MANAGING PRODUCED WATER FROM COALBED METHANE OPERATIONS:
A CRITICAL EXAMINATION OF ALBERTA’S REGULATORY FRAMEWORK

Sander Duncanson, Osler, Hoskin & Harcourt LLP

Prepared for the Canadian Bar Association’s National Environmental, Energy and Resources Law Summit: Water Law - Property, Protection and Policy
Banff, Alberta,
April 7 to 9, 2011

---

1 This paper was originally prepared in 2009 for the Faculty of Law, University of Calgary. The author has updated this paper to address recent developments in this area.
# TABLE OF CONTENTS

INTRODUCTION ......................................................................................................................... 1

COALBED METHANE AND PRODUCED WATER......................................................................... 2
   Coalbed Methane and Produced Water in Alberta ................................................................. 4
   Produced Water Disposal: What to Do With All This Water .............................................. 5

COMPETING FRAMEWORKS FOR REGULATING THE DISPOSAL OF
   PRODUCED WATER FROM CBM DEVELOPMENT .............................................................. 9
   Western United States ........................................................................................................ 9
   British Columbia .............................................................................................................. 13

REGULATION OF CBM PRODUCED WATER DISPOSAL IN ALBERTA .................... 16

RECOMMENDATIONS TO IMPROVE ALBERTA’S FRAMEWORK ...................................... 21

CONCLUSION ............................................................................................................................ 22
INTRODUCTION

When research for this paper began over two years ago, coalbed methane (“CBM”) was quickly becoming one of Alberta’s primary sources of energy production. Though CBM development was not economically viable on a large scale before the significant increase in natural gas prices in 2002-2003, by the end of 2006 there were already 10,723 CBM wells in Alberta.\(^2\) Forecasters at the time predicted that by 2025 eighty percent of new natural gas wells drilled in the province would target CBM and that the resource would account for fifty percent of Alberta’s total marketable natural gas production.\(^3\)

Since the end of 2008, a combination of low natural gas prices and technological advances in shale gas development has resulted in fewer investments in CBM in Alberta than was originally predicted. Nonetheless, the potential of CBM in Alberta is immense. The provincial government estimates that there could be as much as 14 trillion cubic metres (about 500 trillion cubic feet or Tcf) of CBM in Alberta.\(^4\) In contrast, the amount of conventional natural gas in Alberta that could be potentially marketed is estimated to be between 5.7 and 7.1 trillion cubic metres (205-253 Tcf).\(^5\) The provincial government has recently amended its Mines and Minerals Act to clarify CBM ownership in an attempt to encourage more CBM activity.\(^6\) As a result, when natural gas prices ultimately recover, CBM development will almost certainly increase as well.

CBM as a resource has significant economic potential, but it also poses several unique environmental challenges. Among these, the issues surrounding the disposal of produced water from CBM extraction may represent the greatest long-term risk to Alberta’s environment. As Gary Bryner has written, “[g]iven the importance of clean water in the arid West, no environmental issue has been more contentious or critical to the future of CBM development than that of the impacts on local water.”\(^7\)

The aim of this paper is to explore the issues surrounding produced water disposal from CBM development and to compare Alberta’s regulatory approach with those of other CBM-producing jurisdictions, namely British Columbia and several western U.S. states. While we will see that

---


\(^5\) Ibid.

\(^6\) R.S.A. 2000, c. M-17, s. 10.1 (amended on December 2, 2010).

Alberta’s approach is preferable in some ways to the systems adopted in other jurisdictions, all of the regimes fail to satisfy the basic regulatory requirements that are suggested in this paper. Specifically, Alberta fails to adequately promote re-use of CBM produced water for irrigation, livestock watering, municipal uses and industrial purposes wherever possible, thereby squandering the potential for CBM produced water to relieve some of the stresses on water resources in the province. Furthermore, the province’s framework appropriately establishes subsurface injection to be the default method of disposal for unusable CBM produced water, but regulates these injections in a way that allows for significant quantities of re-usable produced water to be wasted. Alberta’s subsurface injection strategy also fails to adequately protect groundwater reservoirs from being contaminated by the injected produced water through cross-aquifer seepage.

Alberta is already facing water shortages and over-allocation in some of its largest river basins, and scientists predict that water scarcity in the province will only increase in the future. Accordingly, the Alberta government ought to regulate CBM produced water disposal in a way that both protects existing water supplies and also preserves any value in the produced water itself.

The first section of this paper will examine the technical issues of coalbed methane extraction and produced water disposal. We will also look at some of the environmental impacts that CBM produced water disposal has had in the Western United States, where CBM production has been occurring for several decades. The second section will then discuss the regulatory regimes in the Western U.S. and in British Columbia to assess how jurisdictions outside of Alberta have addressed these environmental challenges. Next, we will examine and evaluate Alberta’s regulatory approach in relation to the specific issues applicable to the province and in contrast with the other jurisdictions. After highlighting some of the shortfalls in Alberta’s regulatory regime, especially in light of likely future changes in CBM developments, the final section will propose some recommendations for the Alberta government to improve the success of its framework for the long-term conservation of water resources in the province.

**COALBED METHANE AND PRODUCED WATER**

CBM is a form of natural gas that is found in coal seams. Historically, this largely odourless gas was deemed to be a dangerous obstacle to coal mining as miners could be killed through explosions or asphyxiation without any warning from smell, leading to the practice of bringing birds down into the mines to serve as living gas detectors (hence the popular maxim “a canary in a coal mine”). It has only been in the last several decades that this gas has been captured and sold as natural gas on a large scale. CBM development in Alberta was generally experimental and sporadic until the significant increase in natural gas prices in 2002-2003, which then made production of the gas economically viable for many natural gas operators in the province.

---


9 Bohrman, *supra* note 2 at 185.
CBM production differs from conventional natural gas production in several regards. Coalbed methane gas is adsorbed in coal formations under high pressures and only detaches from the coal when the pressure in the coal seam is reduced. Often, the coal seams are “wet” seams, meaning that they are saturated with groundwater. In order to depressurize the coal seam and allow the CBM gas to be released from the coal, wet coal seams must be “de-watered” prior to production.\(^{10}\) This de-watering process often takes many months (sometimes years) of continuous groundwater extraction, leading one commentator to note that “CBM development might better be described as a water management business rather than a gas business”.\(^{11}\) The water that is produced in this process may contain drill bit cuttings, lubricants, oil and diesel fuel from the drilling process, but the water is groundwater that may be part of or connected to aquifers that serve domestic, agricultural, commercial, or industrial needs.\(^{12}\)

Some CBM produced water is highly saline, akin to seawater, but it can also be fresh enough to meet drinking water standards. Salinity is measured by the amount of total dissolved solids (“TDS”) in the water. Water that is potable for human consumption usually contains less than 1000 mg/L of TDS, while seawater contains roughly 35,000 mg/L.\(^{13}\) Salinity of CBM produced water can vary throughout this spectrum; in fact, studies have indicated that the levels of TDS in water produced from coal seams during CBM operations can vary from basin to basin and even at individual sites within each basin.\(^{14}\)

The quantity of water that needs to be extracted from the coal seam prior to CBM production also varies greatly between regions and within coal seams, depending on the “permeability” of the coal.\(^{15}\) In the Powder River Basin in Montana and Wyoming, an average CBM well produces 2.5 gallons (9.5 litres) of water per minute, amounting to over 26 million gallons – or almost 100,000 cubic metres – of water over the full life of each well.\(^{16}\) This is the equivalent of more

