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COALBED METHANE:

A CITIZEN'S GUIDE

West Coast Environmental Law

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INTRODUCTION

Coal miners fear it because it is highly explosive,[1] but in twenty years coalbed methane (CBM) has gone from 'complete obscurity' to supplying 7% of the total US natural gas production.[2] Along the way it has generated a lot of public controversy.

In BC, the provincial government (the 'Province') is now aggressively pursuing CBM investment. If the CBM industry responds, and some technical problems are solved, many communities across BC will experience the CBM industry first hand.[3]

The Province is promoting CBM as a 'clean, environmentally safe, energy source.' There are many in the US and in Canada who strongly disagree with this characterization. The objective of this Citizen's Guide is to document the views of both proponents and opponents of CBM in order to help inform BC citizens about the potential environmental implications of CBM. The Guide focuses on CBM experience in the US, to help BC citizens articulate questions for BC companies and regulators.

Like conventional oil and gas development, CBM is a fossil fuel. Burning it to make energy will release greenhouse gases and contribute to climate change. Also like conventional oil and gas, it will bring wells, roads, flaring, pipelines, and processing facilities to the farm fields and wilderness areas above where it is found. See West Coast Environmental Law's *Pump it Out: The Environmental Costs of BC's Oil and Gas Industry* for information on a typical oil and gas project and its potential environmental consequences.[4]

CBM development, however, raises a number of unique environmental issues. Examples are *concentrated* land use disruptions (CBM wells are spaced considerably closer than conventional wells), considerable volumes of 'waste' water, and the risk of methane migration into water supplies and soils. Each of these concerns, and others, are summarized in this Guide, as is the regulatory regime set up to address them.

Part 1 of the Guide describes CBM and sets out what is happing in BC, what proponents of CBM say, what US citizen's and landowners are saying, and what US governments have done.

Part 2 of the Guide focuses on CBM and the environment: how to get CBM out of the ground, what could happen to the environment as a result, what environmental laws apply to CBM, and what can be done to reduce or eliminate environmental damage.

Part 3 of the Guide sets out a number of things a BC citizen can do in order to be more involved in the policy-making and decision-making processes.

For a more comprehensive summary of environmental law and upstream oil and gas—including information on the BC Oil and Gas Commission, environmental assessment law, First Nations aboriginal and treaty rights, the Province's compliance and enforcement record with existing laws, and federal environmental laws—please consult *Pump it Out*.

COALBED METHANE: WHAT'S THE BUZZ?

WHAT IS COALBED METHANE?

Coalbed Methane (CBM) is gas formed when plant material is converted into coal, and is therefore found wherever coal is found.[5] Pressure from overlying rock and surrounding water keep CBM molecularly bonded to the surface of the coal.[6]

The Ministry of Energy and Mines (MEM) describes CBM as primarily 'methane' gas, though it says CBM may also contain very small amounts of ethane or propane,[7] and carbon dioxide (CO_2) or nitrogen (N2).[8] In many cases it can go directly from the well to gathering systems, pipelines and customers once trace amounts of water and CO_2 are removed.[9] Methane gas is used to heat homes, generate electricity, and as a fuel for cars, trucks and public transit.[10]

The Province describes CBM as a 'clean, environmentally safe energy source'[11] and the 'fuel of choice in the new millennium'[12]. Natural gas and CBM are widely accepted as the cleanest burning of all fossil fuels, but growing numbers of people — including those whose views are reported in this guide — strongly dispute any characterization of natural gas or CBM as 'clean, environmentally safe, energy.'[13]

WHAT IS HAPPENING IN BRITISH COLUMBIA?

The Province is aggressively pursuing CBM investment as part of its planning for future energy needs.[14] If CBM companies decide to invest, and if some technical problems are resolved, development will take place in many BC communities.

CBM A PROMINENT PART OF BC'S ENERGY POLICY

The Province is promoting CBM as an 'exciting opportunity' and as an important part of its new Energy Plan.[15] To pursue CBM, the Province engaged in a year long consultation with industry,[16] introduced new royalty incentives in March of 2002,[17] gave regulators more legislative flexibility in May of 2002,[18] and prepared draft guidelines to clarify regulatory requirements in October of 2002.[19] The Province has also indicated it intends to upgrade pre-tenure plans and northern roads.[20]

One of MEM's 'service plan' objectives is to 'stimulate and facilitate CBM production.'[21] It has established a number of 'performance measurements' to assess progress towards this goal, including: commence drilling exploratory CBM wells (02/03), CBM experimental scheme goes into production (03/04), and commercial CBM production from at least one CBM project (04/05). MEM has also committed to 'maintaining high environmental and health and safety standards by defining a mitigation strategy for CBM production environmental issues.'[22]

MANY BC COMMUNITIES AFFECTED

The Province says CBM potential is good in the major coalfields of the northeast and southeast, Hat Creek in the south-central interior, Vancouver Island, and the Princeton area.[23] The Province further says that CBM has been identified in the Klappan-Groundhog area in

the north-central Interior, Telkwa in the central Interior, Merritt in the south-central Interior, and the northwest Tuya region near Dease Lake.[24]

Nine experimental projects are underway — seven in the northeast, one in the southeast, and one on Vancouver Island.[25]

Northeast

In the northeast, MEM reports at least 8 companies have obtained approval for experimental schemes, that over $25 million has already been invested, and 6 wells have been drilled.[26] MEM is also promoting the sale of Crown subsurface rights.[27]

In Hudson Hope, a company called Peace River Corporation has bought the sub-surface rights in the region[28]. PRC has been recently incorporated in BC. Its parent company is Petra CBM Ventures, Inc., headquartered in Baton Rouge, Louisiana.

Southeast

In the Southeast (Elk Valley Coalfield), MEM reports over 16 wells have been drilled under one experimental scheme, and that testing is ongoing. One company has been given time-limited authority under the *Waste Management Act* to dispose, test, and monitor its produced water on the surface.[29]

MEM reports that the project, near Sparwood, was the most active CBM exploration area in the year 2000.[30] MEM says the company exploring the area consulted with the public, First Nations and local industry and promoted the use of local services and contractors. To minimize environmental impact, MEM says the company used existing trails and logging roads wherever possible.[31]

Vancouver Island

On Vancouver Island, MEM reports it is trying to resolve gas ownership and title issues, that companies are acquiring subsurface rights, and that Priority Ventures Ltd. has drilled a CBM test well in the Comox Basin.[32] Fifty investors, city officials, and members of the media turned out for a media event related to the test well.[33]

It is Priority Ventures' view that barriers to CBM development on the Island include complex regulations/paperwork, land tenure (obtaining leases from gas right holders) and the lack of local drilling companies.[34] The company cites as long-term assets the higher than average retail gas costs on Vancouver Island, a pipeline that already runs through Vancouver Island coalfields, and the proximity of customers in nearby Courtenay (one km away).[35] The company is currently under a cease-trade order from the BC Securities Commission because it failed to provide materials in support of its resource size estimates.[36]

Southwest

In the Southwest (Hat Creek), MEM reports that over 10 billion tonnes of coal exist, but Provincial subsurface tenure is not currently available for posting.[37]

WHAT BC PROPONENTS OF CBM SAY

Proponents of CBM say there's ten centuries of coal under the ground in BC, and as a result, 90 trillion cubic feet of CBM reserves.[38] CBM reserves are reported to be bigger than offshore reserves of natural gas, and big enough to meet all of BC's energy needs for the next several decades.[39] Even assuming only 20% of CBM reserves will be recoverable, the Province estimates that there is the equivalent of 25 to 75 years of gas supply for both domestic and export markets.[40] On Vancouver Island alone, MEM estimates marketable volumes of CBM could provide 25 years of energy for every gas customer.[41]

Consequently, both the Province and the CBM industry argue CBM offers the following formidable economic benefits:

- **Capital investment.** Five years of CBM development in Wyoming's Powder River Basin has attracted US$1.4 billion of infrastructure and drilling investment.[42] British Petroleum and other large companies are actively engaged in CBM development.[43]

- **Corporate income.** For some small US companies, CBM has yielded spectacular returns.[44] The risks, however, are considerable: A CBM geologist and others familiar with the US experience describe CBM as 'variable across every part of the business': geology, geography, engineering, drilling, completions, regulations, and return on investment.[45]

- **Lease, royalty, and tax revenue.** In the year and a half ending December 31, 2002, Provincial revenue from the disposition of CBM *exploration* rights grew from $20 million to $50 million.[46] If CBM in Wyoming's Powder River Basin is fully developed, the US Bureau of Land Management estimates federal government royalty revenue would be $3.1 billion over 10 years. State of Wyoming royalty revenue would be $462 million and tax revenue would be $2.5 billion. Payrolls and personal income in the region would rise accordingly.[47]

- **High-paying jobs.** The average salary in the US CBM industry is $40,000/year (CDN$60,000).[48] MEM reports CBM development in Wyoming's Powder River Basin is expected to generate 7,000 new jobs for the local economy.[49]

- **Distributed local benefits.** Local economic benefits will flow to the many BC communities near CBM deposits — helping to restore and diversify local economies like the former coal-mining town, Tumbler Ridge.[50] Local CBM jobs will be related to drilling supply and service; pipeline and facility construction; facility maintenance and operations; equipment and water transportation, and 'spin-off industries' such as local hotels, and catering.[51] Fort St. John, the centre of BC's 'oil patch', is reported to have one of the highest employment rates in Canada and some of the highest wages in the province.[52]

- **Export markets.** CBM can be transported through existing BC pipelines to more distant markets such as the US and Eastern Canada.[53]

- **Lower costs, more reliable supply, for consumers.** With a local supply of CBM, suppliers could offer lower prices and more reliable service to local homes and businesses.[54]

WHAT US CITIZENS AND LANDOWNERS ARE SAYING

Despite the general promise of CBM wealth, the US communities in which drilling takes place rarely support it.[55]

> The gas companies love to show that clean blue flame. But to burn methane — to get at that clean blue flame — you have to extract it. And there's nothing clean about that.
>
> Eric Barlow, Wyoming veterinarian and rancher[56]

Given their experiences to date, many US citizens and landowners question the local economic benefits of CBM, and regret the environmental costs associated with it. Where there are real economic gains, many feel they're not worth it in light of the environmental costs. As a consequence, many groups are banding together to protect their land, and are looking to the courts for relief.

