay was calculated in the RGS using the same flawed techniques described above. If the minimum error recorded on the cored wells (8% overstatement) is applied to this well, the actual net pay would be 14.6m, which is less than the proposed cutoff. As the errors can be much larger, the true net pay is likely to be even lower. Further, both wells have small intervals counted as both gas and bitumen. The third well, which the RGS calculated a log net pay of 15.6m would also drop below the 15m proposed cutoff if the minimum 8% correction is applied. This well also has an interval of 1.35m which is counted as both gas and bitumen. From this information the only conclusion which can be made is that all three, and hence the entire pool, have net pays in the Wabiskaw B Valley fill less than the 15m cutoff. As such, Case 4 of the RGS would not apply. Even with the overstated pays, none of the wells in the Kirby Upper Mannville B4B pool (Figure 8) exceed the 15m cutoff, so again Case 4 also does not apply.

In summary, the RGS has used inaccurate and biased techniques to evaluate bitumen pay in the Wabiskaw B Valley fill. It then applied cutoffs that are clearly inappropriate for the Wabiskaw B Valley fill to determine that the Kirby Upper Mannville J and B4B pools should be shut in under Case 4. CNRL has presented data that demonstrates that the

Wabiskaw B Valley fill is an inferior bitumen resource, and the cutoffs used should reflect this as has been done at Tar. CNRL has also demonstrated that the methodologies to determine net pay in the RGS are inaccurate and biased. CNRL has further demonstrated that the true pay in the Kirby Upper Mannville J and B4B pools would be below the proposed 15m cutoff. As such both pools do not fall under Case 4 of the RGS.

CASE 3 CONSIDERATIONS

The Kirby Upper Mannville J and B4B pools were also condemned under Case 3 of the RGS. In simple terms, each of these pools have been determined to lack a regional seal which would isolate the gas bearing interval from potentially recoverable bitumen in underlying units. In both cases, confirmation of the lack of a seal is based on a single well. In the following sections, CNRL will show that in the case of the Kirby Upper Mannville J pool, fluid contact data shows the problem well does not belong to the pool. In the case of the Kirby Upper Mannville B4B pool, the regional sealing shale is present, and has simply been missed in the RGS.

Figure 10, is a map extract from the RGS which shows the extent of the McMurray A2 and B2 Mudstones in TWP 73-7 & 8W4, overlain by an outline of the Kirby Upper Mannville J & B4B Pools. The single well identified in which the regional sealing shale of the McMurray A1 and A2 does not underlie the Upper Mannville J pool was the 11-25-073-08W4. This well was drilled and tested and abandoned in 1982, prior to any production from the pool. Based on this fact, the well cannot be conclusively placed in the Kirby Upper Mannville J pool on the basis of pressure data.

Figure 11 is a 3 well structural cross section between 11-25-73-8W4 and its 2 nearest offsets in the Kirby Upper Mannville J pool (1-25-73-8W4, and 16-23-73-8W4). An examination of the log from the 11-25-073-08W4 well shows neutron density crossover at the top of the Wabiskaw B Valley fill. The RGS gas evaluation and delineation data places this interval at 459.0 – 460.2mkb. This coincides with a relatively high resistivity (20 ohms), and has been documented in the RGS as gas. The RGS describes the basal contact of this gas as a gas/oil contact located at 239.8m asl. On the resistivity log there is however an interval of low resistivity between 460.2 and 462.1m kb. This interval corresponds to a clean gamma ray, low SP, and good porosity. This response is typical of a top water zone. This top water, with a gas water contact at 460.2mkb (239.8m asl), is not recognized in the RGS mapping.

It is readily apparent the adjacent 1-25-73-8W4 does not have top water zone like that of 11-25. The RGS gas evaluation and delineation data places the base of gas in 1-25 at 463.5mkb (238.6m asl). Thus the base of gas in 1-25 is 1.3m lower than the gas / water contact in 11-25. On page 75, the RGS states "gas was pooled between wells if the following conditions were met:

- Gas was present in the same stratigraphic interval.
- Gas/water interfaces were within ± 1 m.
- Wells were in adjacent sections.

In this instance, the presence of the previously missed top water results in a fluid contact discrepancy which exceeds the criteria. The case is the same when 16-23-73-8W4 is compared to 11-25-73-8W4, except the contact difference increases to 3.1m. From this data it is clear that the 11-25-73-8W4 well cannot be part of the Upper Mannville J Pool. Since all of the remaining wells in the pool are underlain by regionally sealing McMurray A and B shales, the removal of 11-25-73-8W4 from the pool means that Case 3 does not apply.

If Figure 10 is examined again, the Kirby Upper Mannville B4B pool is shown as also having a single well (100/9-34-073-08W4) in which the Wabiskaw B Valley fill is not underlain by the regionally sealing McMurray A & B mudstones. CNRL contends that the RGS mapping is in error, and that the pool is entirely underlain by the regional shales. Figure 12 is a stratigraphic cross section through all the logged wells in the pool with picks from the RGS. On this section the interval in dispute is located immediately below the Wabiskaw B Valley fill (highlighted with a sand pattern fill). This interval consists of the regional McMurray A which is cut into and overlain by the Wabiskaw D Valley fill. The erosional contact between the two is highlighted in blue. The Wabiskaw D Valley fill is in turn overlain by the Wabiskaw C Sand (highlighted in green). At the base of the regional McMurray A is the regional sealing shale mapped by the RGS. On this section, the RGS shows that although the upper portion of the regional McMurray A is eroded, the basal shale is preserved in all wells except 9-34-073-08W4. In this well the RGS takes the erosional unconformity down and places the Wabiskaw D Valley fill directly on the McMurray Channel. If one examines the log for 9-34-073-08w4 there is a shale (indicated by Gamma Ray, Neutron – Density, Sp and Resistivity) at 490.4 - 491.4mkb. The RGS picks will place this shale within the Wabiskaw D Valley fill. CNRL contends this correlation is in error, and this shale is the regional sealing shale at the base of the McMurray A.

Figure 13 is CNRL's alternative correlation. The location, coloring scheme of units and picks is identical to the previous section with two exceptions. Firstly, a number of additional stratigraphic correlations are added in pink. Secondly, the erosional pick for the base of the Wabiskaw D Valley fill is shifted up to where CNRL contends is its correct location.

In the CNRL model the shale (490.4 - 491.4mkb) is considered to be the regional shale at the base of the McMurray A. The erosional contact that marks the base of the Wabiskaw D Valley fill is placed immediately above the shale, but has not cut through it. This model is based on two features. Firstly, the shale in question is located stratigraphically exactly where the regional McMurray A shale would be expected to occur. In contrast the RGS model would require the Wabiskaw D Valley fill unit to have first eroded, then

deposited a shale that is identical in thickness, petrophysical signature, and stratigraphic elevation to the original. Clearly, this sort of serendipity is unlikely.

Secondly, the section also shows strata, bounded by the pink markers, which lie immediately under the McMurray A regional shale. This strata consists of two upward coarsening shale sand cycles 2-3m thick. They not only occur in all of the wells where the RGS recognizes the regional McMurray A Shale, but also in 9-34-73-8W4, where the shale is supposed to have been eroded. In order for the RGS picks to be correct, the Wabiskaw D Valley fill not only has to erode and duplicate the McMurray A shale, it must stop at its base, and not erode this underlying unit. Alternatively the unit must be eroded and strata deposited that are exact duplicates. Geologically it is highly unlikely that either event could occur.

CNRL contends that the RGS model requires the unlikely erosion and redeposition of units in 9-34-73-8W4 which exactly mimic the un-eroded strata in adjacent wells. The model proposed by CNRL requires no such serendipity, and clearly is a far more reasonable interpretation. This model also proves that the regional shale at the base of the McMurray A2 sequence underlies the entirety of the Upper Mannville B4B Pool. As such, the finding of association is incorrect, and the pool should be allowed to produce.

Further confidence can be placed on the isolation of the Wabiskaw B Valley fill from the underlying McMurray by examining the Wabiskaw C sand. The RGS shows this unit (highlighted in green) as underlying the entire Upper Mannville B4B pool. Although called a sand, the RGS describes it as a glauconitic and lithic sandstone sometimes alternating with silts and mudstones. The log character of the unit below the B4B pool strongly suggests that in this area, the Wabiskaw C is largely mud. The large neutron density separation, the high SP values, and the low resistivity all indicate a very shaley deposit. These petrophysical characteristics are in fact so poor as to be indistinguishable from those of the regional McMurray shales. The only indication that this unit contains any sand at all is the relatively high Gamma Ray signature relative to a true shale. Although this unit cannot be conclusively shown to be a pressure seal, it is sufficiently thick, widespread, and of such poor quality that it would effectively make the operation of a SAGD chamber across this barrier a practical impossibility.

CNRL has shown that based on fluid contact data, the only well which the RGS does not find isolation from underlying bitumen, cannot be part of the Kirby Upper Mannville J pool. With this well removed, the pool is isolated across its entire area of influence. In the Kirby Upper Mannville B4B pool, CNRL has demonstrated that the RGS mapping of the regional McMurray sealing shale is unlikely & unreasonable. The simpler and more reasonable conclusion is that the shale is present across the entire area of influence. In both cases the presence of the sealing shale shows the finding of association under case 3 to be incorrect.

CONCLUSION

In the previous sections, CNRL, using public data sources, has shown that the RGS was incorrect in recommending the shut in of the Kirby Upper Mannville J and B4B gas pools. We have shown that the use of the McMurray cutoff in Wabiskaw B Valley fill is inappropriate. The geologic data shows the bitumen resource in this unit to be inferior to that of the McMurray. The bitumen cutoffs used should reflect this, as in the Tar – Ells area. It has been further shown that the analysis techniques used to evaluate the Wabiskaw B Valley fill are seriously inaccurate, and biased. Finally, CNRL has demonstrated that there are small, but significant errors in the mapping of these pools.

It has also been demonstrated that if the bias in the bitumen evaluation is removed, and more appropriate cutoffs, such as those of Tar – Ells, are applied, the gas from these pools is not in association with potentially recoverable bitumen under Case 4. Both pools were also condemned under Case 3 because of a single well lacking a regional seal. We have demonstrated that in the case of the Upper Mannville J Pool, the problem well is not part of the pool. In the B4B pool, the shale was simply incorrectly mapped, and is present in all wells. Again, this means that these pools are not in association with potentially recoverable bitumen under Case 3. As neither Case 3 nor Case 4 applies, CNRL seeks to have the Board reverse the shut in order, and allow these pools to produce.