---


\(^{14}\) Ingelson, McLean & Gray, supra note 12 at 25.


than 40 Olympic-sized swimming pools for each well, of which there are tens of thousands.17 Gary Bryner suggests that during the early phases of de-watering, average CBM wells in North America generally produce even more water, claiming that the “rate of water production during initial stages of development range from 400-800 barrels/day to 1,000-1,500 barrels/day in deeper wells.”18 Even at the lowest end of this range, water production would be over 10 gallons (38 litres) per minute. In exceptional cases, wells can far surpass these projections – in Gillette, Wyoming, for example, CBM wells have been documented producing 100 gallons of potable water each minute.19

Coalbed Methane and Produced Water in Alberta

CBM development in Alberta has not yet encountered the volumes of produced water that have been extracted in the western United States. To some extent, this can be attributed to the tendency for coal seams in Alberta to be less permeable than their American counterparts, thus capable of holding far less water.20 Another factor, however, may be the relative youth of Alberta’s CBM industry and its focus on regions containing “dry” coals. As Mary Griffiths has noted, “[b]y the end of 2006 there were 10,723 gas wells in Alberta that had been drilled or recompleted for CBM. More than 9,700 of these wells were in the Horseshoe Canyon/Belly River Formations, where the focus has been on the dry coals.”21

After the Horseshoe Canyon Formation and the Belly River Group, the next likely targets for CBM exploitation are expected to be the Ardley Zone and the Manville Group.22 The Manville coals are considered to have the greatest potential for CBM in Alberta, but they are fully saturated with water that generally contains over 4,000 mg/L TDS.23 Initial CBM production from the Manville Group began in 2005.24 The Ardley coals are also expected to be saturated with groundwater, though the TDS in groundwater extracted from the Ardley Zone will likely be

17 Olympic swimming pools are 50m x 25m x 2m, amounting to 2500 cubic metres. According to the testimony of John Bredohoeft, Ph.D, for the Wyoming & Montana Final Environmental Impact Statement on the development of Coal-Bed Methane (available online: <http://www.powderriverbasin.org/expert-john-bredohoeft-ph-d-final-eis-comments/>), there will be more than 75,000 CBM wells drilled in the Powder River Basin by 2017.

18 Bryner, supra note 7 at 545.


21 Griffiths, “Protecting Water”, supra note 3 at 27.


24 Griffiths, “Protecting Water”, supra note 3 at 27.
low enough for these water sources to be considered usable aquifers. CBM development in the Ardley Zone has consisted solely of test wells to date. Other likely areas of future CBM development in Alberta include the Foothills region, which is predicted to contain 20 Tcf of recoverable CBM. The geology in this region is less predictable than on the Prairies (where the divide between saline and non-saline water is relatively constant) and it is anticipated that much of the water that is located in the Foothills’ coal will be non-saline. As of 2007, the only pilot project in the Foothills region had been cancelled for producing too much water and too little gas.

Thus, once the most accessible CBM reserves in Alberta have been developed, CBM production will likely move to those formations that require much more de-watering. Even if the quantities of produced water on a per well basis are less than in the United States (due to lower permeability), they will nevertheless be significant. Perhaps with this realization in mind, the Alberta Energy Resources Conservation Board (“ERCB”, or the “Board”) recently proposed amendments to its Directive 044 to allow for increased non-saline water production thresholds for hydrocarbon wells. However, the Alberta government must also ensure that its regulatory framework is capable of managing the disposal of much greater volumes of saline and non-saline water that will likely be produced from CBM developments in the future.

Produced Water Disposal: What to Do With All This Water

Due to the immense quantities of water that may be produced during CBM production, the immediate question becomes what to do with all of this water, much of which is of a relatively high quality when compared with conventional oil and gas produced water. The most desirable options involve putting the water to some useful purpose such as irrigation, livestock watering,

---

25 Alberta Environment, supra note 22 at 11.
28 Ibid.
30 By 2003, conventional sources of oil and gas production generated an average of 1.6 million cubic meters of produced water each day. See Florence Hum et al., “Alberta Energy Futures Project Paper No. 19, Review of Produced Water Recycle and Beneficial Reuse” (2006) online: University of Calgary Institute for Sustainable Energy, Environment & Economics <http://www.ucalgary.ca/files/isee/ABEnergyFutures-19.pdf>. As CBM production generates much more produced water than conventional sources (Bryner’s lowest range for initial production was 400 barrels of produced water per day per well) and CBM may expand to 50% of the province’s natural gas production by 2025, it is likely that CBM operations in the province will generate produced water in the millions of cubic meters per day in the near future.
32 Coal deposits tend to be far shallower than the conventional resources that produce water along with hydrocarbons and salinity increases with depth. See Hum et al, supra note 30 at 11.
municipal purposes and industrial uses. These options generally require the CBM produced water to be of a relatively high quality (i.e. low TDS), though some applications such as oilfield injection and, to a certain extent, livestock watering can utilize water with more TDS than is fit for human consumption. In addition, current water treatment technologies allow produced water of any initial quality to be treated so that the water’s TDS levels are brought within acceptable thresholds for almost any purpose.

While converting CBM produced water to useful purposes should be encouraged wherever possible, this may not be feasible in some circumstances. The salinity of CBM produced water if untreated is often high enough to contaminate soils if used for irrigation and may also be high enough to harm livestock if the water is used for livestock watering. Municipal and industrial applications for produced water may also be limited by the quality of the water if untreated and, additionally, this water must often be transported over long distances to reach municipalities or industrial facilities. Transporting produced water over such distances raises further issues, including the cost of pipelines or trucks and the possibility of pipeline leaks. Treating produced water to remove the unwanted ions is feasible, but remains expensive and may be uneconomic for some applications. Therefore, putting CBM produced water to useful purposes may be impractical in situations where the water is either too saline or is produced in an area with no potential uses for the water. In these circumstances, some produced water will inevitably need to be disposed of.

The predominant disposal options for CBM produced water are surface disposal (with or without treatment), evaporation through evaporation ponds, and subsurface disposal. Evaporation ponds are the least common of these three options, largely because these ponds require large tracts of land – roughly five to six acres for every 20 CBM wells – and there are concerns regarding the release of toxic organics into the atmosphere. Surface disposal is certainly the cheapest method of disposing produced water, so if the produced water is pure enough that its discharge into surface water will not adversely affect the chemical composition of the river or stream, it can be argued that this is an economic and responsible disposal option. Surface disposal requires very

---


34 Ibid, at 177.

35 Bryner, supra note 7 at 545. Even though some studies have suggested that cows, for example, can consume far higher TDS quantities in their water than can humans, the salts and minerals in the produced water – even at very low concentrations – have been found to contaminate soils when they accumulate due to evaporation, resulting in poor yields and less grass available for livestock.

36 In 2001-2002 alone there were 174 leaks or ruptures affecting pipelines carrying water in the oilpatch in Alberta, from a total pipeline length of 18,800 km. As we will discuss in relation to surface disposal of CBM produced water, these waters may contaminate the environments that they are discharged into. See Griffiths & Severson-Baker, supra note 15 at 34.