CBM ACTIVITY IN THE US

CBM activity is well established in Wyoming, Montana, Northern New Mexico, southern Colorado, and eastern Utah.[57] Many of the written reports in the US originate from an area near Wyoming and Montana called the Powder River Basin. Thousands of CBM wells are also operating in Alabama.[58]

It is not clear how much or which parts of the US experience will translate to BC given differences in geology and geography. Information is conflicting: some industry representatives say wastewater in BC will be injected into deep wells. Provincial policy says surface disposal is an option in some circumstances, and some geologists say BC rocks do not provide suitable spaces for safe wastewater disposal.

The Powder River Basin, however, appears to be the US area that has generated the most CBM controversy. Described as '9.1 million acres of largely pristine rangeland,'[59] the Powder River Basin is home to 14,200 CBM wells and there are plans for 70,000 wells by the end of the decade.[60] To service 70,000 wells, some observers predict the CBM industry will have to build 32,700 miles of new roads, and 73,000 miles of new pipelines and power lines.[61] When all the wells begin pumping, they could draw a billion gallons of water out of the ground every day.[62]

About 75 CBM companies work in the Powder River Basin.[63] Most are small. Some are perceived as courteous, others as sloppy and belligerent.[64]

DUBIOUS LOCAL ECONOMIC BENEFITS

At least one county in the US disputes the promise of local economic benefits. An 'Impact Report' by La Plata County, Colorado, concluded CBM development would lead to 'little impact to employment, per capita income, population, or housing.'[65]

Faced with the prospect of concentrated oil and gas development, Colorado developers and landowners worry about economic damage in the form of reduced property values and impediments to 'orderly, attractive, environmentally sound development'.[66]

CONSIDERABLE ENVIRONMENTAL COSTS

US citizens and landowners report a number of environmental costs associated with CBM development. Examples are industrialized landscapes,[67] miles upon miles of roads, pipelines, and power lines, massive reservoirs, numerous compressor stations, billions of produced and wasted water,[68] and seriously depleted regional aquifers.[69] A full summary of potential CBM environmental costs is set out below (See 'What could happen to the environment as a result?').

Some of the outspoken landowners are people who do not normally speak out:

> When the oil and gas companies cleared dirt roads on his property and created traffic, noise and dust, he didn't complain. When a gas company left a deep pit on his land, he cleaned it up. When a gas well exploded, and when 300-year-old trees were logged, and when his well water was contaminated with methane, he worked it out quietly with the gas companies. But things are different now, he says, and the underlying economics of his town and western Colorado have changed; natural resources no longer rule.
>
> Rebecca Clarren describing Arnold Mackley, Garfield County, Colorado[70]

THE MONEY DOESN'T COMPENSATE

In return for CBM activity on their property, landowners are entitled to rent money from the CBM company. However, for $30/month (in some cases), some landowners think the rent fails to compensate for the damage they suffer.[71]

A few landowners receive royalties because they also own the rights to the CBM under their properties. But for some of them, even 'sizable' royalties fail to compensate for dry water wells:

> It defies logic to say there's no relation between these aquifers and the millions of gallons of water they pull out of the ground. I can't even go to that part of the ranch now. It makes me sick that their gas pumps took away our lifeblood.
>
> Mac and Ron Burkett, Durango, Colorado[72]

One observer of CBM development in the Powder River Basin suggests it would be 'vastly cheaper, more efficient, and less environmentally destructive' for Americans to conserve natural gas than to extract it from a fragile ecosystem.[73]

> If the methane play goes the way the players want it to go, they'll take one year's worth of methane out of the ground, turn it into cash and electricity, and watch it disappear at the hands of American consumers.
>
> Verlyn Klinkenborg, Mother Jones Reporter.[74]

CITIZEN ACTION AND LAWSUITS

In response to the risks of CBM development, many US citizens are organizing into groups to collectively protect their interests, and are looking to the law for a solution.

Ten citizen conservation and tribal organizations, for example, have formed the Oil and Gas Accountability Project in Durango, Colorado and are running a campaign called the Western Coalbed Methane Project (WCBMP).[75]

US citizens have filed several lawsuits, and are pursuing several administrative actions.[76] Two Wyoming environmental organizations, the Powder River Basin Resource Council and the Wyoming Outdoor Council, have successfully challenged several leases held by one of the largest methane operators in the state.[77]

One Colorado landowner is suing a CBM company to respect a 100-year-old 'Rule of Accommodation'—which says the right to extract gas is limited by a duty to minimize adverse impacts to the landowner.[78] If he wins, he won't be able to evict the company, but he expects he can make it more difficult for the company to continue.[79]

Citizen groups in the US have made a number of recommendations for change in the CBM industry, many of which may be applicable in BC. They are summarized below (see 'What can be done to reduce or eliminate environmental damage?'). The also argue that the CBM industry can afford to make the changes:

> It takes approximately $65,000 to establish a producing well in Montana; depending on gas prices, an average well brings in $600,000 to $1.2 million over its productive life. That leaves several hundred thousand dollars—a percentage of which will be paid for taxes and general operations—per well. Clearly, the methane industry can afford to do it right. Montana citizens, however, cannot afford otherwise.[80]

WHAT US GOVERNMENTS HAVE DONE

Although some government agencies have expressed caution, US federal and state governments appear to be aggressively pursuing CBM. The same is not true at the local level where local governments have made several successful and unsuccessful attempts to restrict CBM development.

FEDERAL AND STATE GOVERNMENT SUPPORT FOR CBM

Interest in CBM as an energy source was originally sparked by a 1980 federal tax incentive for developing alternative fuels,[81] and $3 billion in new tax credits are expected to boost production even more.[82] Federal departments and agencies are reportedly now under instructions to speed up the approval of CBM leases.[83]

In April of 2003, the Republican-led US Congress passed new energy laws that, among other things, will require government officials to identify and correct inefficiencies in the processes used to lease and permit oil, gas and CBM.[84] Democrats felt the laws failed to address environmental and social impacts, but were unable to convince Congress to make changes.[85]

At the state level, there is a perception that authorities routinely grant permits for wells with minimum protection for the environment and little opportunity for public input.[86]

SOME GOVERNMENT CAUTION

In April 2002, the US Department of Interior invalidated federal CBM leases for 2,500 acres in Wyoming because the US Bureau of Land Management (BLM) issued them without properly examining CBM's unique environmental impacts.[87] This ruling could affect a further 51,000 proposed CBM wells.[88]

In May 2002, a regional office of the US Environmental Protection Agency (EPA) rated as 'unsatisfactory' a BLM draft environmental-impact statement for the Powder River Basin.[89] The EPA noted that the project would violate state clean-water and potentially clean-air requirements, could render river water 'unsuitable for irrigation,' and cause 'irreversible impact to soils'.[90] Wyoming's governor wrote to the EPA administrator, arguing the agency had commented too critically.[91]

The State of Montana has temporarily issued a moratorium on CBM development until environmental impacts have been more carefully assessed.[92]

LOCAL GOVERNMENT RESISTANCE

Much of the political pressure, however, is coming from US local governments.