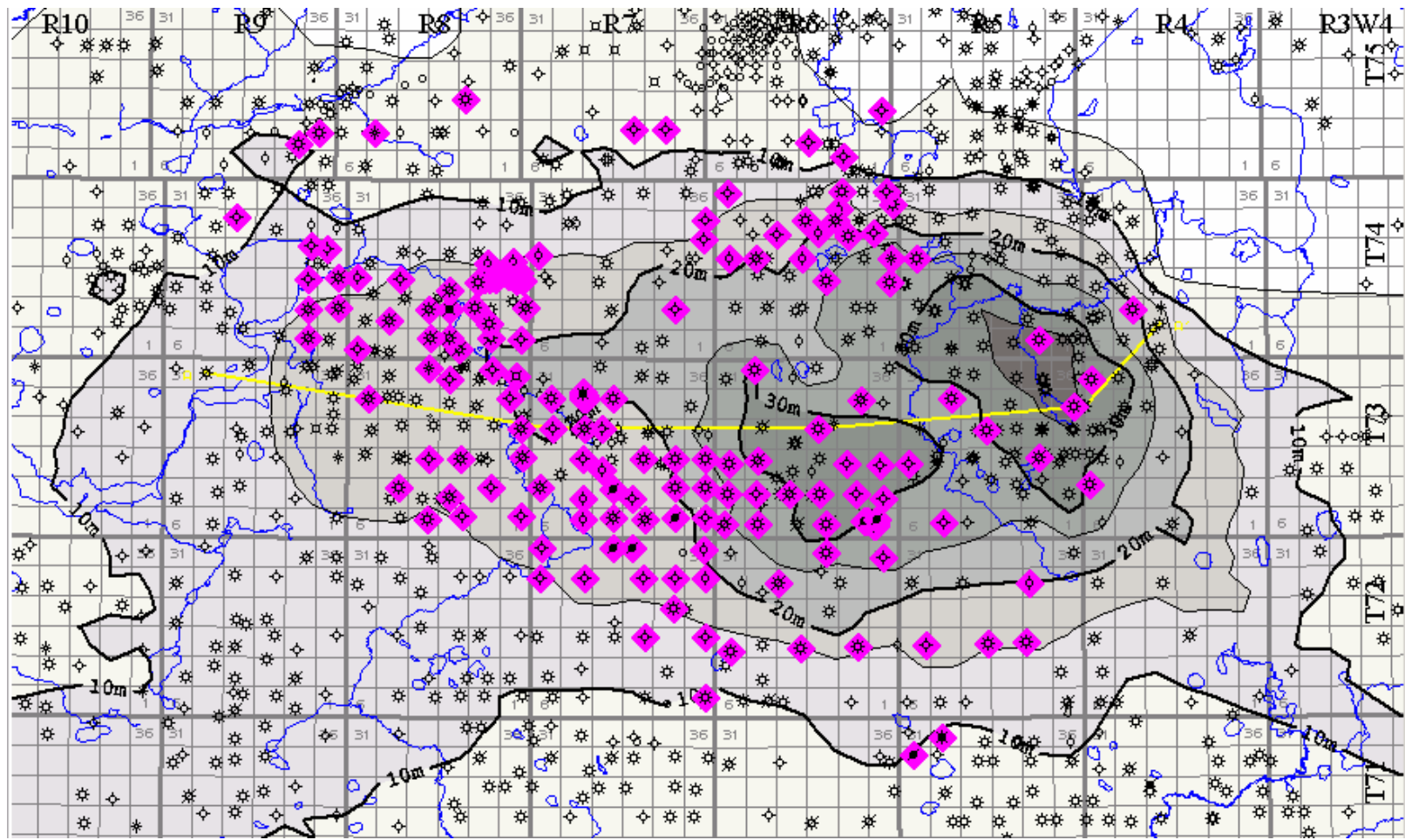


Figure 2
 Wabiskaw B Valley Fill
 Digital Core Analysis
 Kirby Region

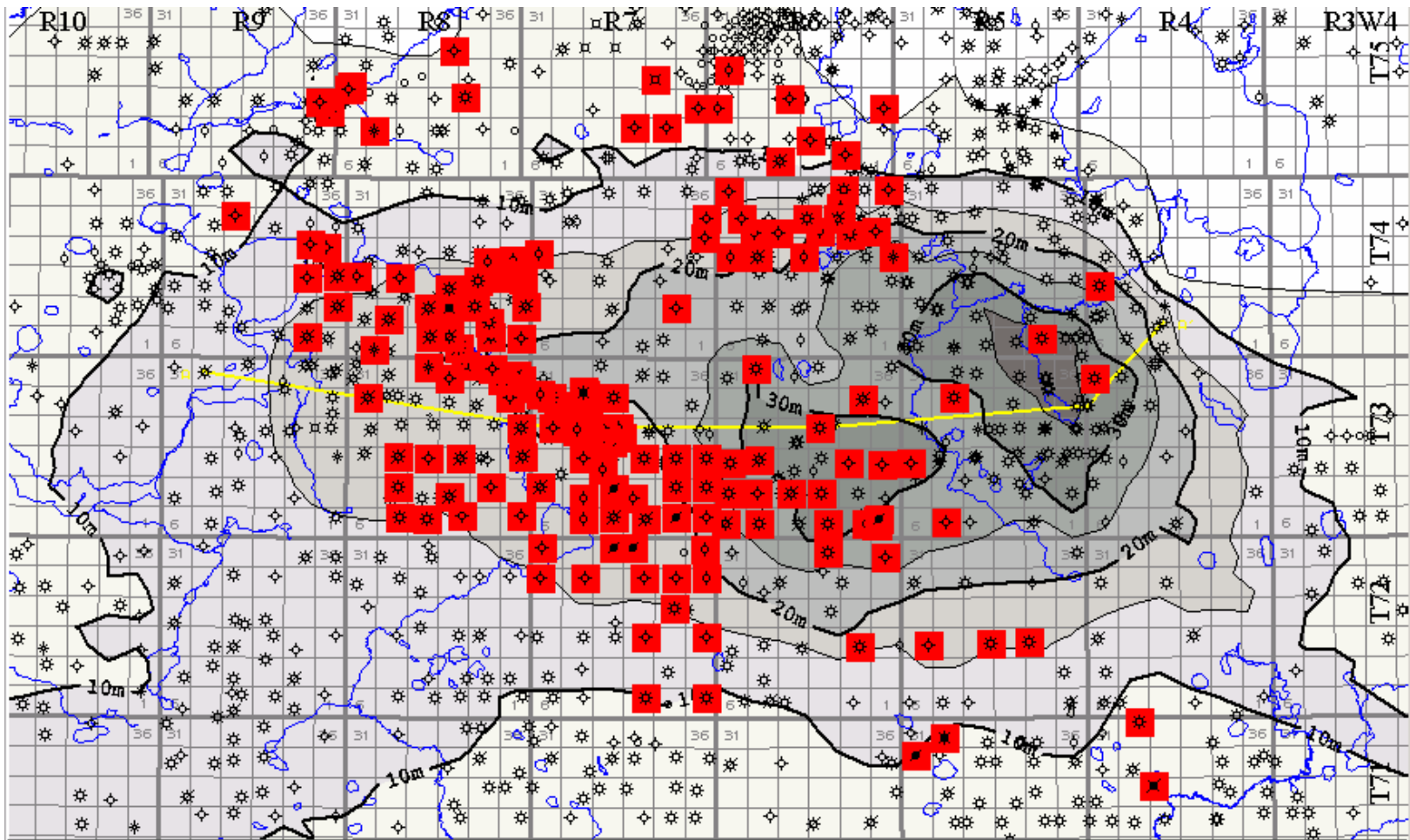


Figure 3
McMurray Digital Core Analysis
Kirby Region

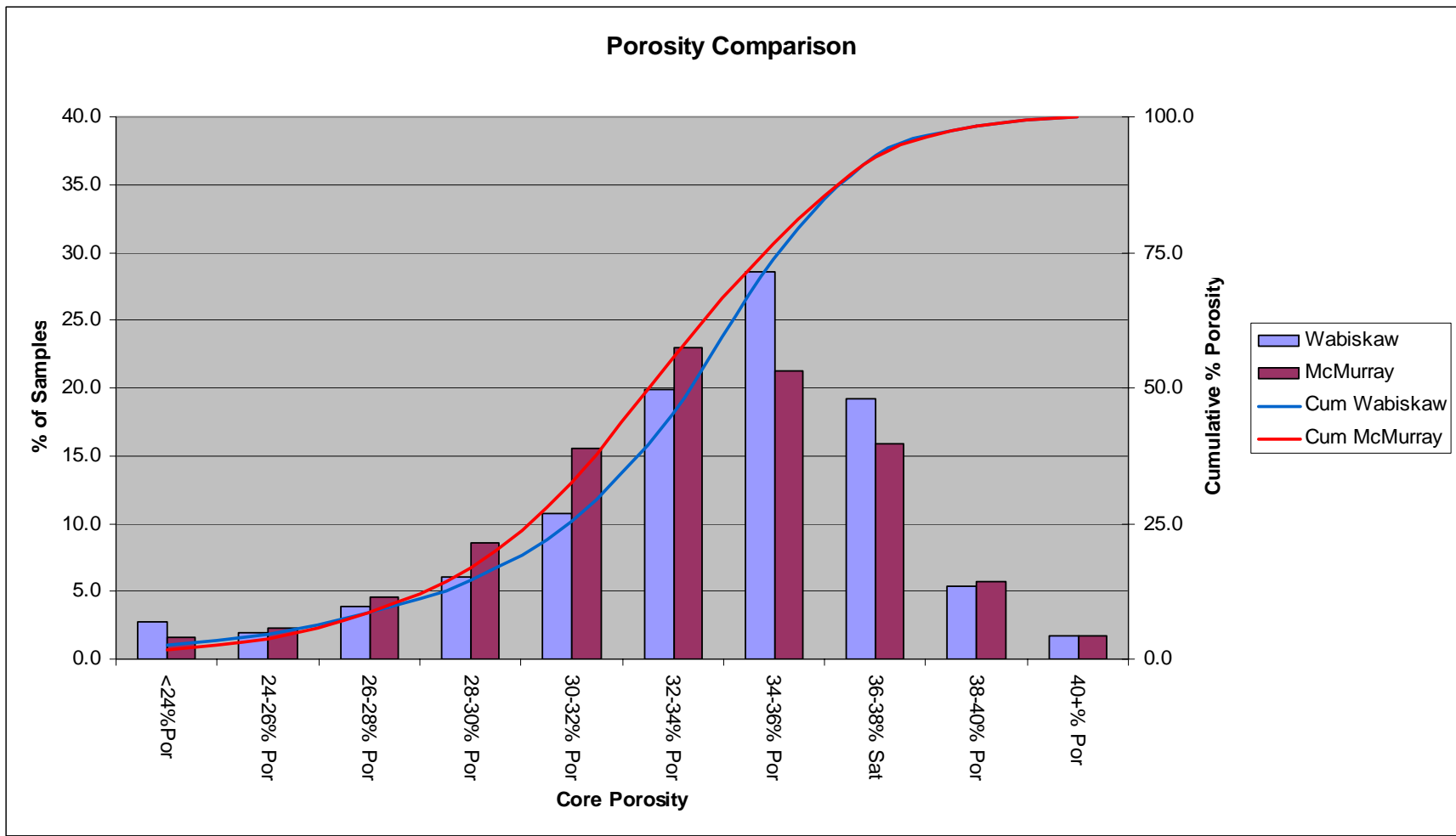


Figure 4

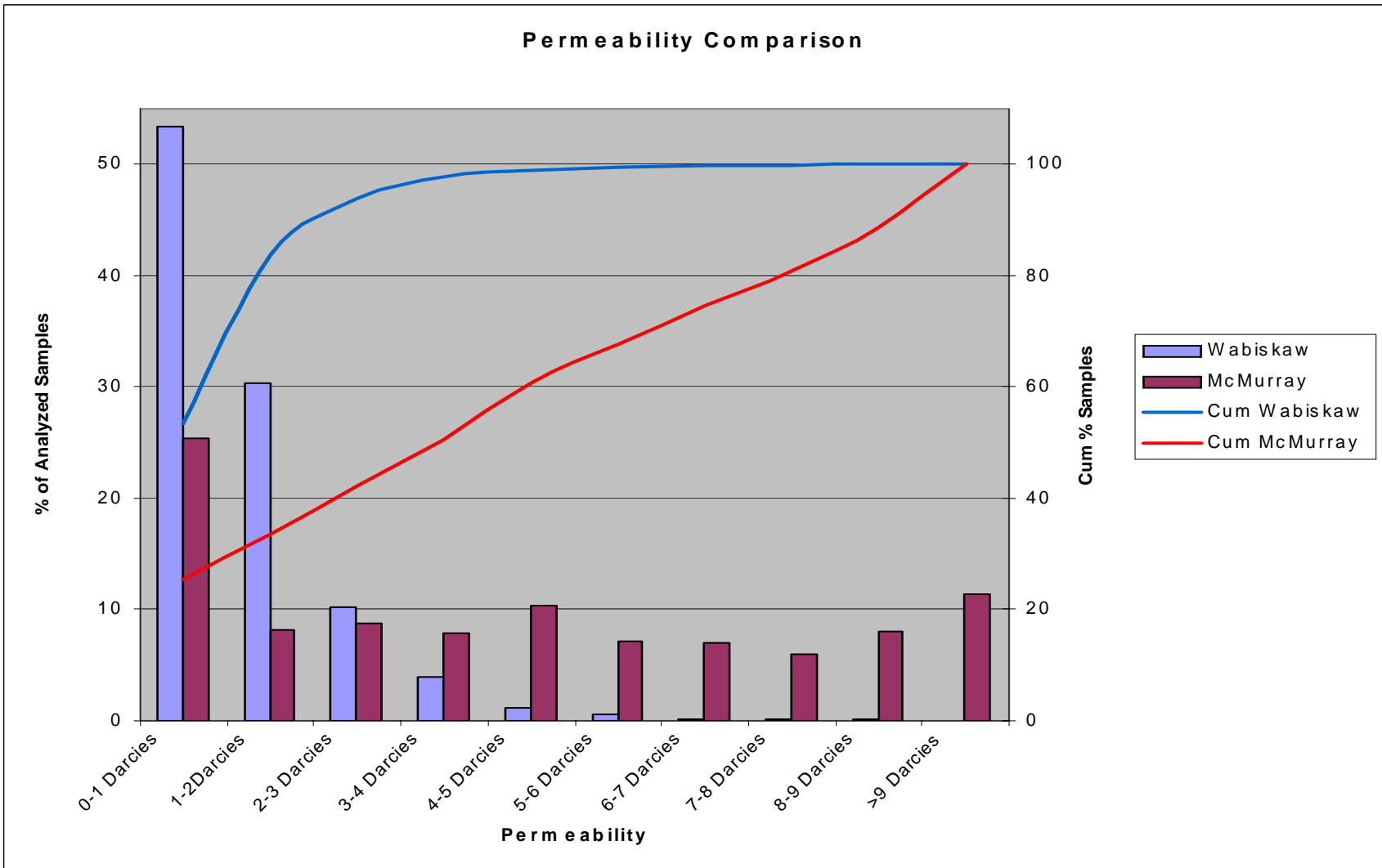


Figure 5

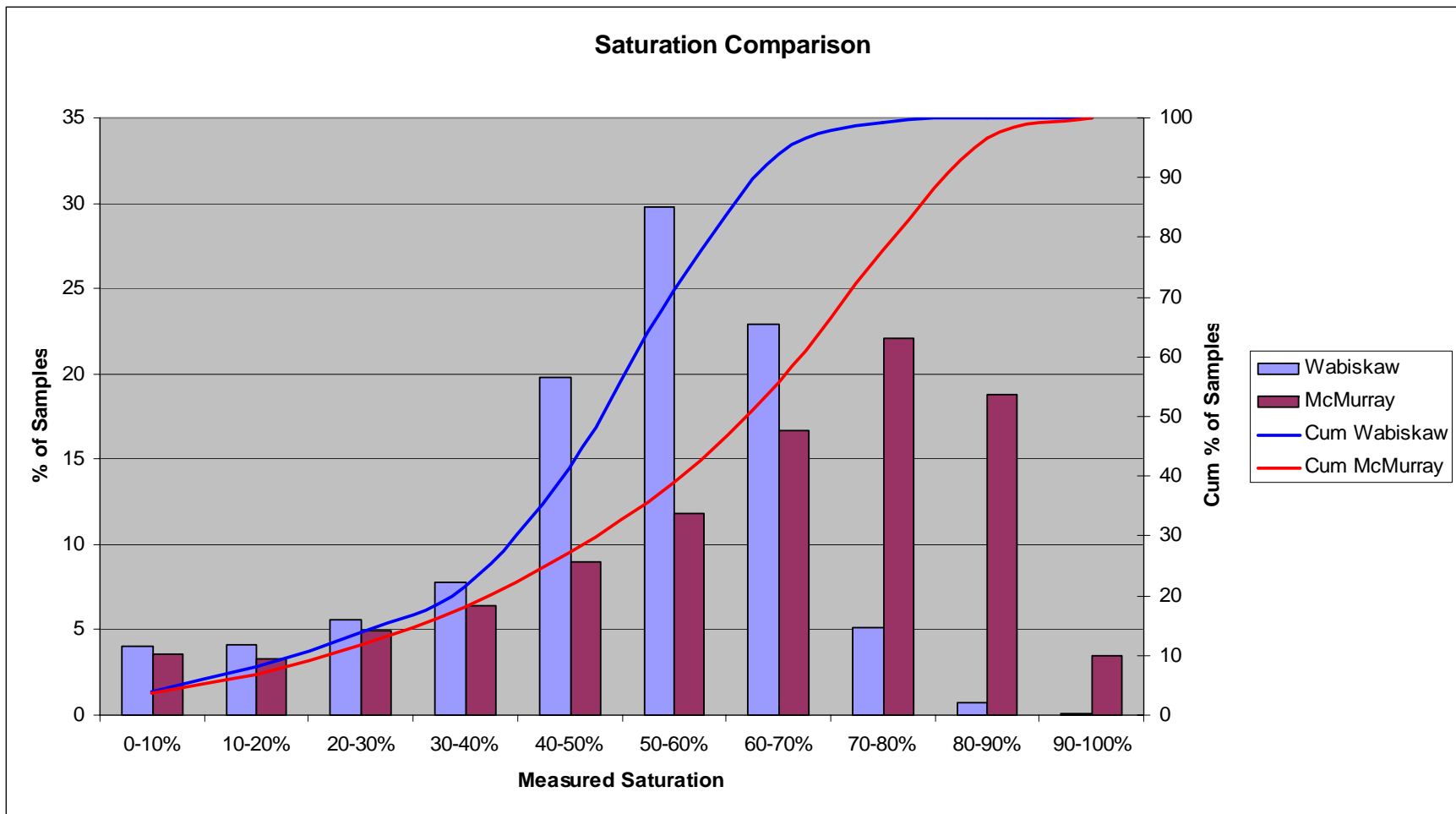


Figure 6