37 Guntis Moritis, "Managing produced water" Oil & Gas Journal (3 September 2007) 15 (QL).

rigorous oversight, however, as the minerals commonly found in CBM produced water can be toxic to freshwater organisms.\textsuperscript{39} In addition, the quality of CBM produced water generally decreases over time.\textsuperscript{40} This means that any failure of regulators and/or operators to adequately manage surface disposal can result in severe environmental damage. In fact, the widespread use and inadequate management of surface disposal in some regions of the Western United States have been found to completely alter aquatic ecosystems, killing off salt-intolerant vegetation and organisms, and consequently causing extensive erosion.\textsuperscript{41} A second concern with surface discharge of produced water is that through disposing the water into rivers and streams, this water loses much of its potential for future re-use in the region where the water originated. This has been highlighted by the experiences of some States, such as Montana, Colorado and Wyoming, who recorded their fifth straight season of drought in the summer of 2002, while their CBM operators were disposing of billions of gallons of water, much of which was potable, into rivers and streams.\textsuperscript{42} Some of this discharged water can be used by consumers in the region who withdraw their water supplies from the rivers, but the remainder of this water will flow out of the jurisdiction forever.\textsuperscript{43} Users of this water farther downstream may be impacted as well, albeit less directly, as reliance on water supplies from rivers and streams that are artificially supplemented by produced water from CBM development may result in over-allocation when produced water discharges decrease in the future.

The final dominant disposal option for CBM produced water is subsurface injection. This method typically involves injecting the water into the same formation from where it originated or into deeper, lower quality, aquifers. Though producers are often required to test the water in the targeted aquifer to ensure that its ion concentration is equal to that of the produced water or higher (so that freshwater aquifers are not contaminated by produced water), there is a risk of the injected produced water contaminating aquifers that are connected to the targeted disposal formation due to the lack of adequate information about aquifer hydroconnectivity.\textsuperscript{44} Furthermore, by injecting produced water into deep aquifers of high ion concentrations (thereby protecting the higher quality shallow aquifers), any potential future re-use of the produced water itself may be squandered. CBM produced water is often marginally saline; saline enough to contaminate fresh water aquifers but of a quality that can readily be treated and put to useful

\textsuperscript{39} D. D. Gulley \textit{et al.}, "A Statistical Model to Predict Toxicity of Saline Produced Waters to Freshwater Organisms" \textit{Produced Water: Technological/Environmental Issues and Solutions} ed. James P. Ray & F. Rainer Engelhardt (New York: Plenum Press, 1992) at 89; One of the largest sources of litigation in the United States involving CBM produced water has surrounded surface disposal and its resulting degradation of aquatic ecosystems. For example, in the \textit{Wyo. Outdoor Council v. Army Corps of Engineers} 351 F. Supp. 2d. 1232, 1237 (D. Wyo. 2005) decision, the court found that the authority responsible for approving surface disposal proposals failed to consider the effects the permit would have on aquatic life, in violation of its own guidelines.

\textsuperscript{40} Griffiths & Severson-Baker, \textit{supra} note 15 at 35.

\textsuperscript{41} Murphy, \textit{supra} note 16 at 340.


\textsuperscript{43} Darin claims that the aquifers that are de-watered by CBM producers will not be naturally re-charged for hundreds of years. \textit{See ibid.}

\textsuperscript{44} Murphy, \textit{supra} note 16 at 342.
purposes.\textsuperscript{45} By injecting this marginally saline water into deep, highly saline aquifers, any re-use value in the produced water is lost.

The choice of disposal method utilized by any given CBM producer is ultimately determined by the regulatory regime in place in the operating area. In the United States, approximately 99\% of CBM produced water from the Powder River Basin in Montana and Wyoming is discharged to surface streams and rivers, while roughly 99\% of CBM produced water from the San Juan Basin in New Mexico is injected to subsurface reservoirs due to regulator concerns of environmental degradation.\textsuperscript{46}

The potential for serious and long-term environmental damage from mismanaged produced water disposal requires that government closely regulate these activities in a way that best serves the public interest. Despite the potential shortfalls of subsurface injection of CBM produced water, many believe it to be the most desirable disposal option in relation to the other methods. For example, West Coast Environmental Law has stated that they believe deep well injection to be the most sustainable method of disposal, presumably because this method can theoretically be used to store the water in accessible formations for future access.\textsuperscript{47} R.J. Cox has also concluded that, “[s]ubsurface disposal of produced water and wastes through deep wells is a safe and responsible practice where wellbore and formation integrity can be achieved….”\textsuperscript{48}

Therefore, subsurface injection seems to be the preferable disposal method of the three; it is much more plausible for province or State-wide operations than evaporation ponds and poses less of a threat to the environment than surface disposal. In addition, it has the potential to store marginally saline produced water for future re-use. As we have seen, however, there are some potential shortfalls of this method – namely the possibilities of cross-aquifer contamination and wasting re-usable produced water – that must be overcome by regulators if subsurface injection is to be used as the default disposal option for a whole jurisdiction.

Based on the foregoing, responsible regulation of CBM produced water disposal should adhere to the following three guidelines:

- First, the regulatory regime must promote re-use of the produced water for irrigation, livestock watering, municipal uses and industrial purposes wherever possible.

\textsuperscript{45} Florence Hum \textit{et al.}, \textit{supra} note 30.

\textsuperscript{46} Harvie, \textit{supra} note 11 at 15. It should be noted that CBM produced water in these two basins are generally of different qualities – produced water in the San Juan Basin tends to be far more saline than in the Powder River Basin.


• Second, surface disposal of CBM produced water should be avoided. Not only does this method risk extreme environmental degradation, but it also wastes water for future re-use.

• Finally, regulators should establish subsurface disposal as the default disposal method for unusable produced water, but must aim to prevent cross-aquifer contamination and must protect any potentially usable water, either groundwater or the produced water itself, from being mixed with water that is so saline that its potential value is lost.

Before turning to Alberta’s regulatory regime to evaluate its adherence to these principles, it will be useful to first examine the laws in other CBM-producing regions to see whether there are any strategies that have been effective in meeting these guidelines.

COMPETING FRAMEWORKS FOR REGULATING THE DISPOSAL OF PRODUCED WATER FROM CBM DEVELOPMENT

Western United States

CBM produced water in the United States is jointly regulated by the federal government and state governments. In order to put produced water to a useful purpose (such as irrigation, stock watering, etc.), CBM operators must first have rights to the water – the parameters for which are established by the state. In the western United States, water rights systems revolve around two key principles: first, water is a precious resource that should not be wasted and, secondly, any diversion of water must be for some “beneficial use”. Therefore, in contrast to public law jurisdictions where water is owned by the Crown who then allocates rights to use specified quantities of water for specific purposes, water rights in the Western United States arise when a user appropriates water for an application that is recognized by the State to be “beneficial”.

In theory, CBM producers would seem to be legally obligated to put produced water to a “beneficial use” in order to lawfully divert the water in the first place. In practice, however, States have adopted one of two approaches to CBM produced water: either the produced water is deemed to be a waste by-product of gas production, in which case the developer has not diverted it and has no rights to it; or, the de-watering process is itself deemed to be a beneficial use for produced water, thereby conferring water rights on the developer with no subsequent requirement to put the water to a useful purpose. As we will see, neither of these approaches is effective in promoting re-use of CBM produced water.