> I consider it all out war. We've got to do everything we can to win, within the law. Full-scale mineral exploration and extraction is contrary to the long-term economy here.
>
> John Vincent, Gallatin County (Colorado) Commissioner.[93]

Responding to local concerns about oil and gas generally, several local governments have attempted to restrict development. In 1985, the city of Greeley, Colorado unsuccessfully enacted a total ban on gas wells within city limits.[94] The Supreme Court of Colorado struck down Greeley's ban saying the state has an over-riding interest in making sure resources aren't 'wasted' by not being developed at all.[95] Also in Colorado, the Town of Frederick's standards for well placement, etc. were struck down by the Colorado Court of Appeals on the basis they were 'operational considerations' and decisions solely for the Colorado Oil and Gas Commission.[96] La Plata County, Colorado, had two laws struck down — a noise standard and an attempt to let landowners decide where gas companies can drill wells — but obtained court support for requiring companies to go through local review.[97]

Resident fears about CBM have now motivated more local governments to act. The result in Colorado has been 11 counties and 15 municipalities adopting laws to address public health, safety, the environment, and 'orderly land use.'[98] Gunnison County has imposed a moratorium on CBM drilling. Delta County has become the first county in Colorado to reject wells approved by the state. In response, the Colorado Oil and Gas Commission adopted a rule that says its approvals are binding despite local government laws. Five counties then sued the Commission in over to overturn the rule.[99]

Residents of the affluent Gallatin County in Montana formed a zoning district and planning commission.[100] Faced with what it felt to be company arrogance, the planning commission unanimously rejected a CBM development — although at one time it was prepared to approve the project with 37 conditions and a $25 million bond.[101] The proponent sued the County for lack of jurisdiction and 'unconstitutional takings' and proposed drilling on

adjacent lands.[102] The County countered by creating an emergency zoning district and one-year moratorium for all land not already zoned. Nearby Park County is now considering the Gallatin County model.[103]

CBM AND THE ENVIRONMENT

The process for getting CBM out of the ground is in many respects similar to the process for getting other forms of natural gas out of the ground. West Coast Environmental Law has described the process for natural gas in *Pump it Out: The Environmental Costs of BC's Upstream Oil and Gas Industry.*[104] At each step in the process, there are potential costs to the environment.

HOW TO GET CBM OUT OF THE GROUND

KEY DIFFERENCES FROM CONVENTIONAL NATURAL GAS

A typical CBM project and a typical natural gas project are similar in many respects: they share common production methods and advanced exploration technologies, drilling equipment, pipelines and compressor systems.[105] But, CBM projects differ from other natural gas projects in the following ways:

- CBM wells are usually shallower and therefore often require smaller rigs and involve smaller surface areas.[106]
- CBM wells are spaced closer together to ensure 'optimum production' and increase gas recovery.[107]
- CBM wells have a longer lifespan: 10 to 40 years (average conventional well is 25).[108]
- CBM wells produces less gas at a much lower rate than a conventional well.[109]
- CBM projects are less likely to expose workers and communities to the dangers of hydrogen sulphide ('sour gas') even when extracted from high-sulphur coals.[110]
- A CBM company may not begin to make money months or years after a successful well; a natural gas company reaches peak revenue almost immediately.[111]

A TYPICAL CBM PROJECT

- ***Explore for CBM prospects.*** A typical CBM project begins with a CBM company exploring for places where there are likely to be CBM deposits. A company typically starts by identifying areas where coal deposits are known to exist[112] — and to assist in this search there is often a considerable volume of public information available. To narrow down the prospects, a company will look for a number of 'attractive' characteristics, including coal depth, existence of a 'trapping mechanism', thermal maturity, and evidence of gas.[113]
- ***Obtain 'subsurface' rights to conduct more testing.*** Once a prospect is found, the company will want to drill a series of test holes to sample the coal below. Before it can drill wells (though not necessarily before test wells), it must obtain rights to the CBM

either by leasing the rights from the owner or by purchasing existing rights from a company that is leasing them. In BC, most of the subsurface rights are owned by the Province and leased to CBM companies by the Titles Branch of the Ministry of Energy and Mines under the *Petroleum and Natural Gas Act*.[114] A company that wishes to obtain rights can nominate specific parcels for inclusion in a competition for petroleum and natural gas rights administered by the Ministry.[115]

- ***Negotiate surface lease with landowner.*** Before drilling test holes or gas wells, the company must obtain the right to build wells, roads and pipelines on the surface of the land by negotiating a surface lease with the landowner. Perhaps surprisingly, in many cases the right to enter onto property to build wells and roads, etc. is held by the Province and not a landowner. For all grants of Crown land to private landowners after 1891, the Province kept for the Crown the right to enter onto the land to extract the resource.[116] The *Petroleum and Natural Gas Act* requires a company to obtain a landowner's consent or provide adequate compensation before entering onto land.[117] If the landowner refuses to negotiate a surface lease that is 'satisfactory' to the company, the company can apply to the Mediation and Arbitration Board for an 'entry order'.[118] The Board cannot issue an entry order without requiring a deposit from the company and fixing amounts of compensation and/or rent for the landowner.[119] Landowners can apply to the Board for suffering or damage to land caused by the entry onto land.[120]

- ***Build a road to the well site.*** On the landowners' land, the company will then build a road to the well site — sometimes in a location where there were no previous roads. For some US landowners, the roads have 'sliced across pastures and fence lines,' and have shown 'no regard to the contours of the land.'[121]

- ***Drill 'shallow' test wells.*** At the well site, truck-mounted rigs will drill a relatively shallow, inexpensive well and install a drilling system.[122] For each well a CBM company will build a temporary mud pit, 6 feet deep, 10 feet wide, and up to 30 feet long.[123] To protect drinking water sources, fish habitat and local vegetation, the drill hole is lined with steel or plastic casing and the spaces between casing and bedrock are filled with cement.[124] If test results are positive, a pilot program is often conducted on four or five wells in close proximity.[125]

- ***Build tens or hundreds more 'closely spaced' wells.*** If results are still positive, the company will build 'tens to hundreds' more wells.[126] CBM is only profitable if there are several wells to take advantage of economies of scale.[127] CBM wells may need to be spaced closer together than conventional gas wells. The Ministry of Energy and Mines says a typical US project is spaced one well per every 320, 160, or 80 acres.[128] State governments in Colorado and Wyoming allow one well every 40 acres[129] — though Wyoming has changed the rule to one every 80 acres for the Powder River Basin.[130] Each well is connected to the other with pipelines, compressor stations and roads.[131] The Oil and Gas Commission describes a CBM production site as an 'extensive infrastructure of gas and water lines (often laid in the same trench), compressors, pumps, electricity feed lines, and other major equipment.'[132]

- ***Pump out the groundwater.*** Drilling into a coal seam will not normally by itself cause CBM to flow. A company must first decrease the natural pressure in the coal seam by 'de-watering' or pumping out water in the seam.[133] Months or years of pumping may be necessary before seam pressure is low enough to allow CBM to flow.[134] Depending on

water quality and quantity, the company will pump the water to a central discharge point and then allow it to flow into surface drainage, or inject it into a deep underground formation.[135] It's not clear how much water would be harboured in BC coal seams, but the average CBM well in the Powder River basin pumps out 15,000 to 20,000 US gallons of salty water per day.[136] 80,000 CBM wells in Montana and Wyoming will pump out four trillion gallons of water over the next 15 years.[137]

- ***Fracture the seam to allow CBM or water to flow easier.*** A company may need to inject into the well a high-pressure compound of sand and toxic chemicals, called 'fraccing fluid,' to fracture the coal seam and allow the CBM or water to flow more easily.[138]

- ***Flare the gas, if necessary.*** CBM that comes up during de-watering is usually ignited or 'flared' because the CBM company will only add pipelines once it is assured there are economic volumes of gas. When the well is economically viable, and pipelines are in place, flaring is essentially unnecessary, though some flaring may also be necessary during additional work to maintain or improve production levels.[139] CBM wells are likely to be flared for longer periods than conventional gas wells.[140]

- ***Produce a steady flow of CBM for a decade or more.*** Although considered a 'trickle' relative to a conventional gas well, a successful CBM well will produce a steady flow of CBM for a decade or more.[141] The flow must be steady if the operation is to be commercially successful; if the well shuts down for any reason, water will collect at the well bore, and the company will have to 'de-water' it again.[142]

- ***Pipe to compressor station and on to market.*** CBM from a number of wells is piped through plastic pipes to a central processing station (the size of a two-car garage) where the pressure of the gas is boosted.[143] From there it is piped into a steel pipeline, and then ultimately into the high-pressure pipeline that carries it to energy markets.[144] Because of the relatively low pressure of CBM projects, several stages of compression may be necessary, resulting in more compressor stations than a conventional natural gas project.[145]

- ***Restore disturbed areas to natural state.*** Once a well is depleted, the company is expected to restore the area to 'close to its original state.'[146] A company will typically use cement to permanently seal the flow of gas and water from the coal.[147]

WHAT COULD HAPPEN TO THE ENVIRONMENT AS A RESULT?

At each step in a typical CBM project, there are potential environmental costs. A master bibliography of 360 references on water handling, environmental, and land use aspects of CBM is available on the Ministry of Energy and Mines website.[148] The authors also provide a top ten list of reports they rate as generally the most informative,[149] and references for 'two very comprehensive environmental impact statement (EIS) reports' that became available after their review was closed.[150]

In a 2000 publication, the US Geological Survey reports scientific understanding of CBM is in the 'early learning stages' and that much has yet to be learned about the environmental implications of developing the resource.[151]

What follows is a brief survey of CBM implications for the environment.