Comparison of SAGD Oil Production Rates (10 m Pay, 100 m Spacing and 700 Horizontal Length)

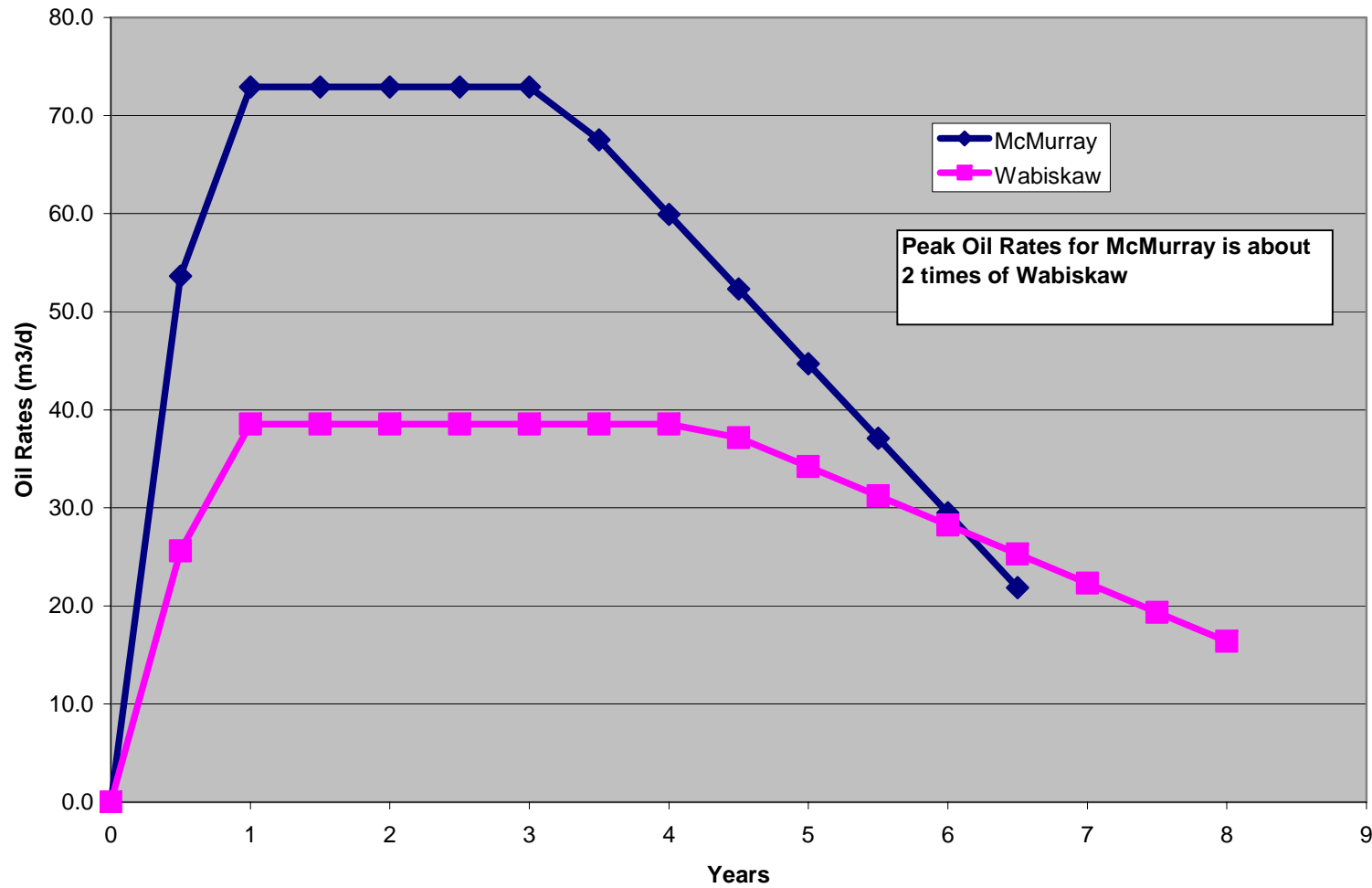


Figure 7

Comparison of SAGD Cum. Oil Production (10 m Pay, 100 m Spacing and 700 Horizontal Length)

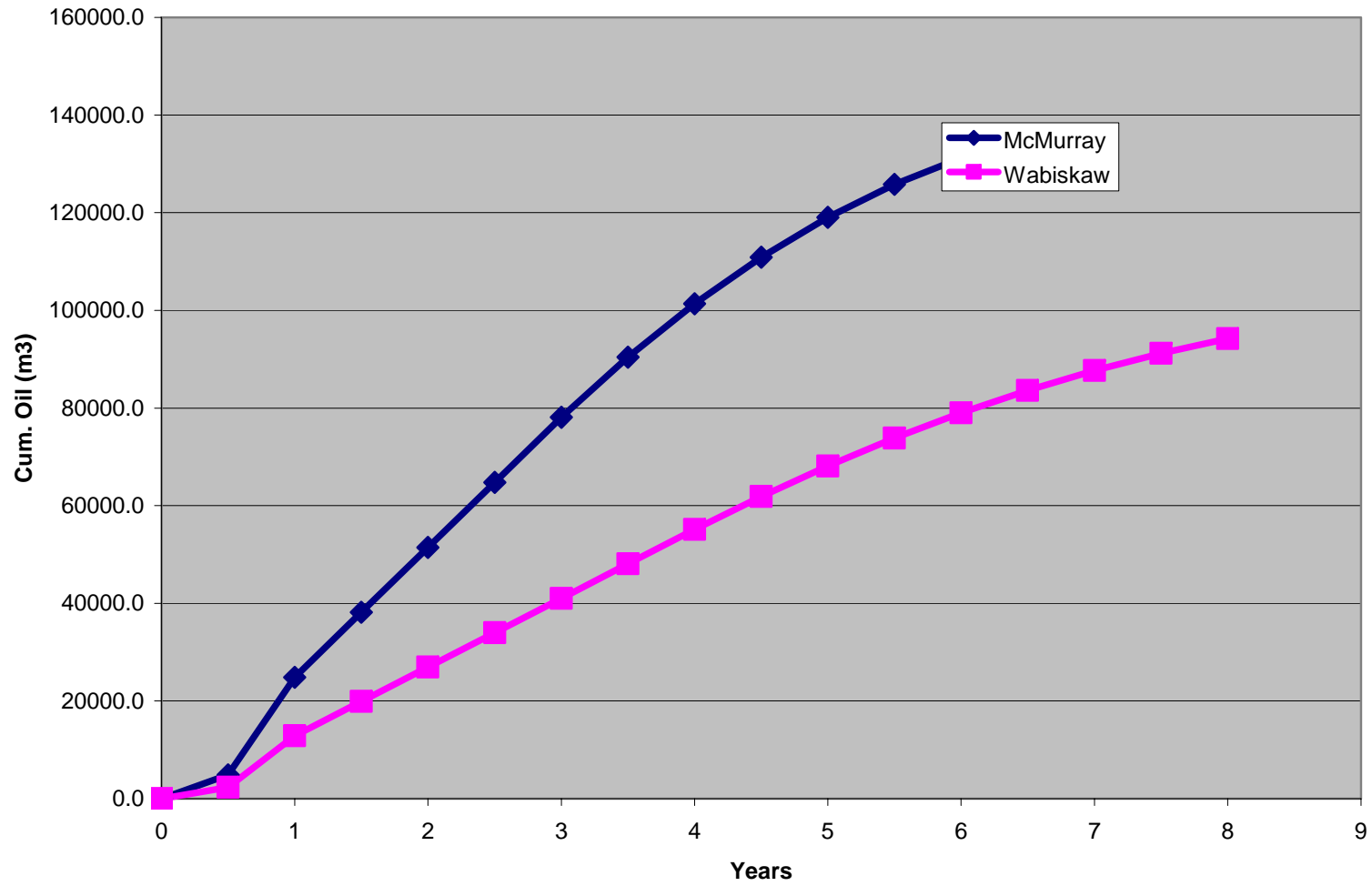


Figure 8

Comparison of SAGD Cum. SOR (10 m Pay, 100 m Spacing and 700 Horizontal Length)