Colorado has adopted the first option, characterizing CBM produced water as a waste by-product of gas production. This means that while withdrawal of groundwater in Colorado typically requires it to be for a beneficial purpose and needs a permit from the state’s water regulator, the Colorado Division of Water Resources (“CDWR”), CBM produced water can be extracted

49 Darin, supra note 42 at 291.


without either.\textsuperscript{52} The CBM developer then has no rights to the water, so they must choose to do one of two things: dispose of the water pursuant to statutes regulated by the oil and gas regulator (in which case the CDWR never actually becomes involved, despite the significant potential impacts on the state’s water supply), or seek to put the water to a useful purpose. The latter option requires rights to water, so the developer must apply for a permit from the CDWR to use the water. Even if this permit is granted, the rights that are obtained by the developer are subject to the first-in-time, first-in-right principle.\textsuperscript{53} This means that even if the CBM operator were to treat the water in order to transfer it for a useful purpose, they would not necessarily have first rights to it.\textsuperscript{54} In practice, this system effectively encourages the CBM operator to dispose of the water rather than attempt to put it to a useful purpose.\textsuperscript{55} As Thomas Darin summarizes, “[b]y generally disposing of this byproduct water pursuant to statutes that assume the water to be ‘waste’ … these states are in fact wasting a valuable and scarce resource”.\textsuperscript{56}

The second approach to CBM produced water in the western U.S. is to characterize the extraction process as a beneficial use in and of itself, thereby conferring rights to the produced water on the CBM developer. Wyoming is an example of a state that has adopted this strategy, though it has been recognized that “Wyoming’s regulatory framework related to oil and gas development and to water management was never really structured to handle the particular challenges posed by CBM development”.\textsuperscript{57} In application, though CBM producers have rights to the produced water, they still require a permit from the State Engineer’s Office to put the water to any subsequent useful purpose.\textsuperscript{58} The CBM operator’s rights to the produced water are also subject to the first-in-time, first-in-right principle; thereby again creating the potential for the operator to lose priority to water it has extracted and treated. As with the first approach exemplified by Colorado, the requirement of obtaining a permit prior to putting the water to a useful purpose, coupled with the potential to lose water rights in accordance with the first-in-time, first-in-right principle, discourages the CBM operator from considering any potential applications for the produced water aside from disposal.\textsuperscript{59} In addition, characterizing the de-watering process as a beneficial use implies that the water has been diverted for a legitimate beneficial purpose (the equivalent of irrigation, stock watering, etc.) when in fact the only utility in the de-watering process is to allow subsequent gas production, a purpose completely unrelated to water.\textsuperscript{60}

\textsuperscript{52} Kwasniak, “Waste not Want not”, \textit{supra} note 12 at 369.

\textsuperscript{53} This rule confers the right to divert water to the longest-held rights-holders first, and then to the second-most senior rights-holder – assuming there remains water to be diverted, and so on. See Kwasniak & Lucas, \textit{supra} note 51 at 16-27.

\textsuperscript{54} Kwasniak & Lucas, \textit{supra} note 51 at 16-27.

\textsuperscript{55} \textit{Ibid} at 16-29.

\textsuperscript{56} Darin, \textit{supra} note 42 at 283.

\textsuperscript{57} Ruckelshaus Inst. of Envtl. & Natural Res., \textit{supra} note 10 at 2.

\textsuperscript{58} Kwasniak & Lucas, \textit{supra} note 51 at 16-27.

\textsuperscript{59} \textit{Ibid} at 16-29 to 30.

\textsuperscript{60} Kwasniak, “Waste not Want not”, \textit{supra} note 12 at 374.
Thus, neither approach to water rights in the Western United States has adequately established incentives for a CBM operator to put CBM produced water to a beneficial purpose outside of the de-watering process. As the Committee on Management and Effects of Coalbed Methane Development and Produced Water in the United States recently concluded, “[c]urrent regulations and water law do not provide incentives to CBM operating companies (or other stakeholders) to put produced water to beneficial use or offer many options to consider other than to dispose of [...] CBM produced water”.  

As we saw in the previous section, significant volumes of CBM produced water in the United States are discharged directly into surface rivers and streams. The U.S. Federal government regulates surface water and water pollution throughout the country through the Clean Water Act (“CWA”). This Act is administered by each State Engineer’s Office and establishes water quality standards designed to protect designated uses of water such as drinking water, agriculture, and fisheries. Pursuant to the Act, permits are required for any discharge of a pollutant into surface water and such permits are only to be granted if the discharge will not bring the quality of water below the CWA standards. In Northern Plains Resource Council v. Fidelity Exploration and Development Co., the United States Court of Appeals for the Ninth Circuit held that water discharged during CBM extraction is considered a pollutant and subject to the standards of the CWA. Therefore, CBM developers need to apply for a permit pursuant to the CWA if they wish to discharge any produced water into surface water, and their applications must demonstrate that the produced water will not bring the quality of surface water below the CWA standards. While this permit process would seem adequate in regulating surface disposal of produced water from CBM operations, it fails to consider that the quality of CBM produced water generally decreases over time. Additionally, as the Wyo. Outdoor Council v. Army Corps of Engineers case highlighted in 2005, the administrators of the Act may not consider the cumulative impacts of CBM produced water disposal from multiple wells. These shortfalls in how surface discharge of CBM produced water is regulated in the U.S. in practice demonstrate the difficulty in regulating surface discharge of CBM produced water, as even the slightest oversight can result in serious environmental damage.

The CWA applies only to surface waters, so the Federal government (through the Environmental Protection Agency, or “EPA”) in the United States regulates subsurface disposal of CBM

---

63 Bryner, supra note 7 at 547.
64 Clean Water Act, supra note 62 at §1311(a).
66 Griffiths & Severson-Baker, supra note 15 at 35.
produced water through the *Safe Water Drinking Act* (“SWDA”). Pursuant to the SWDA, no underground injection of water is allowed without a permit and injections cannot “endanger” formations that contain water that can potentially be used as a source of drinking water. In defining this standard, the EPA notes that “although aquifers with greater than 500 mg/L TDS are rarely used for drinking water supplies without treatment, the Agency believes that protecting waters with less than 10,000 mg/L TDS will ensure an adequate supply for present and future generations.” Therefore, the SWDA protects all aquifers with 10,000 mg/L TDS or less from subsurface injections of produced water unless it can be demonstrated that the produced water poses no threat to the aquifer’s quality. The presence of drill-bit cuttings, lubricants, oil and diesel fuel in the produced water left over from the drilling process could effectively prevent any injection of this water into a potential source of drinking water, even one that would require treatment to meet drinking water standards. As a result, the SWDA encourages regulators to require subsurface injections of produced water to formations containing water with more than 10,000 mg/L TDS.

This framework aims to protect groundwater resources for future generations and, in doing so, establishes conservative standards for groundwater quality worthy of protection. The SWDA does not, however, meet our guidelines for successful regulation of subsurface disposal. The SWDA affords administrators discretion in whether or not to include monitoring requirements in injection permits to test whether seepage occurs between the target formation and adjacent aquifers. These monitoring requirements are crucial to guarding against cross-aquifer contamination, but are not mandatory under the Act. In addition, the SWDA effectively directs operators to waste significant volumes of produced water that could potentially be put to useful purposes by injecting it into groundwater formations containing more than 10,000 mg/L TDS. Thus, in both of our guidelines for subsurface injection – preventing cross-aquifer contamination and protecting all non-saline and marginally saline water, including the produced water itself – the regulatory regimes in the Western United States fall short.

The United States offers several important lessons for Alberta with regard to how it has regulated CBM produced water disposal. First, it shows that appropriation rather than allocation of water rights is ineffective in regulating CBM produced water so that it may be put to a useful purpose rather than being disposed of. Second, by permitting surface disposal of CBM produced water at all, a jurisdiction opens the door for significant environmental damage resulting from any oversights by administrators or operators. Third, the EPA in the U.S. has set a conservative level for TDS in water that requires government protection. This target addresses concerns of future water scarcity and ensures that even water that is not desirable at present is protected so that future generations may treat it and use it. The final lesson for Alberta from the regulatory approaches in the United States is that in focusing primarily on protecting groundwater resources from contamination by produced water, U.S. regulators have failed to adequately protect any value in the produced water itself.