SURFACE DISTURBANCES

Each CBM well will likely disturb three to four acres of land.[152] Each well will also require roads and pipelines to service it. The Province hasn't provided any BC estimates, but in Montana and Wyoming, for example, CBM companies are expecting to build 80,000 wells, 17,000 miles of new roads, and 20,000 miles of new pipelines over the next 15 years.[153] Each linear mile of road disrupts approximately four acres of adjacent habitat.[154]

Much of the CBM development in BC is expected to take place in areas where there has been no previous oil and gas drilling[155] — although the Province says the presence of existing natural gas pipelines should help minimize surface disturbances.[156]

Each new well, road, compressor, and pipeline brings a number of ecological risks:[157]

Wildlife

The linear nature and volume of CBM surface disturbances can harm wildlife:[158]

- Roads and pipelines fragment the wilderness, making life difficult for species like the pileated woodpecker that avoid the edges of wilderness and require minimum 'patch sizes.'
- The cumulative loss of habitat from roads and pipelines is substantial and is particularly hard on large mammals such as the grizzly bear that need large contiguous tracts of wilderness for 'security cover'.
- Roads and pipelines can alter predator-prey relationships. Wolves, for example, are able to move faster along roads than in the forest, increasing predation pressures on caribou.
- Reproductive failure in birds is higher near linear disturbances.
- Hunting and poaching increase when roads open up previously inaccessible areas.

For nine years, University of Alberta researchers have studied the impact of 833,000 km of seismic lines, oil and gas roads, and pipelines on the Alberta's boreal forests. As part of the study the researchers have documented a 20-50% decline in some migratory bird populations 'probably because of habitat disturbance.' In the central-Alberta Swan Hills region, the researchers say grizzly bear populations have dropped from 400 to 80, Woodland caribou are in decline, and some Woodland caribou herds are close to extinction.

Habitat disturbances could be more significant if a company discharges the water it pumps out onto surface drainage (see water below).

Streams

The construction of roads can alter drainage patterns, trigger landslides, increase stream sedimentation and bank erosion, create barriers to fish passage, and destroy aquatic habitats.

In 1996, environment ministry officials estimated 9,000 stream crossings were needed for general oil and gas seismic line, pipeline and road developments.[159]

Forests

Trees removed to create roads can no longer serve as 'carbon sinks' to absorb carbon dioxide — one of the major greenhouse gases. Large amounts of greenhouse gases are also released when cleared brush and trees are burned or allowed to rot.[160]

Farms

Wells, roads, pipelines, and other CBM surface disturbances result in a direct loss of agricultural land.[161] According to the US Bureau of Land Management, the construction of 80,000 wells will result in the loss of 200,000 acres of soil.[162]

Trucks travelling on oil and gas roads can inadvertently pick up and transport noxious weeds from one eco-system to another — sometimes resulting in considerable problems for farmers.[163] Risk can be addressed if projects implement steam-cleaning and other mitigation programs

For one Wyoming farmer, wet weather changed the main CBM access roads to deep trenches causing serious erosion.[164]

CBM-PRODUCED WATER

CBM wells in the US can generate 10 to 100 times more produced water than a conventional gas well.[165] CBM-produced water can vary in quality from fresh to saline. The Province doesn't expect BC's coal seams to hold the same volume of water as the Powder River Basin, but the expected 80,000 CBM wells in the Basin are could discharge four trillion gallons of salty water over the next 15 years.[166] Some commentators believe CBM is more a water management business than a gas business.[167]

Proponents say the quantity of CBM wastewater pales in comparison to what's used in farming and mining: 'there's more water falling out the sky'.[168] Critics say CBM can dramatically lower aquifers for hundreds of years, and harm surface waters and soils.

Dramatic drops in aquifers

The US Bureau of Land Management estimates that one CBM well can lower aquifer levels by 34 feet within ten feet of the well.[169] In the Powder River and San Juan Basins, the level of drinking water wells near CBM development have reportedly dropped by over 200 feet.[170] Artesian wells that tap into coal beds have also disappeared.[171] Some families have had to drill deeper to obtain a steady supply.[172]

It is not clear that anyone has adequately studied the capacity for aquifers to recharge in the context of CBM development.[173] Modeling prepared for some coal mining projects predicts 50% groundwater recharge after 200-300 years and 100% recharge after 800-1000 years.[174]

Once coal seams are completely or partially dewatered, there is a danger (characterized by regulators as remote) they will subside or collapse.[175]

Harm to surface waters and soils

Given current economic formulas, a CBM company's lowest cost option for CBM-produced water is to dispose of it on the surface.[176]

The Ministry of Energy and Mines (MEM) says water-quality testing in the US indicates that CBM-produced water is generally of good quality (e.g., low total dissolved solids and chlorides).[177] MEM says, however, that CBM wells usually draw water from a deeper place than most drinking water wells.[178] There are examples in the US where, without treatment, produced water has been used for livestock watering, irrigation and domestic purposes.[179]

Indeed, soil and water resource consultants in Montana report that CBM-produced water from southeast Montana meets both 'primary' state/federal drinking water standards, and national livestock guidelines.[180] They argue the water can be used to feed deer, antelope, small mammals and birds, irrigate 'suitable' soils, and protect aquatic life if discharged into rivers.[181] They also report that excessive salt content may cause diarrhoea or be undesirable for use by pregnant or lactating cows, that most produced water in the Powder River Basin is unsuitable for irrigation on most soils, and that concentrations of ammonia and fluoride exceed state and federal 'safe levels' for discharge into surface water.[182]

The handling and disposal of produced water has attracted significant controversy in the US.[183] Many fear surface disposal could permanently change the composition and structure of soils and vegetation (because of high salt and sodium content),[184] contaminate lands and surface water resources with trace metals such as arsenic and barium,[185] result in massive reservoirs to contain the high volumes,[186] and cause erosion and flooding.[187]

Piping the water into streams could erode stream banks, damage aquatic vegetation, toxify fish, increase stream sedimentation,[188] change stream temperature and hydrology, plug irrigation canals, and destroy spawning grounds.[189]

Rising Groundwater Temperatures

Another option for a CBM company is to re-inject the water into deep aquifers — below potential groundwater zones.[190]

Although it could be an isolated and extreme case, one Colorado resident believes underground injection is responsible for changing her freshwater into hot mineral springs, heating her soil to 99 degrees F, and gradually killing most of her century-old fruit trees, blue spruce and firs.[191] The state's Oil and Gas Commission thought the cause could be a wastewater re-injection project 9 miles to the south.[192] Her problems eased when the state stopped the re-injection.[193] The company says 'there's no measurable evidence between the two.'[194]

DRINKING WATER

US experience with CBM to date suggests drinking water is at risk because of the practice of 'fraccing' and because of migrating methane in some situations.

Fraccing

To allow water or CBM to flow more easily, CBM companies will sometimes inject into the coal seam a high-pressure compound of sand and chemicals to fracture or 'frac' the coal seam.[195] The compound often contains substances to destroy living organisms in the wells.[196] A Louisiana chemist and recipient of the MacArthur 'genius' award reports that fraccing chemicals are extremely toxic to the environment and human health.[197] Some of the chemicals would be restricted if used by the dry cleaning, mining, or auto manufacturing industries, but the US Environmental Protection Agency (EPA) does not regulate them when they're used by the oil and gas industry.[198]

Some scientists believe fraccing fluid can travel along the cracks they create and reach natural geologic fractures — often containing drinking water.[199] US Citizens groups believe the risk of contaminating drinking water is 'significant.'[200] In a brief to the US Senate, the Natural Resources Defense Council argued very small quantities of toxic chemicals are capable of contaminating millions of gallons of water.[201] The brief summarizes instances of drinking water contamination that occurred near and at the same time as fraccing projects in the US. Citizen and ranching groups have been unable, however, to precisely find out what chemicals the CBM companies are putting in fraccing fluid because CBM companies say the information is proprietary.[202]

A federal appeals court recently held that fracturing fluid falls under the US *Safe Drinking Water Act* because it is pumped into the ground.[203] The chair of the US Senate Energy Committee is now trying to 'free the fluids from federal oversight.'[204] The EPA has recently completed an assessment of potential risks associated with fraccing.[205]

Migrating Methane

The US Geological Survey reports that in some US areas, methane migration may have contaminated ground-water sources.[206]

In La Plata County, Colorado, methane has leaked out through older conventional gas wells and drifted into drinking water wells.[207]

In the early 1990s, several residents were evacuated from their homes along the Pine River (Colorado) after methane saturated the soil and bubbled up through river water.[208] A CBM company reached an undisclosed settlement with the residents, bought and levelled four of the homes, but attributes the problem to natural seeps.[209]

Methane-saturated soils are reported to have starved the roots of vegetation and killed 100 year-old trees in the San Juan Basin (Colorado).[210]

Colorado officials say there is no evidence that CBM is responsible for fires or methane migration into shallow aquifers: all fires have occurred outside of CBM production areas or predate CBM development; and that methane migration predates CBM and oil and gas development.[211]

AIR QUALITY

Flaring

Flaring fossil fuels results in several air emissions, many of which can damage human health. With fewer impurities, CBM is likely to cause fewer emissions when flared than other fossil fuels.