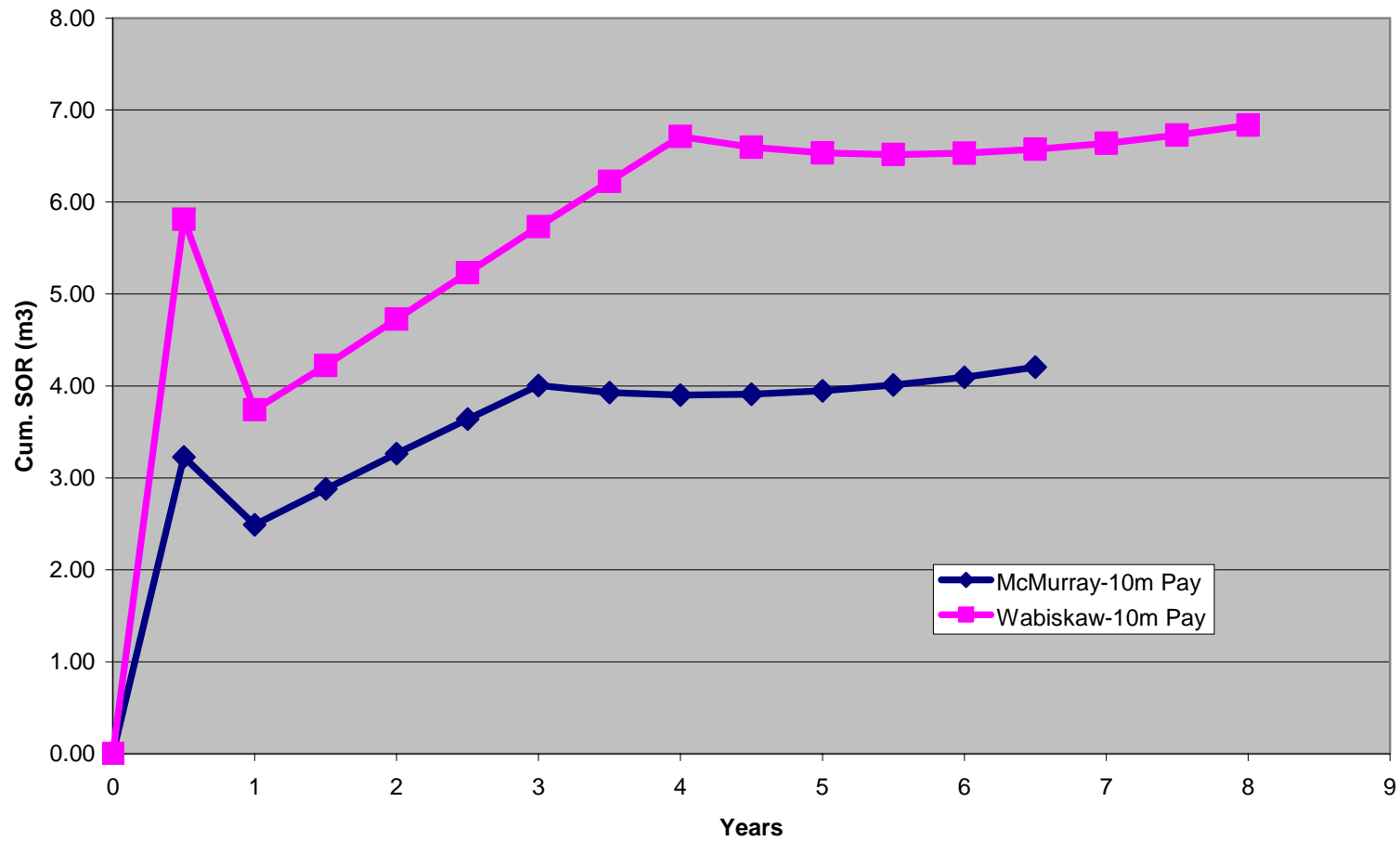
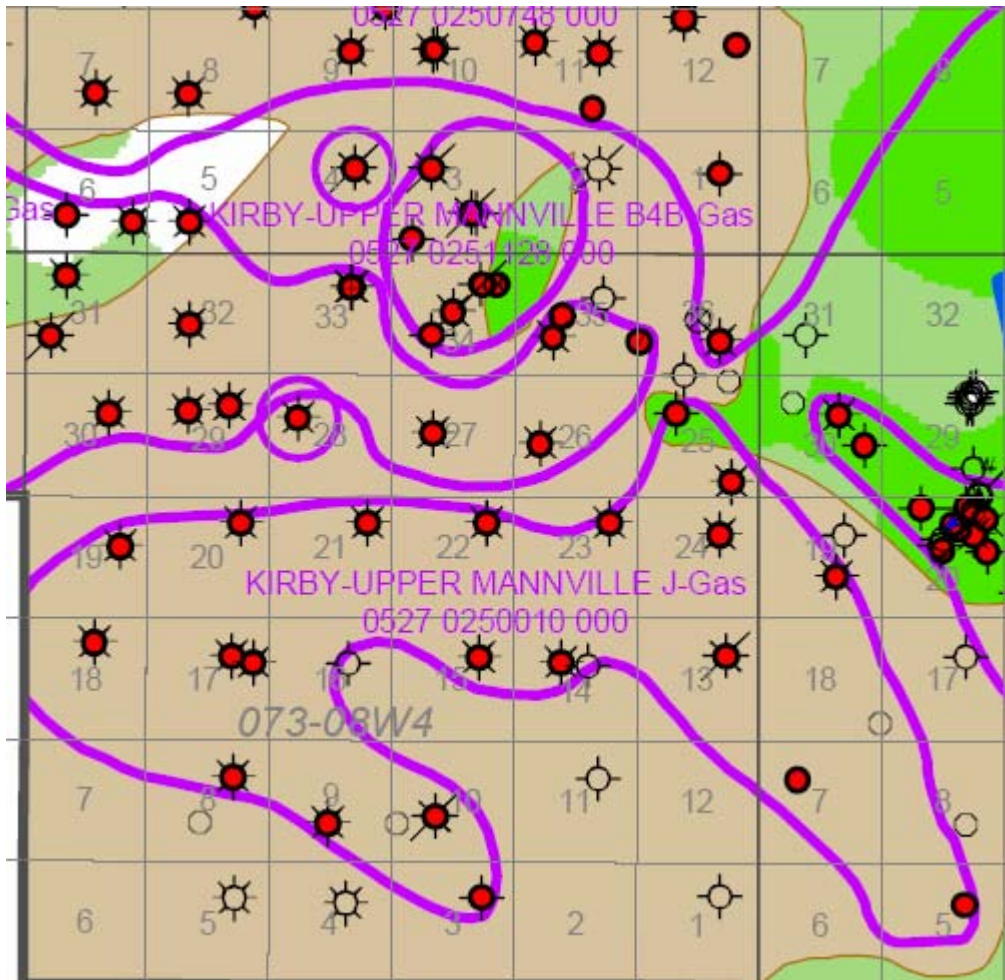


Figure 9



Communication Assessment 3
 Wbsk B Valley-fill & Wbsk C Sd Gas
 McM Chnl/C Chnl Bitumen
 UTM Zone 12, NAD83
 Jan 24/04

Figure 10

Input Parameters for the Model

	McMurray	Wabiskaw
Porosity (fraction)	0.33	0.32
Permeability (μm^2)	7.1	1.6
Initial Oil Saturation (fraction)	0.79	0.61
Reservoir Temperature ($^{\circ}\text{C}$)	15	15
Steam Chamber Pressure (MPa)	2.0	2.0
Steam Temperature ($^{\circ}\text{C}$)	212	212
Viscosity at Steam Temperature(mPa.s)	11.0	7.3
“m” Factor in Viscosity Function (dimensionless)	3.7	3.4
Residual Oil in Steam Chamber (fraction)	0.10	0.10
Well Length (m)	700	700
Lateral Well Spacing (m)	100	100
Sub-Cool ($^{\circ}\text{C}$)	15	15

Table 1

Well ID	RGS Gross Bitumen Interval	RGS Net Bitumen Interval	Core	Cored Interval Below Cutoffs	Core Max Interval Pay	Overlap
00/10-05-073-07W4/0	12.3	7.5	Cored Incomplete			
00/11-07-073-07W4/0	16.15	14.05	Cored Complete	6.2	9.95	15cm Counter as both Gas & Bitumen
00/07-19-073-07W4/0	18	14.7				15cm counted as both Gas & Bitumen
00/10-03-073-08W4/0	#N/A	#N/A	Cored Incomplete			
00/10-08-073-08W4/0	6.3	6.3	Cored Complete	4.65	1.65	
00/06-09-073-08W4/0	3.6	3.6				
00/06-10-073-08W4/0	1.39	1.09	Cored Complete	1.39	0	
00/10-13-073-08W4/0	18.3	15.59	Cored Incomplete			1.35m counted as both Gas & Bitumen
00/11-14-073-08W4/0	10.75	10.75				
00/10-15-073-08W4/0	12	9.3	Cored Incomplete			
00/09-17-073-08W4/0	#N/A	#N/A				
00/10-17-073-08W4/0	9.89	5.99				
00/15-18-073-08W4/0	6.6	4.2				15cm counted as both Gas & Bitumen
00/09-19-073-08W4/0	3.89	1.79				
00/16-20-073-08W4/0	10.49	8.39				
00/16-21-073-08W4/0	12	9.6				25cm counted as both Gas & Bitumen
00/16-22-073-08W4/0	12.6	11.7				
00/16-23-073-08W4/0	15.9	15.9				5cm Counted as both Gas & Bitumen
00/10-24-073-08W4/0	14.1	12.89	Cored Complete	5.61	8.49	15cm counted as both Gas & Bitumen
00/01-25-073-08W4/0	18.6	15.9				15cm counted as both Gas & Bitumen
00/11-25-073-08W4/0	15.6	11.99	Cored Complete	4.53	11.07	15cm counted as both Gas & Bitumen

Table 2

Appendix 1

Core Analysis Data

Kirby Upper Mannville J Pool

Location	S#	Sample Top(m)	Sample Base(m)	Thickness (m)	SampleForms	RSat Oil Ratio	RSat Wtr Ratio	Lithology	<50% Sat	Shale/Tight
00/11-07-073-07W4/0	1	450	450.25	0.25	WBSK,WBSK C	0.514	0.486	SS VF		
00/11-07-073-07W4/0	2	450.25	450.5	0.25	WBSK,WBSK C	0.542	0.458	SS VF		
00/11-07-073-07W4/0	3	450.5	450.75	0.25	WBSK,WBSK C	0.544	0.456	SS VF		
								SS VF ARGLSLT		
00/11-07-073-07W4/0	4	450.75	451	0.25	WBSK,WBSK C	0.543	0.457	CARB		
00/11-07-073-07W4/0	5	451	451.25	0.25	WBSK,WBSK C	0.536	0.464	SS VF SLT		
00/11-07-073-07W4/0	6	451.25	451.5	0.25	WBSK,WBSK C	0.532	0.468	SS VF SLT CARB		
00/11-07-073-07W4/0	7	451.5	451.75	0.25	WBSK,WBSK C	0.636	0.364	SS VF ARGLSLT		
00/11-07-073-07W4/0	8	451.75	452	0.25	WBSK,WBSK C	0.571	0.429	SS VF SLT		
00/11-07-073-07W4/0	9	452	452.35	0.35	WBSK,WBSK C	0.459	0.541	SS VF ARGLSLT	0.35	
								NOT ANALYSED -		
00/11-07-073-07W4/0	10	452.35	452.6	0.25	WBSK,WBSK C	0	0	DENSE		0.25
00/11-07-073-07W4/0	11	452.6	452.8	0.2	WBSK,WBSK C	0.543	0.457	SS VF CARB		
00/11-07-073-07W4/0	12	452.8	453	0.2	WBSK,WBSK C	0.565	0.435	SS VF		
								NOT ANALYSED -		
00/11-07-073-07W4/0	13	453	453.3	0.3	WBSK,WBSK C	0	0	RUBBLE		
00/11-07-073-07W4/0	14	453.3	453.52	0.22	WBSK,WBSK C	0.525	0.475	SS VF CARB		
00/11-07-073-07W4/0	15	453.52	453.75	0.23	WBSK,WBSK C	0.5	0.5	SS VF CARB		
00/11-07-073-07W4/0	16	453.75	454	0.25	WBSK,WBSK C	0.506	0.494	SS VF CARB		
00/11-07-073-07W4/0	17	454	454.25	0.25	WBSK,WBSK C	0.621	0.379	SS VF		
00/11-07-073-07W4/0	18	454.25	454.5	0.25	WBSK,WBSK C	0.61	0.39	SS VF		
00/11-07-073-07W4/0	19	454.5	454.75	0.25	WBSK,WBSK C	0.559	0.441	SS VF CARB		
00/11-07-073-07W4/0	20	454.75	455	0.25	WBSK,WBSK C	0.631	0.369	SS VF CARB		
00/11-07-073-07W4/0	21	455	455.25	0.25	WBSK,WBSK C	0.593	0.407	SS VF		
00/11-07-073-07W4/0	22	455.25	455.5	0.25	WBSK,WBSK C	0.554	0.446	SS VF CARB		
00/11-07-073-07W4/0	23	455.5	455.75	0.25	WBSK,WBSK C	0.629	0.371	SS VF		
00/11-07-073-07W4/0	24	455.75	456	0.25	WBSK,WBSK C	0.545	0.455	SS VF		
00/11-07-073-07W4/0	1	456	456.3	0.3	WBSK,WBSK C	0.433	0.567	SS VF	0.3	
00/11-07-073-07W4/0	2	456.3	456.6	0.3	WBSK,WBSK C	0.414	0.586	SS VF	0.3	
00/11-07-073-07W4/0	3	456.6	456.87	0.27	WBSK,WBSK C	0.452	0.548	SS VF	0.27	
								NOT ANALYSED -		
00/11-07-073-07W4/0	4	456.87	457.23	0.36	WBSK,WBSK C	0	0	DENSE		0.36