---


69 *Ibid*, at s. 1421.

British Columbia

All water in British Columbia is owned by the Crown, meaning that any rights to use or divert water in the province are conferred by the Ministry of Environment ("MOE") through a license issued under its Water Act.71 However, section 1.1 of the Water Act exempts groundwater extractions from any licensing requirement. Accordingly, CBM operators do not require a license in order to divert groundwater during the de-watering process. The only approval required to de-water a coal seam in British Columbia is a well authorization from the Oil and Gas Commission ("OGC") under the Oil and Gas Activities Act.72

The CBM industry in B.C. is in its infancy, so the B.C. government enacted a “Code of Practice for the Discharge of Produced Water from Coalbed Gas Operations” ("COP") under its Environmental Management Act in 2005 to clarify its regulations regarding CBM produced water disposal.73 The COP expressly considers beneficial use of non-saline produced water for irrigation, habitat, livestock, or recreation purposes.74 In fact, subsection 3(1) of the COP holds that “a discharger must evaluate options for potential beneficial uses of produced water before beginning any discharge of produced water under this code of practice.”75 In contrast to the American approaches, British Columbia thus explicitly recognizes that putting CBM produced water to a useful purpose should be encouraged at the outset, before any disposal scheme is commenced. How this requirement is to be enforced, however, is unclear. The COP shifts the regulatory process from a prescriptive, rules-based approach to a more flexible, guideline-based approach; placing the onus on industry itself to develop schemes for produced water disposals. While the COP expects that industry will consider “potential beneficial uses” of produced water prior to disposing of the water, it is the operator that will ultimately decide whether it will seriously consider putting the water to a useful purpose or not.76 Even if adequate enforcement mechanisms were in place, the evidentiary burden on the regulator to prove that the CBM producer had failed to explore potential uses for the water would likely discourage the regulator from enforcing this provision in absence of a clear breach. Nevertheless, the intention of the B.C. government in encouraging industry to consider potential useful purposes of CBM produced water is a clear improvement over the western U.S. models.

In terms of surface disposal, the COP, like the CWA in the U.S., focuses on regulating, rather than prohibiting, this method of disposing of CBM produced water, perhaps in an attempt to attract CBM operators to the province through lower disposal costs. Pursuant to the COP, disposal of produced water directly into perennial and seasonal streams is permitted so long as it does not “impair the proper ecological function of the … stream or otherwise [cause] excessive

71 Water Act, R.S.B.C. 1996, c. 483 [B.C. Water Act]
72 Oil and Gas Activities Act, R.S.B.C. 2008 c. 36.
73 Code of Practice for the Discharge of Produced Water from Coalbed Gas Operations, B.C. Reg 156/2005 (CanLII) [COP].
74 Ingelson, McLean & Gray, supra note 12 at 37.
75 COP, supra note 73 s. 3(1) [emphasis added].
76 West Coast Environmental Law, supra note 47.
erosion.” As we have seen with the experiences in the United States, by permitting surface disposal at all, regulators create serious risks to the environment in the occasion that their regulatory oversight fails to adequately protect the surface water from contamination. In fact, critics in British Columbia have argued that regulators in the province place no limit on the number of operations that can discharge into the same river or stream, suggesting that the cumulative impacts of all produced water discharges may not be sufficiently considered by the regulators. Perhaps in response to these concerns, the government of British Columbia amended the COP in 2008 to prohibit all surface discharge of CBM produced water unless an exemption has been granted under the Waste Discharge Regulation. It has yet to be seen how stringent the government’s requirements will be in granting such exemptions, but this amendment reflects the experiences in other jurisdictions and evidences the government’s support of our conclusion that surface disposal of CBM produced water should be avoided wherever possible.

Similarly, the B.C. government’s Energy Plan mandates that subsurface injection is to be the new default method for disposal of unusable CBM produced water. These injections are regulated by the OGC pursuant to its “Guideline for Approval to Dispose of Produced Water”, the Oil and Gas Activities Act, the Environmental Protection and Management Regulation, and the Drilling and Production Regulation. Notably, the only mentions of water quality in B.C.’s laws surrounding subsurface injection are in clause 6(1)(b) of the COP, which holds that the TDS in the produced water must be “less than or equal to 2 times the [TDS] in the underlying groundwater…to a maximum of 4 000 mg/L”, and the requirement in the Environmental Protection and Management Regulation that an oil and gas operator not cause any “material adverse effect on the quality, quantity or natural timing of flow of water” in any aquifer or waterworks. “Aquifer” is defined in subsection 1(z) of the Regulation as one or more geological formations

---

77 COP, supra note 73 at s. 4(2).
79 Code of Practice for the Discharge of Produced Water from Coalbed Gas Operations, B.C. Reg. 156/2005. Available online: Government of British Columbia, Ministry of Energy <http://www.env.gov.B.C.ca/epd/industrial/regs/codes/coalbed/pdf/minister-order-294.pdf>. It should be noted that the way in which the COP has been amended is to prohibit surface disposal unless an exception has been granted in section 4.1 of the Waste Discharge Regulation, B.C. Reg. 320/2004 – a section that sets out a general exception for all coalbed methane wells once certain administrative procedures have been complied with. It is unclear as to whether this amendment to the COP will achieve the B.C. Government’s objective of curbing surface disposal of CBM produced water, as the Ministry of Energy has set out in its Energy Plan, available at <http://www.energyplan.gov.B.C.ca/PDF/B.C._Energy_Plan_Oil_and_Gas.pdf>.
80 Energy Plan, ibid.
82 Environmental Protection and Management Regulation, B.C. Reg. 200/2010.
84 COP, supra note 73 at s. 6(1)(b).
85 Environmental Protection and Management Regulation, supra note 82, s. 9 and 10.
containing water with up to 4,000 milligrams per litre of TDS and is capable of storing, transmitting and yielding that water. 86

This regime is considerably weaker than the EPA framework we examined above. Not only does B.C.’s framework potentially allow for produced water (which, as we have seen, can contain many harmful substances besides ions and salts) to be injected directly into fresh water aquifers – so long as the produced water has a low TDS and does not result in a “material adverse effect” – but it also fails to prevent high-quality produced water from being injected into deep, highly-saline aquifers, thereby wasting its potential future value. In fact, all produced water that contains more than 4,000 mg/L TDS must be sent to deep formations, despite the U.S. EPA’s recognition that all water with less than 10,000 mg/L TDS may be valuable in the future. A second striking shortfall of B.C.’s regulatory regime for subsurface disposal is the absence of any input from the provincial water regulator (MOE) in the approval process. The OGC here is the sole government overseer of subsurface disposal, despite the MOE’s relative expertise in water issues and the mandate of the OGC to regulate oil and gas activities, 87 as opposed to the MOE’s mandate to generally manage, protect and enhance the environment. 88 Arguably, the MOE is better suited to managing the issues surrounding produced water disposal. A final criticism of B.C.’s regulation of subsurface disposal of CBM produced water is that there are no mandatory monitoring requirements on the CBM operators to ensure that the aquifers surrounding the injection formation are protected from cross-aquifer contamination.