Flaring fossil fuels, for example, releases a wide range of harmful substances that can damage vegetation and affect human and animal health (examples are: nitrogen oxides (NOx), sulphur dioxide (SO_2), volatile organic compounds (VOCs), carbon monoxide (CO), and benzene).[212] A 1996 book by Theo Colborn contends that chemicals produced by burning fossil fuels can set off skin disorders, certain cancers, birth defects and reproductive problems. With support from leading air pollution researchers, Alberta ranchers have argued that flaring is responsible for their asthma, coughs, headaches, aching muscles, shortness of breath, and memory loss. Residents downwind of flaring in both BC and Alberta report premature births, cancer, sick or dead livestock, allergies, multiple sclerosis, bloody noses, and nausea. A 1999 Alberta health study of the Northern River Basin showed rates for six diseases that were higher than other regions in the province: endometriosis, selected congenital anomalies, bronchitis, pneumonia, peptic ulcers, and epilepsy. Given social and environmental differences in the region, however, the study's authors found these results to be inconclusive.

Venting

Although not specifically related to CBM, a 1996 study by the Alberta Research Council found that flares of fossil fuels don't burn efficiently and leave anywhere from 16 to 38 percent of the gases intact. Incomplete combustion can release more than 250 other hazardous air emissions known to cause cancer, or negatively affect reproduction, respiratory, or cardiopulmonary health.[213]

Explosive levels of vented methane can accumulate in buildings and asphyxiate burrowing animals.[214]

In Colorado, CBM extraction has caused explosive levels of methane to be vented to the surface, and has been linked to underground coal fires that vent noxious gases.[215]

Pumps and compressors

Each new well brings drilling rigs, gas compressors, generators, earth-moving machines, and trucks — generating hazardous air pollutants including nitrous oxide (NOx), carbon monoxide (CO), sulphur dioxide (SO_2), particulates, and volatile organic compounds (VOCs).[216] Traffic from the CBM boom is crowding roads in Wyoming.[217]

To minimize air emissions, CBM companies sometimes use electrical or CBM-burning compressor engines.[218] Emissions resulting from the processing of CBM (i.e., removing impurities) are likely less than emissions from processing natural gas.[219]

CLIMATE CHANGE

The CBM industry contributes to climate change in at least three ways:

- ***Venting.*** Methane is a powerful greenhouse gas, and when it vents or escapes during a CBM project, it contributes to climate change. US CBM companies also commonly vent into the atmosphere large amounts of CO_2 — another greenhouse gas found naturally (but in varying concentrations) in CBM.[220]

- ***Flaring or burning.*** Flaring CBM, or burning it to heat homes, fuel cars etc., will also contribute to climate change. If, however, CBM is used to replace the burning of coal or natural gas, CBM can reduce impacts on air quality.[221]

- ***Pumping it out***. Substantial amount of fossil fuels will also likely be burned to extract CBM from the underground (e.g. as fuel for water pumps, compressors, trucks, etc.).

The provincial government reports that climate change is already responsible for infestations of forest-destroying beetles, and threats to temperature-sensitive sockeye salmon on the Fraser River.[222] Natural eco-systems are extremely vulnerable to climate change, and continued emissions may lead to irreversible damage.

Although its potential is uncertain, governments and the energy industry are investigating ways to inject CO_2 into coal beds in order to drive out the CBM. The result could be less CO_2 in the atmosphere — and an emission reduction credit — and enhanced CBM recovery.[223] The Alberta Research Council is leading research and pilot projects in Alberta and Colorado.[224]

WHAT ENVIRONMENTAL LAWS APPLY TO CBM IN BC?

In the spring of 2003, the Province enacted legislation that confirms longstanding provincial policy — CBM is natural gas and that is owned by the natural gas owner.[225] The Province expects that by codifying the policy in law, it can eliminate the 'threat of a legal challenge' believed to be inhibiting the development of the CBM industry in BC.[226]

As natural gas, the Province regulates CBM under the *Petroleum and Natural Gas Act* and other BC statutes and regulations. In October of 2002, the BC Oil and Gas Commission (OGC) released draft guidelines for CBM projects in BC.[227] The OGC says the vast majority of rules for CBM will be identical to those governing conventional oil and gas.[228]

What follows is a brief summary of rules governing a CBM project based on the existing law and proposed guidelines. The summary is organized according to the list of environmental risks set out above (see 'What could happen to the environment as a result?' above).

For a more comprehensive summary of environmental law and upstream oil and gas — including information on the OGC, environmental assessment law, aboriginal and treaty rights, the Province's compliance and enforcement record with existing laws, federal environmental laws, and the regulation of oil and gas on federal land — please consult *Pump it Out: The Environmental Costs of BC's Upstream Oil and Gas Industry*.[229]

GENERAL

The OGC's regulatory goal for CBM is to regulate it 'in a in a manner that will facilitate its development in the province, while ensuring protection of the resource, the environment, workers, and the public.[230] To acknowledge CBM's high up-front capital costs, relatively high

operating costs, and lower production rates, the OGC wants to be flexible in accommodating CBM developments 'where warranted and prudent.'[231]

The OGC says it recognizes the 'significant implications' CBM projects can have for the environment. It says existing policy and regulations are designed to address environmental matters, and it wants to work closely with proponents and operators to implement programs for managing environmental impacts.[232] It also says future regulatory changes may be necessary to better allow for CBM's 'specific needs.'[233]

In general, a company must acquire rights from the owner of the CBM — in most cases the Province, negotiate access to the surface from landowners, and consult with First Nations and the public. To facilitate CBM development, the Province is offering economic incentives and approval for early CBM projects under an 'experimental scheme.'

A CBM project does not automatically attract review under environmental assessment legislation, and the Province does not have a legal duty to conduct an assessment of its entire CBM program.[234]

Company acquires subsurface rights

Most of BC's natural gas rights (including CBM rights) are owned by the Province — except on Vancouver Island or the Fraser Valley where subsurface rights were granted along with early land grants to private landowners in the late 1800s and early 1900s.[235]

A CBM company wishing to acquire CBM rights must request the Ministry of Energy and Mines (MEM) to include the rights in its monthly auction of subsurface rights.[236] MEM collects all requests and then forwards them to First Nations, local governments and 'other agencies' for review and comment.[237] Significant concerns may be added as conditions to the transaction. The Province says it will take into account any coal rights in the area to the extent that they could be injuriously affected by a CBM project.[238]

Before the auction, MEM will publish a notice in local newspapers and trade journals, the BC Gazette, and on the MEM website.[239] MEM awards the rights to the company with the highest 'reasonable bid'.[240]

A company does not require subsurface rights to drill a test CBM hole.[241]

Company negotiates access with landowner

Before a company can enter onto private land to drill a test hole, well, road or any other CBM structure, it must negotiate a surface lease with the owner of the surface land.

The *Petroleum and Natural Gas Act* requires a company to obtain a landowner's consent or provide adequate compensation before entering onto land.[242] If the landowner refuses to negotiate a surface lease that is 'satisfactory' to the company, the company can apply to the Mediation and Arbitration Board for an 'entry order'.[243] The Board cannot issue an entry order without requiring a deposit from the company and fixing amounts of compensation and/or rent for the landowner.[244] Landowners can apply to the Board for suffering or damage to land caused by the entry onto land.[245]

A company must file the surface lease, or entry order, with the Registrar of Land Titles before entering onto private land.[246]

Company consults with First Nations

The Province, through its agent the OGC, is responsible for consulting First Nations with respect to potential infringement of aboriginal or treaty rights.[247] OGC policy, however, encourages CBM companies to consult with First Nations about CBM projects and associated economic development opportunities.[248] Consultation agreements signed with many First Nations in the northeast (Treaty 8 Nations) establish formal time-limited review processes.[249] The Province has produced general guidelines for consulting with First Nations.[250]

Company consults with public

Under OGC policy, CBM companies are also responsible for consulting with the public to 'identify and respond to public concerns.'[251] The OGC expects the company to talk to the commission about the extent and form of public consultation before finalizing plans[252] and before applying for well authorizations.[253] The policy says companies must exercise 'due diligence' when educating and informing because the public is unacquainted with CBM, and because of 'significant differences' between CBM projects and conventional projects (e.g., the 'longer lives' of CBM wells and the 'magnitude of disturbance that can be caused by multiple wells').[254]

Also under the policy, a company is expected to:

- Identify all parties who may be impacted by a CBM scheme, and consult with them at 'a level reflective of the potential impact,'[255]
- Respect 'minimum distance requirements from the well site for personal consultation and broader notification,'[256]
- Provide information on the ultimate scale of development based on 'the most reliable information available at the time.'[257]
- Inform the public of the project's progress, scale, and land/water disturbances as development proceeds.[258]

The OGC says it can request a company to conduct an enhanced consultation process — particularly where a project is located outside northeastern BC or close to populated centres.[259]

Economic Incentives

On March 1, 2002, the Province introduced new economic incentives as part of a new royalty regime for CBM development, including:

- Changing the 'producer cost of service' allowance (PCOS) to cover additional water handling costs;
- Creating a 'royalty bank' to collect excess allowance for use against future assessed royalties;

- Increasing the 'low productivity royalty rate adjustment factor threshold' to 600,000 cubic feet per day from 180,000 cubic feet per day, in order to address CBM's lower production rates; and