00/11-07-073-07W4/0	5	457.23	457.48	0.25	WBSK,WBSK C	0.548	0.452	SS VF			
00/11-07-073-07W4/0	6	457.48	457.73	0.25	WBSK,WBSK C	0.591	0.409	SS VF			
00/11-07-073-07W4/0	7	457.73	458.03	0.3	WBSK,WBSK C	0	0	NOT ANALYSED - RUBBLE			
00/11-07-073-07W4/0	8	458.03	458.38	0.35	WBSK,WBSK C	0.484	0.516	SS VF ARGL	0.35		
00/11-07-073-07W4/0	9	458.38	458.71	0.33	WBSK,WBSK C	0.506	0.494	SS VF CARB			
00/11-07-073-07W4/0	10	458.71	459.03	0.32	WBSK,WBSK C	0.5	0.5	SS VF CARB			
00/11-07-073-07W4/0	11	459.03	459.28	0.25	WBSK,WBSK C	0.489	0.511	SS VF SLT CARB	0.25		
00/11-07-073-07W4/0	12	459.28	459.53	0.25	WBSK,WBSK C	0.429	0.571	SS VF CARB	0.25		
00/11-07-073-07W4/0	13	459.53	459.78	0.25	WBSK,WBSK C	0.456	0.544	SS VF CARB	0.25		
00/11-07-073-07W4/0	14	459.78	460.03	0.25	WBSK,WBSK C	0.415	0.585	SS VF ARGL	0.25		
00/11-07-073-07W4/0	15	460.03	460.28	0.25	WBSK,WBSK C	0.503	0.497	SS VF			
00/11-07-073-07W4/0	16	460.28	460.65	0.37	WBSK,WBSK C	0.274	0.726	SS VF SH CARB	0.37		
00/11-07-073-07W4/0	17	460.65	460.9	0.25	WBSK,WBSK C	0.373	0.627	SS VF ARGL	0.25		
00/11-07-073-07W4/0	18	460.9	461.15	0.25	WBSK,WBSK C	0.453	0.547	SS VF ARGL	0.25		
00/11-07-073-07W4/0	19	461.15	461.42	0.27	WBSK,WBSK C	0.367	0.633	SS VF ARGLCALCCARB	0.27		
00/11-07-073-07W4/0	20	461.42	461.7	0.28	WBSK,WBSK C	0	0	NOT ANALYSED - DENSE		0.28	
00/11-07-073-07W4/0	21	461.7	462	0.3	WBSK,WBSK C	0	0	NOT ANALYSED - RUBBLE			
00/11-07-073-07W4/0	22	462	462.33	0.33	WBSK,WBSK C	0.36	0.64	SS VF ARGL	0.33		
00/11-07-073-07W4/0	23	462.33	462.65	0.32	WBSK,WBSK C	0.492	0.508	SS VF	0.32		
00/11-07-073-07W4/0	24	462.65	462.95	0.3	WBSK,WBSK C	0	0	NOT ANALYSED - RUBBLE			
00/11-07-073-07W4/0	25	462.95	465	2.05	WBSK,WBSK C	0	0	LOST CORE			
00/11-07-073-07W4/0	1	465	465.4	0.4	WBSK,WBSK C	0	0	NOT ANALYSED - SHALE		0.4	
00/11-07-073-07W4/0	2	465.4	465.65	0.25	WBSK,WBSK C	0.132	0.868	SS VF ARGL	0.25		
00/11-07-073-07W4/0	3	465.65	465.95	0.3	WBSK,WBSK C	0.204	0.796	SS VF CARB	0.3		
								Total Non Pay	4.91	1.29	6.2

Location	S#	Sample Top(m)	Sample Base(m)	Thickness (m)	SampleForms	RSat Oil Ratio	RSat Wtr Ratio	Lithology	<50% Sat	Shale/Tight
00/10-08-073-08W4/0	16	477.85	478.15	0.3	WBSK,WBSK C	0.527	0.473	SS F		
00/10-08-073-08W4/0	17	478.15	478.22	0.07	WBSK,WBSK C	0	0	SS F CARB		0.07
00/10-08-073-08W4/0	18	478.22	478.42	0.2	WBSK,WBSK C	0.491	0.509	SS F	0.2	
00/10-08-073-08W4/0	19	478.42	478.75	0.33	WBSK,WBSK C	0.41	0.59	SS F ARGL	0.33	
00/10-08-073-08W4/0	20	478.75	479.01	0.26	WBSK,WBSK C	0.432	0.568	SS F ARGL	0.26	
								SS F		
00/10-08-073-08W4/0	21	479.01	479.08	0.07	WBSK,WBSK C	0	0	ARGLCARB		0.07
00/10-08-073-08W4/0	22	479.08	479.35	0.27	WBSK,WBSK C	0.379	0.621	SS F ARGL	0.27	
00/10-08-073-08W4/0	23	479.35	479.65	0.3	WBSK,WBSK C	0.377	0.623	SS F CARB	0.3	
00/10-08-073-08W4/0	24	479.65	479.9	0.25	WBSK,WBSK C	0.4	0.6	SS F	0.25	
00/10-08-073-08W4/0	25	479.9	479.97	0.07	WBSK,WBSK C	0	0	SS F CARB		0.07
								SS F		
00/10-08-073-08W4/0	26	479.97	480.25	0.28	WBSK,WBSK C	0.348	0.652	ARGLCARB	0.28	
00/10-08-073-08W4/0	27	480.25	480.55	0.3	WBSK,WBSK C	0.399	0.601	SS F	0.3	
00/10-08-073-08W4/0	28	480.55	480.8	0.25	WBSK,WBSK C	0.285	0.715	SS F ARGL	0.25	
00/10-08-073-08W4/0	29	480.8	480.87	0.07	WBSK,WBSK C	0	0	SS F CARB		0.07
00/10-08-073-08W4/0	30	480.87	481.15	0.28	WBSK,WBSK C	0.35	0.65	SS F ARGL	0.28	
00/10-08-073-08W4/0	31	481.15	481.39	0.24	WBSK,WBSK C	0.373	0.627	SS F	0.24	
00/10-08-073-08W4/0	32	481.39	481.45	0.06	WBSK,WBSK C	0	0	SS F CARB		0.06
00/10-08-073-08W4/0	33	481.45	481.75	0.3	WBSK,WBSK C	0.343	0.657	SS F	0.3	
00/10-08-073-08W4/0	34	481.75	483.3	1.55	WBSK,WBSK C	0	0	LOST CORE		
00/10-08-073-08W4/0	1	483.3	483.37	0.07	WBSK,WBSK C	0	0	DENSE		0.07
00/10-08-073-08W4/0	2	483.37	483.71	0.34	WBSK,WBSK C	0.312	0.688	SS F	0.34	
00/10-08-073-08W4/0	3	483.71	483.77	0.06	WBSK,WBSK C	0	0	SS F CARB		0.06
								NOT ANALYSED -		
00/10-08-073-08W4/0	4	483.77	484.64	0.87	WBSK,WBSK C	0	0	SHALE		0.58
								Total Non Pay	3.6	1.05
										4.65

Location	S#	Sample Top(m)	Sample Base(m)	Thickness (m)	SampleForms	RSat Oil Ratio	RSat Wtr Ratio	Lithology	<50% Sat	Shale/Tight	Depth Shifted 1.75m	
00/06-10-073-08W4/0	1	472	472.05	0.05		0	0	NOT ANALYSED - SHALE				
00/06-10-073-08W4/0	2	472.05	472.38	0.33		0.031	0.969	SS VF				
00/06-10-073-08W4/0	3	472.38	472.7	0.32		0.055	0.945	SS VF ARGL				
00/06-10-073-08W4/0	4	472.7	473.02	0.32		0.095	0.905	SS VF SLT SS VF SLT				
00/06-10-073-08W4/0	5	473.02	473.35	0.33		0.11	0.89	CARB				
00/06-10-073-08W4/0	6	473.35	473.6	0.25		0.162	0.838	SS VF SLT				
00/06-10-073-08W4/0	7	473.6	473.85	0.25		0.227	0.773	SS VF SLT				
00/06-10-073-08W4/0	8	473.85	474.1	0.25		0.253	0.747	SS VF SLT				
00/06-10-073-08W4/0	9	474.1	474.3	0.2		0.312	0.688	SS VF CARB				
00/06-10-073-08W4/0	10	474.3	474.55	0.25	WBSK C	0.333	0.667	SS VF ARGL				
00/06-10-073-08W4/0	11	474.55	474.8	0.25	WBSK C	0.335	0.665	SS VF SLT SS VF SLT				
00/06-10-073-08W4/0	12	474.8	475.05	0.25	WBSK C	0.363	0.637	CARB SS VF ARGLSLT				
00/06-10-073-08W4/0	13	475.05	475.3	0.25	WBSK C	0.385	0.615	CARB SS VF SLT				
00/06-10-073-08W4/0	14	475.3	475.55	0.25	WBSK C	0.295	0.705	CARB				
00/06-10-073-08W4/0	15	475.55	475.8	0.25	WBSK C	0.485	0.515	SS VF SLT				
00/06-10-073-08W4/0	16	475.8	476.05	0.25	WBSK C	0.488	0.512	SS VF SLT				
00/06-10-073-08W4/0	17	476.05	476.3	0.25	WBSK C	0.421	0.579	SS VF ARGLSLT SS VF SLT				
00/06-10-073-08W4/0	18	476.3	476.55	0.25	WBSK C	0.44	0.56	CARB				
RGS WAB B VF Top												
00/06-10-073-08W4/0	19	476.55	476.8	0.25	WBSK C	0.476	0.524	SS VF SLT	0.25			
00/06-10-073-08W4/0	20	476.8	477.05	0.25	WBSK C	0.432	0.568	SS VF SLT	0.25			
00/06-10-073-08W4/0	21	477.05	477.3	0.25	WBSK C	0.456	0.544	SS VF SLT	0.25			
00/06-10-073-08W4/0	22	477.3	477.6	0.3	WBSK C	0.346	0.654	SS VF ARGLSLT	0.3			
									Total non Pay	1.05	0	1.05
					WBSK,WBSK				NOT ANALYSED -			
00/06-10-073-08W4/0	23	477.6	478.55	0.95	C	0	0	SHALE				

00/06-10-073-08W4/0	24	478.55	478.85	0.3	WBSK,WBSK C	0.025	0.975	SS VF SLT
00/06-10-073-08W4/0	25	478.85	479.2	0.35	WBSK,WBSK C	0.365	0.635	SS VF SLT
00/06-10-073-08W4/0	26	479.2	479.45	0.25	WBSK,WBSK C	0	0	NOT ANALYSED - SHALES
00/06-10-073-08W4/0	27	479.45	479.75	0.3	WBSK,WBSK C	0.357	0.643	SS VF ARGSLT
00/06-10-073-08W4/0	28	479.75	480	0.25	WBSK,WBSK C	0.301	0.699	SS VF SLT

Core from above and below interval of interest fully recovered. Therefore there is no pay above cutoff in Wabiskaw of this well

Location	S#	Sample Top(m)	Sample Base(m)	Thickness (m)	SampleForms	RSat Oil Ratio	RSat Wtr Ratio	Lithology	<50% Sat	Shale/Tight
00/10-24-073-08W4/0	6	460.14	460.42	0.28	WBSK,WBSK C	0.441	0.559	SS F	0.07	
00/10-24-073-08W4/0	7	460.42	460.5	0.08	WBSK,WBSK C	0	0	SS F SLT		0.08
00/10-24-073-08W4/0	8	460.5	460.83	0.33	WBSK,WBSK C	0.687	0.313	SS VF		
00/10-24-073-08W4/0	9	460.83	460.91	0.08	WBSK,WBSK C	0	0	SS F SLT		0.08
00/10-24-073-08W4/0	10	460.91	461.18	0.27	WBSK,WBSK C	0.607	0.393	SS VF		
00/10-24-073-08W4/0	11	461.18	461.26	0.08	WBSK,WBSK C	0	0	SS F SLT		0.08
00/10-24-073-08W4/0	12	461.26	461.51	0.25	WBSK,WBSK C	0.634	0.366	SS VF		
00/10-24-073-08W4/0	13	461.51	461.59	0.08	WBSK,WBSK C	0	0	SS VF CARB		0.08
00/10-24-073-08W4/0	14	461.59	461.81	0.22	WBSK,WBSK C	0.642	0.358	SS VF		
00/10-24-073-08W4/0	15	461.81	462.01	0.2	WBSK,WBSK C	0.567	0.433	SS VF		
00/10-24-073-08W4/0	16	462.01	462.38	0.37	WBSK,WBSK C	0.644	0.356	SS VF		
00/10-24-073-08W4/0	17	462.38	462.46	0.08	WBSK,WBSK C	0	0	SS VF SLT		0.08
00/10-24-073-08W4/0	18	462.46	462.77	0.31	WBSK,WBSK C	0.651	0.349	SS VF		
00/10-24-073-08W4/0	19	462.77	462.85	0.08	WBSK,WBSK C	0	0	SS F SLT		0.08
00/10-24-073-08W4/0	20	462.85	463.13	0.28	WBSK,WBSK C	0.617	0.383	SS VF		
00/10-24-073-08W4/0	21	463.13	463.21	0.08	WBSK,WBSK C	0	0	SS F		0.08
00/10-24-073-08W4/0	22	463.21	463.5	0.29	WBSK,WBSK C	0.591	0.409	SS VF		
00/10-24-073-08W4/0	1	463.5	463.75	0.25	WBSK,WBSK C	0.456	0.544	SS VF	0.25	
00/10-24-073-08W4/0	2	463.75	463.97	0.22	WBSK,WBSK C	0.81	0.19	SS F		
00/10-24-073-08W4/0	3	463.97	464.05	0.08	WBSK,WBSK C	0	0	SS VF		0.08
00/10-24-073-08W4/0	4	464.05	464.25	0.2	WBSK,WBSK C	0.543	0.457	SS VF		
00/10-24-073-08W4/0	5	464.25	464.46	0.21	WBSK,WBSK C	0.554	0.446	SS VF		
00/10-24-073-08W4/0	6	464.46	464.54	0.08	WBSK,WBSK C	0	0	SS F		0.08
00/10-24-073-08W4/0	7	464.54	464.77	0.23	WBSK,WBSK C	0.63	0.37	SS VF		
00/10-24-073-08W4/0	8	464.77	465.01	0.24	WBSK,WBSK C	0.602	0.398	SS VF		
00/10-24-073-08W4/0	9	465.01	465.36	0.35	WBSK,WBSK C	0.587	0.413	SS VF		
00/10-24-073-08W4/0	10	465.36	465.44	0.08	WBSK,WBSK C	0	0	SS F		0.08
00/10-24-073-08W4/0	11	465.44	465.78	0.34	WBSK,WBSK C	0.557	0.443	SS VF		
00/10-24-073-08W4/0	12	465.78	466.03	0.25	WBSK,WBSK C	0.547	0.453	SS VF		
00/10-24-073-08W4/0	13	466.03	466.11	0.08	WBSK,WBSK C	0	0	SS F		0.08
00/10-24-073-08W4/0	14	466.11	466.36	0.25	WBSK,WBSK C	0.248	0.752	SS F	0.25	