In summary, British Columbia’s model for regulating CBM produced water conforms much closer to our three guidelines than the Western U.S. regimes. First, the B.C. government has emphasized that CBM operators must consider any potential beneficial uses of CBM produced water before that water can be disposed of. Second, while surface disposal of CBM produced water was permitted in B.C. until 2008, the government has recognized that surface disposal must be avoided in order to protect the aquatic environment and to prevent wasting the resource potential in the produced water. Finally, B.C.’s approach does position subsurface disposal as the default disposal method in the province.

B.C.’s regulatory framework does, however, have some notable shortfalls. First of all, de-watering a coal seam does not require a license under the Water Act, despite the volumes of relatively high quality water that may be produced in the process and the significance that this water may have on local water supplies. Secondly, while the 2005 COP encourages putting CBM produced water to useful purposes rather than disposing of it, the lack of enforcement mechanisms and the discretion afforded to industry in the COP are unlikely to motivate CBM operators to pursue any alternative to the most economic option available, regardless of potential uses for the produced water (treatment of CBM produced water in order to re-use it may well be more expensive than simply disposing of it). Third, there are very limited rules surrounding water quality in subsurface injection, allowing for the possibility of contaminating valuable groundwater resources as well as potentially wasting valuable produced water. Fourth, subsurface disposal is regulated entirely by the province’s OGC with no input required from the

86 Ibid, s. 1(z).
87 Supra, note 72 at s. 4.
88 Environmental Management Act, R.S.B.C. 2003, c. 53, s. 5.
MOE, which has far more expertise in water issues. Finally, there are no mandatory monitoring requirements to guard against cross-aquifer contamination.

REGULATION OF CBM PRODUCED WATER DISPOSAL IN ALBERTA

Water is regulated in Alberta primarily by Alberta Environment (“AENV”) through the Water Act, and, like in British Columbia, all rights to water use and water diversion are conferred by the Crown (with some common law and statutory exceptions). The only limits on water rights are those set out in licenses, common law and statutes; there is no limit based on whether or not the water has been put to a “beneficial use”. While the Act requires a government license for all “activities”, including de-watering and water disposal, the Water (Ministerial) Regulation explicitly exempts diversions of saline water (defined as exceeding 4,000 mg/L TDS) from the requirement of a government license. Therefore, an operator who intends to de-water a coal seam in order to extract CBM must first determine the salinity of the water. If it exceeds 4,000 mg/L TDS, the operator can proceed with de-watering without a license. If a license is required, evidence must be provided by the operator to AENV to show that the proposed diversion will not cause adverse effects on the water supply of nearby users over the short-term or long-term, and will not cause adverse effects on the source aquifer or other aquifers. The operator is also required to develop a plan for disposing of the water and this plan must be approved by AENV prior to the granting of any license. For “saline water”, no such AENV approvals or impact assessments are necessary.

While AENV has jurisdiction over water diversions generally, the ERCB administers the Oil and Gas Conservation Act, which requires Board approval for the gathering, storage, and disposal of water produced in conjunction with oil and gas. The Board does not distinguish between saline and non-saline produced water, so even if the produced water has already been licensed by AENV, it must also be disposed of in accordance with a scheme approved by the ERCB. Treating produced water and putting it to a useful purpose – rather than disposing of it – is allowed by the ERCB, but no preference is given to this option and the onus is on the operator to choose the appropriate method for disposal.

89 Water Act R.S.A. 2000, c. W-3, s. 3(2) [Alberta Water Act]


91 Alberta Water Act, supra note 89 at s. 36; Water (Ministerial) Regulation Alta. Reg. 205/1998, s. 1(1)(z), Sched. 3, s. 1(e).


93 Ibid at 6.

94 Oil and Gas Conservation Act R.S.A. 2000, c. O-6, s. 39(1)(c).

95 Oil and Gas Conservation Regulations, Alta. Reg. 151/1971, s. 8.040

For practical and economic reasons, the application of this framework is that CBM operators will be unlikely to attempt to re-use any of their produced water. For both saline and “non-saline” produced water, we have seen that the operator must choose the method of use or disposal of the water at the pre-development stage, before any de-watering can take place. Information regarding the exact quality of the water or the amount of water that will be produced is often imperfect before de-watering, thus creating uncertainty with regard to the extent of any treatment required and the potential applications for that water. Additionally, as we will soon see, there are legal uncertainties regarding the right to use, rather than divert, the water and the ability for the operator to transfer or sell this water to a potential user. As a result, non-saline and saline produced water in Alberta are both usually disposed of rather than converted to a useful purpose, as the risks of pursuing re-use of the produced water outweigh the potential benefits.

The legal uncertainties surrounding re-using produced water stem from the licensing process established in the Water Act. AENV may grant a license to divert water or to use water, but it is unclear under the Act whether a license to divert water may be amended to allow the operator to then use the water. In addition, there are conditions in the license that stipulate the methods to be used for produced water disposal; these too would need to be amended, but as the Water Act enables a licensee to apply to add terms or conditions to their license only, it is unclear as to whether this would enable a licensee to remove a disposal requirement. Unlike B.C.’s Water Act which expressly allows for these amendments to water licenses, Alberta’s Act is silent. Until this uncertainty surrounding the rights of licensees to use, rather than simply divert, produced water is clarified, operators will be unlikely to expend significant resources to treat or find applications for their produced water.

Regarding “saline” water under the Act (which as we have seen may still be well under the EPA’s threshold of 10,000 mg/L TDS), the water is exempt from a license, thereby removing the problems of license amendments to allow for putting the water to a useful purpose. Theoretically then, if an operator wished to treat marginally saline water to put to a useful purpose they would only need to amend their ERCB disposal requirements. However, if an operator wished to transfer that treated water to a third party – such as an irrigation district or another energy company wishing to use water for enhanced recovery – they would likely be prohibited from doing so. Under the Water Act, transfers of water rights are only possible between licenses and saline water is unlicensed. In addition, the Act does not allow for the commercialization (i.e. sale) of produced water, as all water is owned by the Crown. Finally, once saline water is treated and becomes non-saline, it is unclear whether or not the exemption under the Water (Ministerial) Regulation continues to apply. It is possible that once operators treat saline produced water in order to put it towards some useful purpose, they would then need to apply to AENV for a license to use that water.

This combination of legal uncertainties and commercial obstacles present in the Water Act from the perspective of a CBM operator, in conjunction with the discretion afforded to the operator to choose how best to use or dispose of the water, effectively discourages operators from putting

---


98 Alberta Water Act, supra note 89 at s. 54(1)(b)(iii)

either saline or non-saline produced water to any useful purpose. As a result, most CBM produced water in Alberta is simply disposed of.

AENV’s “Guidelines for Groundwater Diversion” and ERCB Information Letter IL 91-11 allow for AENV and the ERCB to consider surface discharge of CBM produced water, provided that other environmental impacts are addressed.100 However, this disposal option method is very rare in the province as AENV has adopted a precautionary approach towards this method of disposal and generally considers surface disposal to be prohibited under the Oil and Gas Conservation Act.101 As such, the ERCB uses subsurface injection as its default method of produced water disposal. In regulating this activity, the Board’s Directive 065 prohibits disposal of produced water into the zone of origin (the aquifer that has been de-watered) or any other formation identified as containing usable groundwater.102 While this framework is very similar in design to the EPA’s in the United States, AENV defines an aquifer containing usable groundwater as any “strata capable of producing water with a total dissolved solids content of less than 4,000 mg/L.”103 Thus, the level of TDS in water that is protected from contamination is substantially lower in Alberta than the EPA’s standard of 10,000 mg/L TDS. The aim of the regulation, however, is the same: to protect usable groundwater resources from contamination by produced water injections. As in the U.S., if the zone of origin does not contain “usable” groundwater, then the ERCB will generally require the CBM operator to return the produced water to that zone.104 If it does contain usable groundwater, then the subsurface injection must target deeper, more saline formations.