- Issuing a $50,000 royalty credit for CBM wells drilled by February 29, 2004.[260]

Experimental schemes

In order to offer flexible well spacing and a longer period of confidentiality for well data, the Province amended the *Petroleum and Natural Gas Act* in 2002 to give the OGC additional powers when approving an 'experimental scheme'.[261] An experimental scheme is a scheme that uses untried or unproved methods.[262] To be eligible, a company must apply before December 31, 2003.[263]

After receiving an application for an experimental scheme on a block of land, the OGC will publish a notice in the BC *Gazette*.[264] The Province publishes the *Gazette* once a week to formally notify BC citizens about notice to creditors, public tenders, and all regulations made under an act of the BC Legislative Assembly.[265] It has a limited circulation but is available at public libraries in larger BC towns and cities. Based on any surface or subsurface concerns it receives in writing, the OGC may attach conditions to the approval it issues.[266] In any event, the OGC may impose conditions respecting flaring and data reporting.[267]

After December 31, 2003, the Province intends to amend regulations to allow CBM projects to be approved under 'conventional' schemes for the development of natural gas.[268] 2002 legislative amendments also give the OGC power to waive well-spacing requirements under conventional schemes.[269]

SURFACE DISTURBANCES

General

Each new well, road, compressor, and pipeline brings a number of ecological risks to the surface of the land (see 'what happens to the environment as a result' above). Minimizing the number of wells, roads, etc. will obviously reduce the industry's ecological impact, but short-term economic pressures sometimes produce very different results. For example, three all-season roads were recently built into the same natural gas producing area known as 'Ladyfern' — prompting local industry representatives to say 'we now have three times the environmental footprint we needed out there.'[270]

For surface disturbances, relevant provincial law and policy include:

- **Enhanced public consultation may be required by policy.** The OGC says it may require a CBM company to conduct 'enhanced consultation' with landowners during geophysical exploration.[271]

- **Spacing.** The Drilling and Production Regulation defines 'normal spacing' as one well every 640 acres.[272] Within this spacing area, wells are to respect a 'setback' of 250 m from the spacing area boundary.[273] With new legislative authority, OGC policy says within an approved experimental or natural gas scheme, a company will be allowed to drill wells 'to any density' and subject to a reduced setback of 100 m within an experimental

scheme.[274] It will also consider approving reduced distances between well sites and roads — given lower volumes and a 'negligible risk' of sour gas.[275] The OGC, however, is willing to approve reduced site sizes for CBM wells — resulting in a smaller area of disturbed landscape around a well.[276]

- **Set backs.** Minimum drilling distances from structures and residences are the same for conventional natural gas projects and set out in the Geophysical Exploration Regulation and the Oil and Gas Handbook.[277]

- **Abandonment.** Before abandoning a well, test hole, or production facility, a CBM company must remove all equipment and waste materials, restore the land as closely as is reasonable to its original condition, and apply to the OGC for a Certificate of Restoration.[278] The application must be accompanied by a *Waste Management Act* (WMA) Site Profile, which is used to determine if a location may be contaminated (note: the Province is currently under review).[279] Where there is potential for contamination, the OGC says further investigation of the site will be ordered.[280] If confirmed, the company must remediate any contamination to 'the appropriate standards.'[281] The OGC says it may issue the Certificate only when it is satisfied that the restoration is complete, or when the operator files a signed release from the landowner.[282] If the project is in the Agricultural Land Reserve, the Land Reserve Commission confirms the restoration before the OGC can issue a Certificate.[283]

Wildlife, Streams and Forests

To protect both domestic and wild animals, MEM says well facilities are fenced and pipelines are buried underground where necessary.[284] The OGC also says CBM operators are also subject to the general wildlife measures outlined in the Forest Practices Code.[285] The general wildlife measures are most meaningful for species that have localized habitat needs, but they have been designed with forestry activities, and not CBM, in mind. The Province is currently re-writing the Forest Practices Code.

Before a CBM company can apply for a well authorization, it must give the Ministry of Energy and Mines a drilling deposit (minimum $7,500) as security for proper drilling, control, completion, suspension, abandonment, reclamation, and restoration of the well and well site.[286] If the Province is the surface landowner, the company is required to obtain comprehensive general liability insurance — with a limit of $1 million — naming the Province and the OGC as the insured.[287] The OGC reviews each application for 'potential impacts on land, fish and wildlife habitat, forest resources, stakeholders, archeology, and First Nations.'[288] The OGC rates each application as 'simple', 'normal', or 'complex', and says depending on the rating it may require a timber harvesting and field assessment, fisheries and habitat assessment, archeological assessment, First Nations consultation, and public consultation.[289] The OGC may attach conditions to any well approval to address environmental concerns.[290]

From each forest district in which it will harvest timber, the company must obtain a 'master licence to cut' — which sets out conditions and standards under which cutting can take place.[291] The OGC then issues cutting permits for particular CBM projects using the terms and conditions of the Master Licence.[292]

The *Pipeline Act* and Pipeline Regulation govern the design, construction, operation, and maintenance of pipelines.[293] If a company wishes to build pipelines on public land, it must obtain approvals from the Province under the *Land Act*. The OGC says a 'paramount concern' is to ensure the safety and integrity of a pipeline with respect to people and the environment.[294]

CBM-PRODUCED WATER

General

Water pumped out of a CBM well must be re-injected in an underground formation, unless otherwise permitted.[295] If a company wishes to discharge water onto the surface, it must apply to the OGC for a permit under the *Waste Management Act*.[296]

The Ministry of Energy and Mines (MEM) has indicated to the CBM industry that 'surface disposal is an option', and that they are working with industry and other stakeholders to provide standards and guidance.[297] The OGC's proposed CBM policy states: 'An operator can apply for approval to inject subsurface water into an underground formation, where the volume or quality of produced water makes surface disposal inappropriate (e.g., the water is highly saline)'.[298] The OGC has authorized surface disposal under the *Waste Management Act* for a CBM project in Southeast BC (Elk Valley Coalfield) approved under an experimental scheme.[299]

A CBM company cannot sell CBM-produced water because the Province owns it.[300] Although the Province does not licence the use of groundwater, Cabinet has the power to do so by enacting a regulation.[301]

Surface waters and soils

To let CBM-produced water flow onto surface drainage or into ponds, a CBM company must apply to the OGC for approval under the *Waste Management Act*.[302] The OGC forwards the application to the Ministry of Water Land and Air Protection (WLAP) for review and comment.[303] WLAP, OGC, and MEM are refining a 'Code of Practice' for CBM-produced water.[304] In advance of the Code of Practice, OGC policy is that CBM produced water must be rigorously tested for total dissolved solids (e.g., salts) and measured against draft standards for other pollutants.[305] The OGC says it issues an approval 'usually with conditions based on WLAP recommendations.'[306]

Given the large volume of water production typically associated with CBM, the federal government is likely to regulate the practice under the *Fisheries Act*.[307]

Groundwater (re-injection)

To re-inject CBM-produced water into an underground formation, a CBM company must apply to the OGC for an approval.[308] The OGC publishes a notice in the BC *Gazette* to allow other subsurface owners a chance to comment.[309] The OGC requires monthly injection/disposal statements for ongoing water injection.[310]

The OGC says groundwater is protected by lining drill holes with steel or plastic 'casing' and by filling the spaces between casing and bedrock with cement.[311]

DRINKING WATER

Fraccing

Government officials say fraccing is regulated by a section of the Drilling and Production Regulation that requires a company to provide a report to the Commission after any operation that has produced a change in a well's production interval or producing characteristics.[312] The OGC requires a report for each separate event and is required within 30 days of the event. Officials say regulatory considerations include maintaining a discrete flow path from the reservoir to the surface, and maintaining integrity of the well bore (hole made by the drilling bit).[313]

Migrating methane

The OGC has power to stop a CBM company by regulation or order from drilling without taking adequate measures to confine natural gas or water to its own stratum.[314] OGC policy says in all cases the OGC must be assured that the company has the ability to control anticipated pressures, and that all drinking water strata are isolated.[315]

A company must not leave any well or test hole unplugged or uncased after it has served its useful purpose.[316] The Drilling and Production Regulation sets out detailed requirements for well plugging.[317] The OGC says, however, that in some instances it will consider reducing requirements for surface casing, blow-out prevention, and equipment spacing because of CBM's lower pressure.[318]

AIR QUALITY

Venting and flaring

A company must not discharge any gas produced (including 'stock tank vapours') to the atmosphere unless it is burned according to detailed requirements — including ensuring that average concentrations of H_2S and SO_2 do not exceed limits under the *Workers Compensation Act* and maximum permissible concentrations set by Ministry of Water, Land and Air Protection.[319]

A company must not flare gas from a well or facility, except in such amounts as may required from 'drill stem testing', or unless the OGC has given permission.[320] The OGC may give the permission orally, and the sour gas requirements of the Drilling and Production Regulation must be followed (flare lines to be a minimum height, fitted with ignition and extinction devices).[321]