00/10-24-073-08W4/0	15	466.36	466.61	0.25	WBSK,WBSK C	0.36	0.64	SS VF ARGL NOT ANALYSED -	0.25
00/10-24-073-08W4/0	16	466.61	467.54	0.93	WBSK,WBSK C	0	0	DENSE	0.93
00/10-24-073-08W4/0	17	467.54	467.62	0.08	WBSK,WBSK C	0	0	SS F	0.08
00/10-24-073-08W4/0	18	467.62	467.88	0.26	WBSK,WBSK C	0.468	0.532	SS VF ARGL	0.26
00/10-24-073-08W4/0	19	467.88	468.1	0.22	WBSK,WBSK C	0.601	0.399	SS F	
00/10-24-073-08W4/0	20	468.1	468.33	0.23	WBSK,WBSK C	0.536	0.464	SS VF	
00/10-24-073-08W4/0	21	468.33	468.41	0.08	WBSK,WBSK C	0	0	SS VF	0.08
00/10-24-073-08W4/0	22	468.41	468.63	0.22	WBSK,WBSK C	0.503	0.497	SS F	
00/10-24-073-08W4/0	23	468.63	468.89	0.26	WBSK,WBSK C	0.606	0.394	SS F	
00/10-24-073-08W4/0	24	468.89	468.97	0.08	WBSK,WBSK C	0	0	SS F	0.08
00/10-24-073-08W4/0	25	468.97	469.19	0.22	WBSK,WBSK C	0.567	0.433	SS VF	
00/10-24-073-08W4/0	26	469.19	469.49	0.3	WBSK,WBSK C	0.575	0.425	SS VF	
00/10-24-073-08W4/0	27	469.49	469.75	0.26	WBSK,WBSK C	0.521	0.479	SS F	
00/10-24-073-08W4/0	28	469.75	469.83	0.08	WBSK,WBSK C	0	0	SS VF	0.08
00/10-24-073-08W4/0	29	469.83	470.03	0.2	WBSK,WBSK C	0.596	0.404	SS VF	
00/10-24-073-08W4/0	30	470.03	470.26	0.23	WBSK,WBSK C	0.562	0.438	SS VF	
00/10-24-073-08W4/0	31	470.26	470.52	0.26	WBSK,WBSK C	0.503	0.497	SS F	
00/10-24-073-08W4/0	32	470.52	470.6	0.08	WBSK,WBSK C	0	0	SS VF	0.08
00/10-24-073-08W4/0	33	470.6	470.78	0.18	WBSK,WBSK C	0.495	0.505	SS F	0.18
00/10-24-073-08W4/0	34	470.78	471	0.22	WBSK,WBSK C	0.559	0.441	SS VF	
00/10-24-073-08W4/0	35	471	471.08	0.08	WBSK,WBSK C	0	0	SS VF	0.08
00/10-24-073-08W4/0	36	471.08	471.36	0.28	WBSK,WBSK C	0.435	0.565	SS VF	0.28
00/10-24-073-08W4/0	37	471.36	471.66	0.3	WBSK,WBSK C	0.565	0.435	SS VF	
00/10-24-073-08W4/0	38	471.66	471.75	0.09	WBSK,WBSK C	0	0	SS VF CARB	0.09
00/10-24-073-08W4/0	39	471.75	471.95	0.2	WBSK,WBSK C	0.57	0.43	SS VF	
00/10-24-073-08W4/0	40	471.95	472.15	0.2	WBSK,WBSK C	0.368	0.632	SS VF	0.2
00/10-24-073-08W4/0	41	472.15	472.35	0.2	WBSK,WBSK C	0.528	0.472	SS VF	
00/10-24-073-08W4/0	42	472.35	472.5	0.15	WBSK,WBSK C	0	0	LOST CORE	
00/10-24-073-08W4/0	1	472.5	472.7	0.2	WBSK,WBSK C	0.329	0.671	SS F ARGL	0.2
00/10-24-073-08W4/0	2	472.7	472.77	0.07	WBSK,WBSK C	0	0	SS VF NOT ANALYSED -	0.07
00/10-24-073-08W4/0	3	472.77	472.84	0.07	WBSK,WBSK C	0	0	SHALE	0.07

00/10-24-073-08W4/0	4	472.84	473.04	0.2	WBSK,WBSK C	0.243	0.757	SS F SLT	0.2		
00/10-24-073-08W4/0	5	473.04	473.37	0.33	WBSK,WBSK C	0.444	0.556	SS F SLT	0.33		
								NOT ANALYSED -			
								SHALE		0.42	
00/10-24-073-08W4/0	6	473.37	473.79	0.42	WBSK,WBSK C	0	0	SS F			
00/10-24-073-08W4/0	7	473.79	474	0.21	WBSK,WBSK C	0.707	0.293	SS VF		0.08	
00/10-24-073-08W4/0	8	474	474.08	0.08	WBSK,WBSK C	0	0	SS F			
00/10-24-073-08W4/0	9	474.08	474.26	0.18	WBSK,WBSK C	0.52	0.48	NOT ANALYSED -			
								SHALE		0.19	
00/10-24-073-08W4/0	10	474.26	474.84	0.58	WBSK,WBSK C	0	0	Total Non Pay	2.4	3.21	5.61

Location	S#	Sample Top(m)	Sample Base(m)	Thickness (m)	SampleForms	RSat Oil Ratio	RSat Wtr Ratio	Lithology	<50% Sat	Shale/Tight
00/11-25-073-08W4/0	1	462	462.3	0.3	WBSK,WBSK C	0.611	0.389	SS VF		
00/11-25-073-08W4/0	2	462.3	462.6	0.3	WBSK,WBSK C	0.592	0.408	SS VF		
00/11-25-073-08W4/0	3	462.6	462.9	0.3	WBSK,WBSK C	0.622	0.378	SS VF		
00/11-25-073-08W4/0	4	462.9	463.2	0.3	WBSK,WBSK C	0.618	0.382	SS VF CARB		
00/11-25-073-08W4/0	5	463.2	463.5	0.3	WBSK,WBSK C	0.419	0.581	SS VF	0.3	
00/11-25-073-08W4/0	6	463.5	463.8	0.3	WBSK,WBSK C	0.634	0.366	SS VF CARB		
00/11-25-073-08W4/0	7	463.8	464.1	0.3	WBSK,WBSK C	0.596	0.404	SS VF		
00/11-25-073-08W4/0	8	464.1	464.4	0.3	WBSK,WBSK C	0.644	0.356	SS VF		
00/11-25-073-08W4/0	9	464.4	464.68	0.28	WBSK,WBSK C	0.752	0.248	SS VF		
								NOT ANALYSED -		
00/11-25-073-08W4/0	10	464.68	465.2	0.52	WBSK,WBSK C	0	0	DENSE		0.52
00/11-25-073-08W4/0	11	465.2	465.46	0.26	WBSK,WBSK C	0.603	0.397	SS VF CARB		
00/11-25-073-08W4/0	12	465.46	465.7	0.24	WBSK,WBSK C	0.574	0.426	SS VF CARB		
00/11-25-073-08W4/0	13	465.7	466.02	0.32	WBSK,WBSK C	0.614	0.386	SS VF CARB		
								NOT ANALYSED -		
00/11-25-073-08W4/0	14	466.02	467.5	1.48	WBSK,WBSK C	0	0	DENSE		1.48
00/11-25-073-08W4/0	15	467.5	467.72	0.22	WBSK,WBSK C	0.614	0.386	SS VF CARB		
00/11-25-073-08W4/0	16	467.72	467.95	0.23	WBSK,WBSK C	0.628	0.372	SS VF CARB		
00/11-25-073-08W4/0	17	467.95	471	3.05	WBSK,WBSK C	0	0	LOST CORE		
00/11-25-073-08W4/0	1	471	471.25	0.25	WBSK,WBSK C	0.433	0.567	SS VF	0.25	
00/11-25-073-08W4/0	2	471.25	471.5	0.25	WBSK,WBSK C	0.553	0.447	SS VF		
00/11-25-073-08W4/0	3	471.5	471.75	0.25	WBSK,WBSK C	0.524	0.476	SS VF		
00/11-25-073-08W4/0	4	471.75	472	0.25	WBSK,WBSK C	0.565	0.435	SS VF		
00/11-25-073-08W4/0	5	472	472.3	0.3	WBSK,WBSK C	0.6	0.4	SS VF		
00/11-25-073-08W4/0	6	472.3	472.6	0.3	WBSK,WBSK C	0.564	0.436	SS VF CARB		
00/11-25-073-08W4/0	7	472.6	472.9	0.3	WBSK,WBSK C	0.519	0.481	SS VF		
00/11-25-073-08W4/0	8	472.9	473.2	0.3	WBSK,WBSK C	0.534	0.466	SS VF		
00/11-25-073-08W4/0	9	473.2	473.5	0.3	WBSK,WBSK C	0.576	0.424	SS VF CARB		
00/11-25-073-08W4/0	10	473.5	473.8	0.3	WBSK,WBSK C	0.534	0.466	SS VF		
00/11-25-073-08W4/0	11	473.8	474.1	0.3	WBSK,WBSK C	0.545	0.455	SS VF		

00/11-25-073-08W4/0	12	474.1	474.4	0.3	WBSK,WBSK C	0.487	0.513	SS VF CARB	0.3		
00/11-25-073-08W4/0	13	474.4	474.7	0.3	WBSK,WBSK C	0.523	0.477	SS VF ARGL			
00/11-25-073-08W4/0	14	474.7	475	0.3	WBSK,WBSK C	0.378	0.622	SS VF ARGL	0.3		
00/11-25-073-08W4/0	15	475	475.3	0.3	WBSK,WBSK C	0.541	0.459	SS VF			
00/11-25-073-08W4/0	16	475.3	475.6	0.3	WBSK,WBSK C	0.532	0.468	SS VF			
00/11-25-073-08W4/0	17	475.6	475.9	0.3	WBSK,WBSK C	0.51	0.49	SS VF ARGL			
00/11-25-073-08W4/0	18	475.9	476.2	0.3	WBSK,WBSK C	0.497	0.503	SS VF ARGL	0.3		
00/11-25-073-08W4/0	19	476.2	476.42	0.22	WBSK,WBSK C	0.525	0.475	SS VF ARGL			
								NOT ANALYSED - SHALE			
00/11-25-073-08W4/0	20	476.42	476.5	0.08	WBSK,WBSK C	0	0	SS VF			0.08
00/11-25-073-08W4/0	21	476.5	476.75	0.25	WBSK,WBSK C	0.221	0.779	ARGLCARB	0.25		
								NOT ANALYSED - SHALE			
00/11-25-073-08W4/0	22	476.75	476.98	0.23	WBSK,WBSK C	0	0	SS VF			0.23
00/11-25-073-08W4/0	23	476.98	477.25	0.27	WBSK,WBSK C	0.257	0.743	ARGLCARB	0.27		
00/11-25-073-08W4/0	24	477.25	477.5	0.25	WBSK,WBSK C	0.351	0.649	SS VF CARB	0.25		
								Total Non Pay	2.22	2.31	4.53

Appendix 2
McMurray Wells
With Digital Core Analysis
Used in Unit
Characterization