Turning to our guidelines for responsible regulation of subsurface injection: preventing cross-aquifer contamination and protecting any value in the produced water itself, Alberta goes farther than either B.C. or the United States in requiring operators to monitor the aquifers surrounding injection formations to guard against cross-aquifer seepage. In fact, the ERCB has stressed that regular monitoring of the target aquifer and surrounding aquifers should be conducted by operators to “ensure initial and ongoing confinement of the disposal fluid in the interests of both hydrocarbon conservation and groundwater protection.”105 Alberta’s framework thus aims to protect usable aquifers from being contaminated through communication with neighbouring formations that are targeted for injection of produced water. With regard to the second of our guidelines for regulating subsurface injection, however, Alberta’s regulatory regime, like the American model, aims primarily at protecting water resources in the ground; it fails to preserve


105 Directive 051, supra note 96 at 5.
any value in the produced water itself. Again, as subsurface injection of produced water is only permitted into formations that are deemed unusable, any potential re-use value in the produced water will be lost when it is mixed with the lower quality water in the target injection formation. As there is no requirement in Alberta’s regulatory framework for subsurface storage of usable produced water for future access, the majority of CBM produced water is injected to deep formations where any of its re-use value is lost for future generations.106

In addition to Alberta’s failure to encourage CBM operators to put produced water to useful purposes and its inadequate strategy for subsurface injection of produced water, there are other shortfalls in its regulatory regime. First, the overlap in jurisdiction between the ERCB and AENV results in conflicting mandates, unnecessary complexities and regulatory gaps.107 Separate applications are often required for each agency and there is a concern that information gathered by one is not adequately shared with the other. In addition, the ERCB must approve all produced water disposal schemes, but its aim is to promote efficient use of the province’s oil and gas resources and it must consider the economics of a scheme in order to avoid placing too large a burden on operators. Industry has made clear that produced water disposal requirements may pose significant obstacles to CBM development and are potentially CBM “project breakers”.108 Thus, there is a risk that the ERCB, in balancing between economic and conservation interests, will fail to adequately protect water resources in order to foster economic development. In contrast, AENV regulates all water in the province with a view to long-term conservation and sustainability. Given the increasing demands on Alberta’s already limited water resources, this agency should be closely involved in how CBM produced water is managed. In practice, however, the ERCB plays the dominant regulatory role for all subsurface injection schemes. Following the Alberta government’s recent announcement that additional upstream oil and gas regulatory functions will be consolidated with the ERCB, the ERCB’s primacy in regulating produced water disposal will likely increase in the near future.109

A second additional shortfall of Alberta’s regulatory framework is with regard to groundwater monitoring. We have seen that the ERCB requires CBM operators to maintain monitoring wells in aquifers surrounding the target formation in order to guard against cross-aquifer seepage. This requirement goes farther than either the U.S. or B.C., but does not provide enough safeguards if subsurface disposal is to be relied on as the primary method of produced water disposal in the province. Across Alberta, there remains limited knowledge of groundwater systems and aquifer connectivity.110 The premise underlying subsurface injection and its

---

106 Griffiths, “Protecting Water”, supra note 3 at 35; See also Mountain View Regional Water Services Commission (Re) [2004] A.E.A.B.D. No. 9. Alberta Environmental Appeal Board, where the use of fresh water for oilfield injection (or enhanced recovery), which involves injecting water into an oil- or gas-bearing formation, was determined to result in the removal of this water from the water system for millions of years.


comparative advantages over other disposal options is that once the water is disposed of, it will remain contained in the targeted subsurface formation. Scholars have noted, however, that “[m]ore research is needed to characterize the hydrologic connection between disposal formations and shallow aquifers/surface water.”¹¹¹ While some communication between different formations has been proven, it is not known the extent of the mixing or how long it takes for mixing to occur.¹¹² In addition, the government must have an understanding of the quality of water in a neighbouring hydrologic formation prior to subsurface injection in order to determine whether the quality of the groundwater is deteriorated as a result of subsurface injections. Again, it is generally accepted by experts that “[t]he baseline data on the province’s groundwater resources is currently inadequate”.¹¹³ Alberta’s groundwater observation well network (“GOWN”) has shrunk by half since the early 1990’s from approximately 400 observation wells to roughly 200 (Manitoba, in contrast, maintains 600 observation wells).¹¹⁴ This is clearly inadequate and must be improved. While operators should continue to be required to maintain monitoring wells in the aquifers surrounding subsurface disposal formations, the government must also actively maintain and expand its own groundwater monitoring network to serve as an early-warning system to ensure that subsurface injection is working in practice as well as planned.

In relation to the United States and British Columbia, Alberta’s regulatory framework does have some comparative strengths such as its mandatory groundwater monitoring requirements, but it has also failed to follow some of the competing frameworks’ more successful strategies. In terms of encouraging operators to put CBM produced water to useful purposes, Alberta fares little better than the United States. In both jurisdictions, practical and legal obstacles effectively discourage operators from considering any option other than disposal. B.C., on the other hand, has explicitly required CBM operators to evaluate potential uses for their produced water other than disposal. As a result, commentators have noted that “[t]he regulatory framework in British Columbia more thoroughly addresses the issue of beneficial use of produced water than does the Alberta framework.”¹¹⁵

Turning to the regulation of disposal, Alberta has effectively avoided surface disposal where possible – unlike many States in the U.S. Its level for protection of usable groundwater at 4,000 mg/L TDS, however, is far lower than the 10,000 mg/L TDS standard set by the EPA. The EPA’s level far more adequately accounts for future water shortages and the necessary implication that lower quality water will be sought for treatment and other applications in the future. In fact, studies indicate that water with up to 7,000 mg/L TDS can be used as a water


¹¹³ Ingelson, McLean & Gray, supra note 12 at 40.

¹¹⁴ Griffiths, “Protecting Water”, supra note 3 at 17.

¹¹⁵ Ingelson, McLean & Gray, supra note 12 at 40.
source for livestock without treatment.\textsuperscript{116} Finally, Alberta, like B.C., has placed its provincial oil and gas regulator in the position of dominant government overseer of subsurface disposals of CBM produced water, thereby placing this activity under the ERCB’s mandate of resource conservation, as opposed to AENV’s mandate of environmental protection. In all of these areas, the Alberta government must strive to improve in order to prepare for far greater volumes of CBM produced water that are likely to be extracted in the province in the future.

RECOMMENDATIONS TO IMPROVE ALBERTA’S FRAMEWORK

The first priority for regulators of CBM produced water must be to promote putting the water to useful purposes. In Alberta, we have seen that CBM operators are not encouraged to put their produced water to useful purposes and this re-use may not even be legally possible. Accordingly, Alberta must revise its \textit{Water Act} to remove the uncertainties and barriers in the Act to re-using produced water and, further, to require CBM operators to consider potential re-uses of produced water before simply disposing of it. Such a revision of the Act is consistent with both the purpose of the Act and the mandate of AENV – to manage and conserve water resources in Alberta in order to sustain the environment and high quality of life in the present and in the future.\textsuperscript{117} In addition, the government must play a more active role in promoting the use of produced water, perhaps even subsidizing operators who use produced water for useful purposes.