A company that complies with the terms of the Oil and Gas Waste Regulation, does not require *Waste Management Act* permits for the discharge of air contaminants during test flaring or discharging water accumulated in flare pits.[322]

The OGC says it limits the duration and extent of flaring 'to allow for adequate testing while conservation of the resource and the minimization of air emissions.'[323] For CBM, however, the OGC says it will consider allowing longer than normal flaring for 'initial flow' testing — subject to a maximum volume of flared gas per well — when reviewing requests for experimental schemes or well authorizations.[324] The OGC is also preparing an information

letter that will require notification instead of an application for flaring conducted when a well is initially completed — subject to volume limits it has yet to determine.[325]

The OGC requires a 'pre-application emission dispersion study' if a company wants to flare gas with more than 5% H_2S.[326]

Pumps and compressors

A company that complies with the terms of the Oil and Gas Waste Regulation does not require *Waste Management Act* permits for air emissions from a 'small' compressor stations (less than 600 kilowatts of total power).[327] The OGWR authorizes emissions if they are under 30 tonnes of sulphur and 4 tonnes of VOCs in any 15-day period.[328] There are also maximum thresholds for NOx emissions from the gas turbine or internal combustion engines used to power the compressors.[329] A company that discharges waste under the OGWR must provide any information requested by a *Waste Management Act* manager, and provide a registration report for each facility.[330]

Despite authorization under the OGWR, if a Ministry of Water Land and Air Protection manager is satisfied on reasonable grounds that the release of a substance is causing pollution, the manager may at any time make a 'pollution abatement' order under the *WMA*.[331] As a general requirement, a company that is operating a compressor station must ensure that 'ground level concentrations' of H_2S from air emissions are not above the concentration specified in the regulation (10 parts per billion).[332] If a company cannot meet the terms of the OGWR and requires a permit under the *WMA* is required, it must obtain one from the OGC.[333]

CLIMATE CHANGE

The Province does not have any enforceable standards for CO_2 or other GHG emissions. For projects undergoing environmental assessment in BC, the Province has prepared a 'draft' set of guidelines for preparing a 'Greenhouse Gas Mitigation Plan'.[334] Without action by the Province, it is unlikely that provincial environmental assessment legislation will apply to a CBM project.[335]

Where relevant, the draft guidelines apply only to projects that expect to increase direct and indirect GHG emissions by a considerable volume (e.g., greater than 65 kilotonnes of CO_2-equivalent) prior to incorporating mitigation measures.[336] Before the Ministry of Water, Land and Air Protection (WLAP) can approve a Plan under the draft guidelines, it must be satisfied that (among other things) the full range of GHG mitigation options have been considered and evaluated and all practical cost-effective options have been selected for implementation.[337]

WLAP and the Ministry of Energy and Mines are leading the development of a comprehensive climate change plan, and examining opportunities for linking CBM development and CO_2 disposal.[338]

WHAT CAN BE DONE TO REDUCE OR ELIMINATE ENVIRONMENTAL DAMAGE?

> You do CBM wrong, and it's the last boom. You mine everything to get this one resource out — your scenery, your lifestyle, your solitude, your wildlife.
>
> Randy Udall, director of the nonprofit Community Office for Resource Efficiency in Aspen, Colorado.[339]

Based on their experiences with CBM, US Citizens' groups from Colorado, Montana, and Wyoming recommend the following actions to reduce or eliminate the potential for environmental damage in the CBM industry:

FOR LANDOWNERS

- ***Know what permits are necessary.*** Make sure you know what permits and environmental analyses are required before drilling can occur and get involved.[340]

- ***Ask company or government to determine baseline conditions.*** Pressure CBM companies and government regulators to determine baseline conditions before development takes place.[341]

- ***Ask key questions about environmental impact.*** Ask CBM companies and government regulators the following questions:

  - How will produced water be managed? If re-injected, how will underground drinking water sources be protected against contamination? If stored or disposed on the surface, how will soils, vegetation, fisheries, livestock, and wildlife be protected from dissolved solids, minerals, and salts?[342]

  - Has the potential for spontaneous combustion in partly dewatered underground coal seams been examined?[343]

  - Have the potential impacts from migrating methane (e.g. impacts to wildlife, soils, and human safety) been examined?[344]

  - Has the possibility of ground sinking or shifting caused by dewatering been examined?[345]

  - How long will it take underground aquifers to recharge and replenish?[346]

  - How many monitoring wells will be employed to assess changing water quality, drops in pressure, lowering of the water table and rates of aquifer recharge?[347]

- ***Get model agreements.*** Obtain copies of model surface protection and water well mitigation agreements.[348]

- ***Monitor developments.*** Monitor drilling and development activities and request frequent on-the-ground inspections.[349]

FOR GOVERNMENTS

General

- ***Collect baseline data.*** Before authorizing any CBM development, establish proper baseline data for soils, vegetation, aquifers, streams,[350] fish, and wildlife.[351]

- ***Halt subsurface leasing pending resource management plan.*** Defer disposition of remaining subsurface leases until resource management plan adequately reflects CBM impacts, and attach CBM-specific conditions when remaining leases are issued.[352]

- ***Require best available technologies.*** Where feasible, require new operators to employ new and advancing technologies to treat saline/sodic waters, eliminate the need for reserve pits, reduce the amount of methane venting/flaring, provide alternative fuel sources, re-inject produced water,[353] recharge aquifers, cluster development, and muffle compressor stations.[354]

- ***Employ 'adaptive management' and 're-open' permits.*** Use results of monitoring to adapt management of CBM activities and corresponding mitigation measures.[355] Re-open authorizations (where possible) to reflect new understandings.[356]

- ***Ensure meaningful public participation.*** Distribute all environmental analyses for well approvals to the public and affected parties at least 30 days prior to approval to allow for public comment.[357]

- ***Take ecological approach to CBM.*** Regulate based on a 'big picture' of CBM development in the region and monitor continuously for cumulative impact.[358] Address impacts of thousands of wells, roads, pipelines, reservoirs, compressor stations, and millions of gallons of produced water.[359]

- ***Promote clean alternatives to CBM, and use clean sources to power CBM activities.*** Reduce the need for CBM through the promotion of energy conservation and clean sources of power. Use clean sources to supply power for CBM development.[360]

- ***Conduct monitoring and enforce laws.*** Effectively monitor CBM activity and actively enforce existing laws.[361]

Surface disturbances

- ***Phase in development.*** Organize CBM development in order to concentrate impacts by clustering roads, pipelines, power lines, compressor stations and other infrastructure.[362]

- ***Request directional drilling.*** Colorado landowners and county commissioners have long asked for directional drilling (drilling at an angle into multiple underground gas pockets) because it requires only one pad. Gas companies have said directional drilling isn't economical.[363] Less than five percent of CBM wells in the US are directionally drilled.[364] CBM companies say directional drilling adds 30 percent to their costs, and argue that government shouldn't force the technology on an already over-regulated business.[365]

- ***Continually reclaim sites.*** Continually reclaim well sites before moving on to a new location so the entire basin is not at one state of development at the same time.[366] Return all resources — both above- and below-ground — to the condition they were at prior to CBM development (including full reclamation of soils, vegetation, eradication of weeds and the restoration of riparian areas, unwanted roads, reservoirs and the landscape).[367]

- ***Protect taxpayers against clean-up liability.*** Require a minimum of $20,000 per well to cover the full costs of reclamation.[368]

- ***Recycle drilling fluids.*** Strip drilled solids from mud while drilling and transport the remaining drilling fluids to the next drill site. This closed-loop system virtually eliminates drilling water, reserve pits, water consumption and drastically reduces vehicle traffic associated with drilling operations.[369]

- ***Help landowners protect their interests.*** Provide legal fees to help landowners protect their property rights.[370]

CBM-produced water

- ***Phase in development.*** Target one coal seam at a time in order to properly gauge underground water impacts.[371]

- ***Protect existing uses.*** Protect existing water uses including irrigation, native vegetation growth, aquatic life, wildlife, and drinking water.[372] Measure and monitor effluents.[373] Require notification for water reservoirs build on-channel.[374] Require well water agreements for all wells within 3 miles of CBM wells; place the burden of proof with CBM operators when hydrostatic pressure is lost.[375]

- ***Conserve water.*** Require re-injection of produced water except where industry can demonstrate it is not feasible or where it would compromise drinking water quality.[376] Re-inject the water so it can be used again, and not simply disposed of.[377]

- ***Desalinate and otherwise treat water.*** Several American companies have developed technologies that remove total dissolved solids, minerals and salts from produced water, for as low a cost as $.013 US a barrel. Once the water has been fully treated it can be safely re-injected, or used for purposes such as irrigation.[378]

- ***Investigate water injection technology***. New technology separates gas from water underground and sends the water to a lower injection zone. Though it shows serious potential to preserve water and energy, the environmental impacts of this practice have yet to be studied.[379]

Air quality

- ***Prevent air pollution and protect visibility.*** Carefully study and mitigate air pollution and harmful emissions of hazardous air pollutants.[380] Protect important viewsheds from further impairment.[381] Carefully monitor and disclose air impacts, and work with other regulatory agencies to develop best available control technologies.[382] Evaluate all feasible alternatives to CBM energy production including conservation.[383]

HOW CAN I GET INVOLVED?