McMurray Core Analysis Used in Formation Evaluation

UWI	RGS Top	RGS Base
00/12-21-071-04W4/0	455	Paleozoic
00/15-32-071-04W4/0	458	Paleozoic
00/06-31-073-04W4/0	441	Paleozoic
00/06-18-074-04W4/0	365	Paleozoic
AA/11-30-071-05W4/0	473	Paleozoic
00/06-32-071-05W4/0	463	Paleozoic
00/12-14-072-05W4/0	495	Paleozoic
00/08-16-072-05W4/0	481	Paleozoic
00/08-18-072-05W4/0	499	Paleozoic
00/11-05-073-05W4/0	486.8	Paleozoic
00/11-18-073-05W4/0	475	Paleozoic
00/10-29-073-05W4/0	435	Paleozoic
00/10-02-074-05W4/0	410	Paleozoic
00/07-14-072-06W4/0	489	Paleozoic
00/10-34-072-06W4/0	499	Paleozoic
00/06-36-072-06W4/0	510.1	Paleozoic
02/05-01-073-06W4/0	500	Paleozoic
03/05-01-073-06W4/0	497	Paleozoic
00/11-01-073-06W4/0	498	Paleozoic
00/12-01-073-06W4/0	502	Paleozoic
02/12-01-073-06W4/0	503	Paleozoic
02/08-02-073-06W4/0	496	Paleozoic
00/07-03-073-06W4/0	499.5	Paleozoic
00/06-05-073-06W4/0	498	Paleozoic
00/06-06-073-06W4/0	511	Paleozoic
00/06-07-073-06W4/0	496	Paleozoic
00/06-08-073-06W4/0	485	Paleozoic
00/11-09-073-06W4/0	464.5	Paleozoic
00/06-10-073-06W4/0	483	Paleozoic
00/06-13-073-06W4/0	481	Paleozoic
00/11-14-073-06W4/0	492	Paleozoic
00/11-17-073-06W4/0	463	Paleozoic
00/06-18-073-06W4/0	466	Paleozoic
00/11-22-073-06W4/0	453	Paleozoic
00/09-26-073-06W4/0	444	Paleozoic
00/11-32-073-06W4/0	430	Paleozoic
00/06-19-074-06W4/0	422	Paleozoic
00/06-20-074-06W4/0	406	Paleozoic
00/08-21-074-06W4/0	395	Paleozoic
00/08-24-074-06W4/0	418	Paleozoic
00/04-25-074-06W4/0	429	Paleozoic
00/03-26-074-06W4/0	423	Paleozoic
00/03-27-074-06W4/0	405	Paleozoic
00/09-27-074-06W4/0	438	Paleozoic
00/04-28-074-06W4/0	405	Paleozoic
00/09-28-074-06W4/0	402	Paleozoic
00/04-29-074-06W4/0	414	Paleozoic

00/09-30-074-06W4/0	417	Paleozoic
00/11-31-074-06W4/0	400	Paleozoic
AA/04-35-074-06W4/0	464	Paleozoic
00/12-35-074-06W4/0	446.5	Paleozoic
00/10-36-074-06W4/0	409	Paleozoic
AA/14-02-075-06W4/0	417	Paleozoic
00/11-04-075-06W4/0	418	Paleozoic
00/06-10-075-06W4/0	412	Paleozoic
00/07-13-075-06W4/0	406.5	Paleozoic
00/10-16-075-06W4/0	395	Paleozoic
00/06-18-075-06W4/0	405	Paleozoic
AA/10-19-075-06W4/0	405	Paleozoic
00/10-01-072-07W4/0	455	Paleozoic
00/10-03-072-07W4/0	459	Paleozoic
00/10-13-072-07W4/0	475	Paleozoic
00/10-15-072-07W4/0	488	Paleozoic
00/10-23-072-07W4/0	482	Paleozoic
00/10-25-072-07W4/0	509	Paleozoic
00/10-26-072-07W4/0	482	Paleozoic
00/10-27-072-07W4/0	480	Paleozoic
00/10-29-072-07W4/0	488.5	Paleozoic
00/11-30-072-07W4/0	473	Paleozoic
00/11-31-072-07W4/0	474	Paleozoic
00/10-33-072-07W4/0	473	Paleozoic
00/11-34-072-07W4/0	487	Paleozoic
00/10-36-072-07W4/0	526	Paleozoic
00/10-01-073-07W4/0	511.5	Paleozoic
00/10-02-073-07W4/0	516	Paleozoic
00/10-03-073-07W4/0	505.8	Paleozoic
00/10-04-073-07W4/0	491.5	Paleozoic
00/10-05-073-07W4/0	466.5	Paleozoic
00/11-07-073-07W4/0	475	Paleozoic
00/07-08-073-07W4/0	488	Paleozoic
00/10-09-073-07W4/0	511	Paleozoic
00/06-10-073-07W4/0	527	Paleozoic
00/10-11-073-07W4/0	515	Paleozoic
00/10-12-073-07W4/0	492	Paleozoic
00/10-13-073-07W4/0	480	Paleozoic
00/10-14-073-07W4/0	501	Paleozoic
00/10-15-073-07W4/0	518	Paleozoic
00/06-16-073-07W4/0	514	Paleozoic
00/10-17-073-07W4/0	507	Paleozoic
00/10-19-073-07W4/0	513	Paleozoic
AA/09-20-073-07W4/0	503.5	Paleozoic
00/10-20-073-07W4/0	506	Paleozoic
02/10-20-073-07W4/0	501	Paleozoic
05/11-20-073-07W4/0	498.5	Paleozoic
AB/11-20-073-07W4/0	499	Paleozoic
02/15-20-073-07W4/0	502	Paleozoic
04/15-20-073-07W4/0	501	Paleozoic

AA/16-20-073-07W4/0	501	Paleozoic
AA/02-21-073-07W4/0	512	Paleozoic
AA/04-21-073-07W4/0	501.5	Paleozoic
AA/08-21-073-07W4/0	507.5	Paleozoic
00/09-21-073-07W4/0	500	Paleozoic
00/11-21-073-07W4/0	505	Paleozoic
00/10-28-073-07W4/0	503	Paleozoic
AA/02-29-073-07W4/0	508	Paleozoic
00/09-29-073-07W4/0	543	Paleozoic
00/10-29-073-07W4/0	520	Paleozoic
02/10-29-073-07W4/0	524	Paleozoic
00/15-29-073-07W4/0	518.1	Paleozoic
03/15-29-073-07W4/0	517	Paleozoic
04/15-29-073-07W4/0	523	Paleozoic
AA/08-30-073-07W4/0	504.3	Paleozoic
00/10-30-073-07W4/0	500	Paleozoic
AA/14-30-073-07W4/0	499	Paleozoic
AA/10-11-074-07W4/0	463	Paleozoic
00/05-19-074-07W4/0	487.5	Paleozoic
00/02-25-074-07W4/0	423	Paleozoic
00/10-25-074-07W4/0	410	Paleozoic
00/10-10-075-07W4/0	423	Paleozoic
00/10-11-075-07W4/0	415	Paleozoic
00/07-13-075-07W4/0	413	Paleozoic
00/06-23-075-07W4/0	440.5	Paleozoic
00/10-01-073-08W4/0	482	Paleozoic
00/10-03-073-08W4/0	494.5	Paleozoic
00/10-04-073-08W4/0	485	Paleozoic
00/10-05-073-08W4/0	490.5	Paleozoic
00/10-08-073-08W4/0	494	Paleozoic
00/06-10-073-08W4/0	493	Paleozoic
00/10-11-073-08W4/0	498	Paleozoic
00/10-13-073-08W4/0	482	Paleozoic
00/10-15-073-08W4/0	498	Paleozoic
00/10-16-073-08W4/0	511	Paleozoic
00/10-17-073-08W4/0	480	Paleozoic
00/10-24-073-08W4/0	475	Paleozoic
00/11-25-073-08W4/0	488	Paleozoic
AA/14-25-073-08W4/0	483	Paleozoic
00/10-30-073-08W4/0	457	Paleozoic
00/10-33-073-08W4/0	481	Paleozoic
00/06-34-073-08W4/0	492	Paleozoic
00/09-34-073-08W4/0	492	Paleozoic
00/10-35-073-08W4/0	481	Paleozoic
AA/05-36-073-08W4/0	481	Paleozoic
00/06-36-073-08W4/0	515.5	Paleozoic
00/07-36-073-08W4/0	508.5	Paleozoic
00/10-01-074-08W4/0	502	Paleozoic
00/10-02-074-08W4/0	481	Paleozoic
02/07-03-074-08W4/0	476.5	Paleozoic

00/11-03-074-08W4/0	476	Paleozoic
00/10-04-074-08W4/0	486	Paleozoic
00/01-06-074-08W4/0	471.5	Paleozoic
00/06-08-074-08W4/0	485.5	Paleozoic
00/10-09-074-08W4/0	486	Paleozoic
00/11-10-074-08W4/0	483	Paleozoic
00/02-11-074-08W4/0	486.5	Paleozoic
00/12-11-074-08W4/0	483	Paleozoic
00/09-12-074-08W4/0	492	Paleozoic
00/10-13-074-08W4/0	501	Paleozoic
00/13-13-074-08W4/0	498	Paleozoic
00/14-13-074-08W4/0	500.5	Paleozoic
00/15-13-074-08W4/0	504.5	Paleozoic
00/09-14-074-08W4/0	491	Paleozoic
00/12-14-074-08W4/0	483	Paleozoic
00/15-14-074-08W4/0	496	Paleozoic
00/16-14-074-08W4/0	495	Paleozoic
00/06-15-074-08W4/0	477	Paleozoic
00/10-17-074-08W4/0	479	Paleozoic
00/11-18-074-08W4/0	455	Paleozoic
00/02-23-074-08W4/0	489	Paleozoic
00/06-24-074-08W4/0	493	Paleozoic
00/11-08-075-08W4/0	441.5	Paleozoic
00/12-14-075-08W4/0	446	Paleozoic
00/14-18-075-08W4/0	460.5	Paleozoic
00/02-19-075-08W4/0	471	Paleozoic
00/10-02-074-09W4/0	450	Paleozoic
00/10-12-074-09W4/0	449	Paleozoic
00/10-13-074-09W4/0	440	Paleozoic
00/10-14-074-09W4/0	438	Paleozoic
00/16-23-074-09W4/0	437.5	Paleozoic
00/11-24-074-09W4/0	444.5	Paleozoic
00/11-28-074-09W4/0	442.5	Paleozoic
00/01-13-075-09W4/0	463	Paleozoic
00/06-13-075-09W4/0	456	Paleozoic

Appendix 3
Wabiskaw Wells
With Digital Core Analysis
Used in Unit
Characterization

Wabiskaw B Valley Fill Core Analysis Used in Formation Evaluation

UWI	RGS Top	RGS Base
AA/11-30-071-05W4/0	460.00	469.00
00/06-32-071-05W4/0	450.00	457.00
00/12-14-072-05W4/0	477.00	492.00
00/08-16-072-05W4/0	465.00	479.50
00/08-18-072-05W4/0	480.00	497.00
00/12-26-072-05W4/0	455.50	475.00
00/07-14-072-06W4/0	471.00	485.00
00/08-16-072-06W4/0	476.40	489.00
00/03-18-072-06W4/0	454.30	467.00
00/12-28-072-06W4/0	485.50	508.00
00/10-34-072-06W4/0	473.00	499.00
00/06-36-072-06W4/0	482.50	510.10
00/10-01-072-07W4/0	440.80	455.00
00/10-13-072-07W4/0	458.00	475.00
00/10-15-072-07W4/0	471.00	488.00
00/10-23-072-07W4/0	465.00	482.00
00/10-25-072-07W4/0	488.50	509.00
00/10-26-072-07W4/0	466.00	482.00
00/10-27-072-07W4/0	464.00	480.00
00/10-29-072-07W4/0	470.30	487.50
00/11-30-072-07W4/0	457.00	473.00
00/11-31-072-07W4/0	456.00	474.00
00/10-33-072-07W4/0	456.00	473.00
00/11-34-072-07W4/0	468.50	485.00
00/10-36-072-07W4/0	502.00	526.00
00/13-07-073-04W4/0	453.00	480.00
00/06-31-073-04W4/0	408.50	441.00
00/11-05-073-05W4/0	459.50	486.80
00/10-14-073-05W4/0	432.00	466.50
00/11-18-073-05W4/0	444.00	475.00
00/09-21-073-05W4/0	423.00	455.00
02/07-25-073-05W4/0	423.00	458.00
00/10-29-073-05W4/0	408.50	435.00
02/05-01-073-06W4/0	471.60	500.00
03/05-01-073-06W4/0	470.00	497.00
00/11-01-073-06W4/0	470.50	498.00
00/12-01-073-06W4/0	473.00	502.00
02/12-01-073-06W4/0	475.00	503.00
00/09-02-073-06W4/0	462.50	
AA/09-02-073-06W4/0	465.00	
00/07-03-073-06W4/0	466.00	499.50
00/06-05-073-06W4/0	472.00	498.00
00/06-06-073-06W4/0	484.50	511.00
00/06-07-073-06W4/0	471.00	496.00
00/06-08-073-06W4/0	458.50	485.00
00/11-09-073-06W4/0	435.00	464.50
00/06-10-073-06W4/0	450.00	483.00