If no practical applications exist for CBM produced water, guidelines must be developed to direct operators to inject any produced water that has potential for re-use such that the water may be accessed in the future and such that its value is not degraded in the process. Injection to the water’s zone of origin may satisfy this requirement, or new formations may need to be identified with this goal in mind.

The Alberta government must also reconsider both the level at which usable water is defined by AENV and the exemption of saline water from AENV licenses in the \textit{Water (Ministerial) Regulation}. As the Rosenberg International Forum on Water Policy noted regarding the current definition of “saline” water in Alberta:

\begin{quote}
Such a regulation was appropriate for a different era in which it was infeasible technologically and financially to reclaim brackish waters with this level of TDS. Today, such waters are routinely desalted and have become important sources of supply in many regions of the world. Indeed, groundwaters between 4000 and 10,000 mg/L have become an important global resource because they can be economically treated for domestic and other uses. Given the potential for heavy demands on water in the future it would be advisable to expand the definition of regulated groundwater in Alberta so as to ensure that all waters with economic value are regulated.\textsuperscript{118}
\end{quote}

\textsuperscript{116} Committee on Management and Effects of Coalbed Methane Development and Produced Water in the United States, \textit{supra} note 33 at 103.

\textsuperscript{117} \textit{Alberta Water Act}, \textit{supra} note 89 at s. 2(a).

\textsuperscript{118} Rosenberg International Forum on Water Policy, \textit{supra} note 110 at 15.
As we have seen, the EPA in the United States protects all water with 10,000 mg/L TDS or less.\textsuperscript{119} Alberta should consider raising the level of TDS for “usable” water to this level, or perhaps even higher. Thomas Darin, for example, claims that water with TDS between 10,000 and 20,000 mg/L can potentially be treated and put to beneficial uses.\textsuperscript{120} In conjunction with raising the level of TDS for “usable” water in the province, the Alberta government should also remove the exemption for “saline” water under the Water (Ministerial) Regulation from obtaining a license for any diversion of water. The exemption is the product of a long history of conventional oil and gas development in Alberta whereby some quantities of saline water from deep hydrocarbon deposits were necessarily produced along with the targeted resource.\textsuperscript{121} The water was unusable and was disposed of to deep subsurface formations almost immediately, so there was little need in having this water regulated by AENV as well as the ERCB. Due to the rapid development of CBM from shallower formations containing water with far less salinity, such an exemption no longer makes sense.

Finally, regulators in Alberta must work to expand knowledge of groundwater systems in the province. As mentioned above, if the default method for produced water disposal in Alberta is to be subsurface injection, and there is limited understanding of how the subsurface formations that the water is injected into communicate with other formations, the province must monitor its groundwater resources closely to ensure that they are not being contaminated. Further, the province must establish safeguards for the possibility that contamination does occur and subsurface injection is found to be unsustainable. Perhaps the simplest strategy in this regard would be to include a condition in all subsurface injection approvals that if ever it became apparent that the specific disposal scheme was not working as originally anticipated, then the disposal would immediately cease until a suitable alternative was agreed upon. Finally, in order for Alberta to adequately regulate CBM produced water disposal for the present and future, the province must ensure that adequate resources are in place to process the increased numbers of applications for CBM produced water disposal that are expected in the coming years.

**CONCLUSION**

There are promising indications that Alberta is already moving towards several of the above recommendations, both as a result of industry and government initiatives. The Canadian Association of Petroleum Producers (“CAPP”) on behalf of the natural gas industry has adopted best management practices that promote CBM operators putting produced water to beneficial uses wherever possible.\textsuperscript{122} On the government side, the province formed the Coalbed Methane/Natural Gas Multi-Stakeholder Advisory Committee (“MAC”) in 2003 as part of a multi-phase review initiated by Alberta Energy to determine if there were areas where the existing rules and regulations governing CBM could be improved. In 2006, the MAC issued a final report that included recommendations for encouraging CBM operators to put produced water to beneficial uses.

\textsuperscript{119} United States Environmental Protection Agency, \textit{supra} note 70 at E-1.

\textsuperscript{120} Darin, \textit{supra} note 42 at 301.

\textsuperscript{121} Kwasniak, “Waste not Want not”, \textit{supra} note 12 at 388.

water to useful applications as a default disposal option; encouraging operators to adopt strategies for treating and re-using marginally saline water; revising existing approvals that allow industry to use fresh water to require them to use produced water when economically available; and, finally, expanding the current groundwater monitoring network and data management system, beginning in areas that could experience intense CBM development.\textsuperscript{123} The Alberta government has accepted all 42 of the MAC’s recommendations pertaining to water and as of August 2009 had claimed to have made progress on each of them.\textsuperscript{124} Progress on encouraging re-use of produced water was evident in the ERCB’s draft directive calling for in-situ operators in the oil sands – who inject water and steam into deep bitumen deposits to force the resource to the surface – to limit their use of fresh water and to take up to 25\% of their total water demands from saline groundwater sources, which would likely include saline produced water.\textsuperscript{125} In terms of groundwater monitoring, the former Leader of the Opposition in Alberta, Dr. David Swann, has also conceded that the government’s efforts in mapping groundwater systems in CBM development areas have been progressing successfully – though he stressed that more must be done.\textsuperscript{126} Finally, the government’s recent decision to consolidate several regulatory functions with the ERCB, including water licensing, is intended to reduce the inefficiencies and uncertainties associated with having to apply to several regulators for different aspects of the same activity.\textsuperscript{127}

This suggests that industry and the Alberta government do recognize the importance of CBM produced water for the future of Alberta and the need to improve the applicable regulatory framework to ensure that any value in the water is utilized and not wasted. CAPP’s “Best Practices”, the MAC report and the government’s progress to date do not, however, address all of our recommendations. Notably, the MAC failed to discuss the underground storage of usable produced water for future access, the definition of “saline” water and its exemption from AENV licenses under the \textit{Water (Ministerial) Regulation}, and the legal uncertainties in the \textit{Water Act} surrounding the ability of CBM operators to \textit{legally} put CBM produced water to useful purposes.

While progress on the other issues is important and should be commended, the effectiveness of these improvements will be limited unless the other of our recommendations are adopted, especially the proposed substantive changes to the \textit{Water Act} and \textit{Water (Ministerial) Regulation}.


\textsuperscript{126} Alberta, Legislative Assembly, \textit{Hansard}, No. 367 (30 April 2008) (David Swann).

\textsuperscript{127} \textit{Supra}, note 109. The Government intends to implement these changes through legislation to be introduced in the spring of 2011. Based on past efforts to streamline the regulatory process in Alberta, it remains unclear at this time to what extent these legislated changes will produce the intended results.
Scientists consider Alberta to be the most vulnerable of all of the prairie provinces to water shortages, and predict that water scarcity in the province will increase in the future as a result of climate change, cyclic drought and rapidly increasing human activity.\textsuperscript{128} Thus, the province must take measures to conserve all of Alberta’s water resources, including groundwater and produced water from CBM developments. In order to tackle the unique challenges posed by CBM in relation to conventional oil and gas, Alberta must update its laws and regulations to specifically address the effects of this emerging resource. To this end, Alberta must regulate CBM produced water so that its re-use is encouraged and so that it is disposed of in a way that both protects existing water supplies and also preserves any value in the produced water itself. This approach is of fundamental importance if Alberta hopes to preserve sufficient water resources for future generations.

\textsuperscript{128} Schindler & Donahue, supra note 8 at 7210 and 7213.