If you're concerned about CBM and its potential risks to the environment, here are a few ways you can get involved:

- ***Learn from others who have experience with CBM.*** Use this Guide and other materials to inform questions that you ask of CBM companies and government regulators (see especially 'What can be done to reduce or eliminate environmental damage' above).

- ***Talk to OGC about its draft CBM guidelines.*** Draft guidelines are posted on the OGC's website: http://www.ogc.gov.bc.ca/guidelines.asp.

- ***Ask for a government CBM investigation.*** Ask the OGC to exercise its power under s. 10 of the Oil and Gas Commission Act to conduct an investigation into the long-term ecological impacts of projected CBM development.

- ***Ask for an environmental assessment of CBM policy.*** Ask the Minister of Sustainable Resource Management to exercise his power under s. 49 of the Environmental Assessment Act to order the Environmental Assessment Office to assess the Province's CBM policy.

- ***Ask government to use ADR.*** Ask the OGC to fulfil its statutory duty to encourage consensual alternative dispute resolution methods when resolving disputes. Where applicable, ask the OGC's advisory committee to request the OGC to reconsider a decision.

- ***Ask government to allocate funds towards CBM-environment issues.*** Ask the OGC to allocate some of its $5 million 'environment fund' towards resolving CBM environmental issues.

- ***Ask to be consulted.*** Ask the Ministry of Energy and Mines to be consulted on CBM law and policy changes, including the Code of Practice now under development for CBM-produced water.

- ***Stay informed about development in your area.*** Watch the BC Gazette for impending leases of CBM subsurface rights and request the Province place conditions on the lease that will protect the environment.

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[2] United States Geological Survey, *Fact Sheet FS-156-00: Water Produced with Coal-Bed Methane* (Denver, USGS, 2000); http://pubs.usgs.gov/fs/fs-0156-00/fs-0156-00.pdf.

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[260] Province of BC, Ministry of Energy and Mines, See also Oil and Gas Commission, *DRAFT Guidelines for Coalbed Methane Project in British Columbia* (Ft. St. John: The Commission, October 21, 2002) at pp. 16-17.

[261] *Petroleum and Natural Gas Act*, R.S.B.C. 1996, c. 361, s. 100, as amended by *Energy and Mines Statutes Amendment Act*, S.B.C. 2002, c. 26. See also Oil and Gas Commission, *DRAFT Guidelines for Coalbed Methane Project in British Columbia* (Ft. St. John: The Commission, October 21, 2002) at p. 6: 'A CBM experimental scheme allows for a longer time period of confidentiality of well data. Data from a given well on a scheme will be released 3 years after the OGC or MEM receives the well data or well report (section 57.4.e of the D&P Regulation). Similarly, test hole data is confidential for 3 years following the rig release date. For a conventional natural gas well, the confidentiality period ranges from

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[263] Oil and Gas Commission, *DRAFT Guidelines for Coalbed Methane Project in British Columbia* (Ft. St. John: The Commission, October 21, 2002) at p. 6.

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[272] Drilling and Production Regulation, B.C. Reg. 362/98, s. 10(1). See also Oil and Gas Commission, *DRAFT Guidelines for Coalbed Methane Project in British Columbia* (Ft. St. John: The Commission, October 21, 2002) at p. 10: 'British Columbia's Drilling and Production Regulation (section 10.1)) requires one section, or approximately 260 hectares (640 acres), for each conventional natural gas well drilled (equivalent to one well per square mile)'.

[273] Drilling and Production Regulation, B.C. Reg. 362/98, s. 10(2). See also Oil and Gas Commission, *DRAFT Guidelines for Coalbed Methane Project in British Columbia* (Ft. St. John: The Commission, October 21, 2002) at p. 10.

[274] Oil and Gas Commission, *DRAFT Guidelines for Coalbed Methane Project in British Columbia* (Ft. St. John: The Commission, October 21, 2002) at p. 10.

[275] Oil and Gas Commission, *DRAFT Guidelines for Coalbed Methane Project in British Columbia* (Ft. St. John: The Commission, October 21, 2002) at p. 10.

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[277] Oil and Gas Commission, *DRAFT Guidelines for Coalbed Methane Project in British Columbia* (Ft. St. John: The Commission, October 21, 2002) at p. 4.

[278] Drilling and Production Regulation, BC. Reg. 362/98, s. 41. See also Oil and Gas Commission, *DRAFT Guidelines for Coalbed Methane Project in British Columbia* (Ft. St. John: The Commission, October 21, 2002) at p. 18.

[279] Oil and Gas Commission, *DRAFT Guidelines for Coalbed Methane Project in British Columbia* (Ft. St. John: The Commission, October 21, 2002) at p. 18. The objective of the Province's *Waste Management Act* review is to: (1) British Columbia has effective waste management and pollution prevention legislation that will protect human health and the environment; and (2) Efficiency and effectiveness are increased by reducing government costs, reducing the costs of those that must meet environmental standards, reducing conflict and litigation, eliminating service backlogs, providing incentives to best practices and focusing efforts in areas where there is the greatest risk to the environment [See Province of BC, Waste Management Act Review Backgrounder (Victoria: the Ministry, 2002): http://wlapwww.gov.bc.ca/epd/waste_mgt_review/backgrounder.html.

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[294] Oil and Gas Commission, *DRAFT Guidelines for Coalbed Methane Project in British Columbia* (Ft. St. John: The Commission, October 21, 2002) at p. 14.

[295] Drilling and Production Regulation, B.C. Reg. 362/98, s. 94(4). See also Oil and Gas Commission, *DRAFT Guidelines for Coalbed Methane Project in British Columbia* (Ft. St. John: The Commission, October 21, 2002) at p. 12.

[296] Oil and Gas Commission, *DRAFT Guidelines for Coalbed Methane Project in British Columbia* (Ft. St. John: The Commission, October 21, 2002) at p. 13.

[297] Province of BC, Ministry of Energy and Mines, 'CBM Activity Update' (Power point presentation delivered to the 4th Annual Unconventional Gas and Coalbed Methane Forum, Calgary, AB, October 25, 2002): 'Surface disposal is an option!'

[298] Oil and Gas Commission, *DRAFT Guidelines for Coalbed Methane Project in British Columbia* (Ft. St. John: The Commission, October 21, 2002) at p. 13. See also: Province of BC, *Coalbed Methane in British Columbia*, (Victoria: Ministry of Energy and Mines, May 2001): 'When the composition or volume of the produced water makes surface disposal inappropriate, subsurface water is injected into deep wells'.

[299] Province of BC, Ministry of Energy and Mines, 'CBM Activity Update' (Power point presentation delivered to the 4th Annual Unconventional Gas and Coalbed Methane Forum, Calgary, AB, October 25, 2002).

[300] *Water Act*, R.S.B.C. 1996, c. 483, s. 2. See also Harvie, A., 'Legal and Regulatory Aspects of Coalbed Methane Development' (Calgary: McLeod Dixon, 2002), at p. 16: online at http://www.macleoddixon.com/content/eng/lawyers/329_13522.htm.

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[311] Province of BC, *Coalbed Methane in British Columbia*, (Victoria: Ministry of Energy and Mines, May 2001).

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[316] Drilling and Production Regulation, B.C. Reg. 362/98, s. 44(1). See also Oil and Gas Commission, *DRAFT Guidelines for Coalbed Methane Project in British Columbia* (Ft. St. John: The Commission, October 21, 2002) at p. 18.

[317] Drilling and Production Regulation, B.C. Reg. 362/98, s. 45.

[318] Oil and Gas Commission, *DRAFT Guidelines for Coalbed Methane Project in British Columbia* (Ft. St. John: The Commission, October 21, 2002) at p. 10-11.

[319] Drilling and Production Regulation, B.C. Reg. 362/98, s. 58(3) and (4).

[320] Drilling and Production Regulation, B.C. Reg. 362/98, s. 71(4).

[321] Drilling and Production Regulation, B.C. Reg. 362/98, s. 71(4).

[322] Oil and Gas Waste Regulation, B.C. Reg. 208/96.

[323] Oil and Gas Commission, *DRAFT Guidelines for Coalbed Methane Project in British Columbia* (Ft. St. John: The Commission, October 21, 2002) at p. 12.

[324] Oil and Gas Commission, *DRAFT Guidelines for Coalbed Methane Project in British Columbia* (Ft. St. John: The Commission, October 21, 2002) at p. 12.

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[326] Harvie, A., 'Legal and Regulatory Aspects of Coalbed Methane Development' (Calgary: McLeod Dixon, 2002), at p. 21: online at http://www.macleoddixon.com/content/eng/lawyers/329_13522.htm: 'A pre-application emission dispersion study is required for application to flare gas with more than 5% H_2S and public consultation is required for all flaring approvals. The requirements to obtain flaring approval are set out in the OGC's *Interim Guideline OGC 00-01: Natural Gas Flaring During Well Testing*'.

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[338] Province of BC, *Energy for Our Future: A Plan for BC* (Victoria: Ministry of Energy and Mines, 2002) at p. 34.

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