00/10-11-073-06W4/0	458.50	492.50
00/06-12-073-06W4/0	457.50	487.00
00/06-13-073-06W4/0	449.00	481.00
00/11-14-073-06W4/0	456.50	492.00
00/11-17-073-06W4/0	431.00	463.00
00/06-18-073-06W4/0	438.50	466.00
00/11-22-073-06W4/0	419.00	453.00
00/09-26-073-06W4/0	415.00	444.00
00/11-32-073-06W4/0	398.50	430.00
00/10-01-073-07W4/0	491.50	511.50
00/10-02-073-07W4/0	497.50	516.00
00/10-03-073-07W4/0	488.00	505.80
00/10-04-073-07W4/0	470.00	489.00
00/10-05-073-07W4/0	450.50	466.50
00/11-07-073-07W4/0	449.00	466.00
00/07-08-073-07W4/0	470.00	487.50
00/10-09-073-07W4/0	490.00	508.50
00/06-10-073-07W4/0	502.00	520.00
00/10-11-073-07W4/0	487.00	508.00
00/10-12-073-07W4/0	470.00	492.00
00/10-13-073-07W4/0	456.00	480.00
00/10-14-073-07W4/0	476.00	495.00
00/10-15-073-07W4/0	494.00	512.50
00/06-16-073-07W4/0	497.00	514.00
00/10-17-073-07W4/0	487.00	507.00
00/10-19-073-07W4/0	491.50	513.00
00/10-20-073-07W4/0	484.00	506.00
00/11-21-073-07W4/0	486.00	505.00
00/10-28-073-07W4/0	475.00	495.00
00/09-29-073-07W4/0	512.00	536.00
00/10-29-073-07W4/0	492.00	515.00
02/10-29-073-07W4/0	497.00	519.00
00/15-29-073-07W4/0	495.92	518.10
03/15-29-073-07W4/0	493.00	515.00
04/15-29-073-07W4/0	493.40	520.00
06/15-29-073-07W4/0	493.00	515.00
00/10-30-073-07W4/0	478.00	498.50
00/10-01-073-08W4/0	463.50	482.00
00/10-03-073-08W4/0	475.50	494.50
00/10-04-073-08W4/0	467.00	484.70
00/10-08-073-08W4/0	475.00	494.00
00/06-10-073-08W4/0	474.50	493.00
00/10-11-073-08W4/0	479.00	500.00
00/10-13-073-08W4/0	462.00	482.00
00/10-15-073-08W4/0	479.50	498.00
00/10-16-073-08W4/0	491.00	511.00
00/10-24-073-08W4/0	456.00	475.00
00/11-25-073-08W4/0	459.00	478.00
00/10-30-073-08W4/0	438.00	457.00
00/10-33-073-08W4/0	458.00	477.50

00/06-34-073-08W4/0	467.50	487.00
00/10-35-073-08W4/0	456.00	476.00
00/06-36-073-08W4/0	489.00	511.00
00/10-08-074-04W4/0	344.00	370.00
00/10-02-074-05W4/0	372.70	410.00
00/07-19-074-05W4/0	398.00	420.50
00/10-13-074-06W4/0	373.00	401.50
00/10-15-074-06W4/0	371.00	396.00
00/06-19-074-06W4/0	402.00	422.00
00/06-20-074-06W4/0	386.50	406.00
00/08-21-074-06W4/0	374.00	395.00
00/08-24-074-06W4/0	391.50	418.00
00/04-25-074-06W4/0	410.00	429.00
00/03-26-074-06W4/0	400.50	423.00
00/03-27-074-06W4/0	386.00	405.00
00/09-27-074-06W4/0	417.00	434.50
00/04-28-074-06W4/0	386.00	404.00
00/09-28-074-06W4/0	382.00	400.00
00/11-31-074-06W4/0	387.00	400.00
AA/04-35-074-06W4/0	441.00	459.00
00/12-35-074-06W4/0	427.50	446.50
02/01-36-074-06W4/0	414.00	426.00
00/10-36-074-06W4/0	399.00	409.00
AA/10-11-074-07W4/0	440.00	463.00
00/05-19-074-07W4/0	458.00	475.00
00/02-25-074-07W4/0	406.40	427.00
00/10-25-074-07W4/0	394.00	410.00
00/10-01-074-08W4/0	483.00	502.00
00/10-02-074-08W4/0	457.00	477.00
02/07-03-074-08W4/0	448.20	467.50
00/11-03-074-08W4/0	452.30	472.00
00/10-04-074-08W4/0	457.00	477.00
00/06-06-074-08W4/0	436.00	456.00
00/06-08-074-08W4/0	457.00	476.00
00/10-09-074-08W4/0	456.10	476.00
00/11-10-074-08W4/0	454.00	472.00
00/02-11-074-08W4/0	467.00	486.50
00/12-11-074-08W4/0	453.20	472.00
00/09-12-074-08W4/0	473.00	492.00
00/10-13-074-08W4/0	470.10	489.00
00/11-13-074-08W4/0	477.50	496.50
00/13-13-074-08W4/0	468.00	486.50
00/14-13-074-08W4/0	470.70	490.00
00/15-13-074-08W4/0	474.00	494.00
00/09-14-074-08W4/0	462.00	480.00
00/10-14-074-08W4/0	458.50	476.50
00/11-14-074-08W4/0	455.10	473.00
00/12-14-074-08W4/0	451.00	469.00
00/15-14-074-08W4/0	456.20	474.00
00/16-14-074-08W4/0	464.50	483.00

00/06-15-074-08W4/0	447.00	467.00
00/10-17-074-08W4/0	456.00	474.00
00/11-18-074-08W4/0	430.90	448.00
00/02-23-074-08W4/0	458.00	476.20
00/06-24-074-08W4/0	465.70	482.50
00/10-02-074-09W4/0	428.50	450.00
00/10-11-074-09W4/0	423.50	442.00
00/10-12-074-09W4/0	429.00	449.00
00/10-13-074-09W4/0	422.00	440.00
00/10-14-074-09W4/0	420.00	438.00
00/16-23-074-09W4/0	423.00	437.50
00/11-24-074-09W4/0	425.20	440.50
00/11-28-074-09W4/0	431.00	442.50
AA/14-02-075-06W4/0	405.00	410.50
00/06-10-075-06W4/0	403.00	412.00
00/07-13-075-06W4/0	397.00	406.50
00/10-10-075-07W4/0	413.00	423.00
00/10-11-075-07W4/0	403.50	414.00
00/11-08-075-08W4/0	431.00	439.00
00/12-14-075-08W4/0	428.00	436.50
00/01-11-075-09W4/0	430.00	440.00
00/11-12-075-09W4/0	430.50	442.00

Appendix 3
Curriculum Vitea

JAMES J. WATERFIELD

Canadian Natural Resources Limited

EDUCATION

M.Sc. Earth Science (1990)
B.Sc. Geology (1986)

Memorial University of Newfoundland, St. John's, NFLD.
Dalhousie University, Halifax, N.S.

PROFESSIONAL AFFILIATIONS

Association of Professional Engineers, Geologists, and Geophysicists of Alberta

PROFESSIONAL EXPERIENCE

Canadian Natural Resources: District Geologist (Heavy Oil Team) (2003-Present)

- Responsible for technical review of geological activities within the heavy oil team.
- Develop exploratory and development opportunities in the Lindburg Area, Alberta.

Area Geologist (Thermal Team) (2002-2003)

- Planned and executed 2002-2003 drilling program including CSS Horizontal pads (Primrose), SAGD pairs (Tangleflags), strat wells and gas wells (Primrose, Wolf Lk Burnt Lk, T Flags). Planned 2003-2004 drilling program.
- Lead geologist on CNRL's Athabasca Gas over Bitumen Team.

Rio Alto Exploration: Geologist (2000-2002)

- Delineated, planned and drilled the SAGD pilot at Kirby. Participated in the planning of the full commercial project and assisted in the creation of the regulatory applications.
- Provided advisory input in Rio Alto's submissions to the Chard / Leismer Hearings.
- Responsible for development geology and divestment activities for all SE Alberta properties (HO, Oil & Gas). Took over responsibilities for all NE Shallow gas properties in addition to Oil Sands and SE lands in 2002.

Wascana Energy: Geologist (Heavy Oil) (1997-2000)

- Work closely with Geophysicist to develop and test Exploration plays and prospects in the Mannville and Bakken strata of SW Saskatchewan.
- Create integrated model of N. Smiley / West Buffalo Coulee pool from 3-D seismic and well data. Utilize results to develop and initiate waterflood expansion program with infill and stepout locations

Imperial Oil Resources Ltd.: Exploitation Geologist (Oil Sands) (1995-1996)

- Established regional mapping of bitumen reserves for accelerated land acquisition program. Posted and acquired leases privately and through Crown Sales.
- Development and execution of strat exploration program on Imperial leases.
- Geologic evaluation of SAGD Pilots at the UTF and Hangingstone sites.

Operations Geologist (Cardium) (1994-1995)

- Responsible for geologic aspects of Imperial's Cardium and Belly River.

Operations Geologist (Norman Wells) (1991-1994)

- Responsible for reservoir / production geology of Norman Wells pool (35000 bbl/day).

Operations Geologist (Judy Creek) (1990-1991)

- Responsible for reservoir geology of the Judy Creek B Pool (4400 bbls/day under horizontal hydrocarbon miscible and waterflood).

Texaco Canada Resources Ltd.: Exploration Geologist (Saskatchewan) (1989-1990)

- Responsible for generation of prospects in the Midale / Bakken of the Williston Basin.

Terry J. Jocksch
Canadian Natural Resources Limited

EDUCATION:

B. Sc. In Petroleum Engineering, 1991
University of Alberta

PROFESSIONAL AFFILIATIONS:

Association of Professional Engineers, Geologists and Geophysicists of Alberta

PROFESSIONAL EXPERIENCE:

Canadian Natural Resources: VP Exploitation (2004-04 to Current)

- Responsible for all reservoir and exploitation engineering in the Eastern Area operations.
- Co-ordinate corporate reserves evaluations.
- Review and analyze acquisitions and divestitures.
- Co-ordinate corporate budgets and strategic plans.

Exploitation Manager (2002-07 to 2004-04)

- Responsible for exploitation engineering in the NW Alberta gas area
- Provide training and guidance for reservoir engineers.
- Review and approve drilling programs and acquisitions.

Exploitation Manager (1999-09 to 2002-07)

- Responsible for exploitation engineering in the primary heavy oil and NE Alberta gas areas
- Provide training and guidance for reservoir engineers.
- Review and approve drilling programs and acquisitions.

Exploitation Engineer (1995-11 to 1999-09)

- Evaluate reserves and acquisitions
- Evaluate drilling prospects and conduct reservoir engineering studies for the primary heavy oil and NE Alberta gas region.

Numac Energy (Calgary, Alberta) (1994-01 to 1995-11)

Reservoir Engineer

- Conduct evaluations for exploration and development projects, including production forecasting, risk analysis, and economic evaluations in Central Alberta

Husky Oil Operations Ltd.: (Calgary, Alberta) (1991-05 to 1993-12)

Reservoir Engineer

- Assisted with preparation of budgets, strategic plans and reserves evaluations.
- Evaluated the field development of Husky's "cold production" program in heavy oil reservoirs.
- Initiated Horizontal well oil development in Morgan

Qi Jiang
Canadian Natural Resources Limited

EDUCATION:

Ph.D. (1997) and M.Sc. (1994) , in Chemical and Petroleum Engineering, University of Calgary
B.Sc. (1983), in Petroleum Engineering, Southwest Petroleum University

PROFESSIONAL AFFILIATIONS:

Association of Professional Engineers, Geologists and Geophysicists of Alberta

PROFESSIONAL EXPERIENCE:

Canadian Natural Resources: Exploitation Engineer (1999 to Current)

- Responsible for development planning and strategies in Athabasca oil sands area.
- Lead exploitation engineer for Primrose East commercial development design and application.
- Conduct field trial of LP- SAGD, gas and gas/solvent, steam/solvent process as follow up to CSS in Primrose.
- Provide technical support to EOR projects for both thermal and non-thermal recovery of heavy oils and bitumen.
- Representative in DOVAP project and other joint industry projects.
- Review reserves and acquisitions.

GravDrain Inc.: Senior Engineering Advisor (1997 to 1999)

- Provided consulting services to domestic and international projects on SAGD, VAPEX and horizontal well related technologies.
- Supervised research project on Steam and Gas Push (SAGP) project at University of Calgary.

Silk Energy Corp: Senior Engineering Advisor (1996 to 1997)

- Provided reservoir engineering evaluation and optimization for horizontal side tracking programs
- Provided strategic plan for acquisition.
- Technical advisory to senior management team.

University of Calgary: Research Assistant (1992 to 1996)

- Ph.D. and M.Sc. studies with focus on development of SAGD and VAPEX processes under supervision of Dr. Roger Butler.
- Developed wellbore simulator for thermal injectors and producers; theory to predict performance with bottom water coning to horizontal wells.
- Provided consulting services to thermal recovery projects.

PetroChina (Beijing): Reservoir Engineer and Team Leader (1983 to 1992)

- Supervised reservoir engineering group and provided training to engineers.
- Reservoir engineering designing and optimization for several commercial CSS and steam drive projects.
- Conducted reservoir simulation and economic evaluations.