Southeastern Environmental Law Journal

Volume 14 | Issue 2 Article 7

Spring 2006

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Julie Murphy

COAL BED METHANE WASTEWATER: ESTABLISHING A BEST AVAILABLE TECHNOLOGY STANDARD FOR DISPOSAL UNDER THE CLEAN WATER ACT

JULIE MURPHY

I. INTRODUCTION

Coal bed methane[1] (CBM)[2] extraction continues to grow at an unprecedented pace in the United States as the Nation's demand for natural gas increases. While CBM is a domestic source of a cleaner burning fossil fuel,[3] there are many costs associated with extraction. Groundwater, as a significant substrata structural component,[4] provides pressure causing methane adsorption onto the coal seam surfaces.[5] Thus, methane extraction requires the removal of enormous amounts of groundwater from the coal seam.[6] As the CBM industry exponentially increases, the quantity of

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[1] "Methane is the principal constituent of natural gas and is created through decomposition of organic matter. Methane is found all over the world in various types of geologic formations. Coalbed methane is the name given to methane found in coal seams. It is formed during coalification, the process that transforms plant material into coal." Environmental Protection Agency (EPA), Coalbed Methane Outreach Program (CMOP), Frequent Questions, http://www.epa.gov/cmop/faq.html#faq (last visited May 30, 2006) [hereinafter "Coal FAQ"].

[2] CBM "is methane contained in coal seams, and is often referred to as virgin coalbed methane, or coal seam gas. . . . In 2002, according to the U.S. Department of Energy, . . . CBM production stood at 1.6 trillion cubic feet (*U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves: 2002 Annual Report DOE/EIA-0216* (2002))." *Id.*

[3] Thomas F. Darin & Amy W. Beatie, *Debunking the Natural Gas "Clean Energy" Myth: Coalbed Methane in Wyoming's Powder River Basin*, 31 ENVTL. L. REV. 10566, 10567 (2001) (identifying natural gas as the cleanest burning fossil fuel).

[4] *See* Larry W. Canter, Robert C. Knox, & Deborah M. Fairchild, *Ground Water Quality Protection* 1 (Lewis Pub. Inc, 1987) ("Ground water may be defined as subsurface water that occurs beneath the water table in soils and geologic formations that are fully saturated. In order for ground water to be used as water supply, the formations must have adequate permeability . . . to transmit and yield water."). *See also* EPA, Browse EPA Topics, Ground Water, http://www.epa.gov/ebtpages/wategroundwater.html (last visited May 30, 2006)

> ("Ground water is an important resource in [the] environment. It replenishes . . . streams, rivers, habitats and also provides fresh water for irrigation, industry, and communities. For many Americans, ground water is also the primary source of drinking water. However, ground water is highly susceptible to contamination from septic tanks, agricultural runoff, highway de-icing, landfills, and pipe leaks.").

[5] *See* EPA, *Inventory of Greenhouse Gas Emissions and Sinks: 1990-2003*, 92 (Apr. 2005), *available at* http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2005.html (methane trapped in coal deposits and in surrounding strata is released during normal mining operations in both underground and surface mines. In addition, handling of the coal after mining results in methane emissions) [hereinafter *Greenhouse Gas Emissions*].

[6] *Id.*

> Regulation of the mining sector involves every major EPA program. Mining operations generate tailings and waste rock that must be disposed of and create wastewater discharges and air emissions. As a result, mining can affect surface and ground water quality, drinking water supplies and air quality. Impacts from

groundwater surfaced becomes overwhelming; thus, the disposal of trillions of gallons of groundwater requires national regulation.

The CBM-extracted groundwater is considered a pollutant and therefore is regulated by the Environmental Protection Agency[7] (EPA) under the Clean Water Act's[8] (CWA) National Pollution Discharge Elimination System[9] (NPDES).[10] Thus, a CBM developer must obtain a permit before discharging extracted groundwater into surface waters.[11] As the mining industry continues to grow, regulators should consider the advantages and disadvantages of the various wastewater disposal methods. Current disposal methods include reinjection or injection, retention or evaporation ponds, discharge into surface waters with or without treatment, and use for irrigation or livestock watering.[12] The sheer scale of this issue should induce the EPA to promulgate uniform, national standards regulating the disposal of the groundwater. EPA initiated the process to establish a Best Professional Judgment[13] (BPJ) determination of effluent limitations for

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> operating and abandoned mines can also cause extensive losses of aquatic and terrestrial habitat. . . .
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> [L]arge scale coal mining in the eastern half of the United States has been underway for the past 150 years and the impacts to watersheds from active as well as abandoned coal mines require regulatory oversight to protect these valuable environmental resources. These situations, combined with an increasing population, has [sic] made mining issues a priority. The growth in population has intensified the use of aquatic and riparian ecosystems for recreation, and has increased the demand on aquifers for domestic water supply.

EPA, National Pollutant Discharge Elimination System (NPDES), Mining, http://cfpub.epa.gov/npdes/indpermitting/mining.cfm (last visited May 30, 2006) [hereinafter "NPDES Mining"].

[7] The EPA Home page can be found at http://www.epa.gov/.

[8] 33 U.S.C. §§ 1251–1387 (2000). The formal name of the statute is the Federal Water Pollution Control Act. Pub. L. No. 95-217, § 1, 101 Stat. 76. The short title "Clean Water Act" was adopted by Congress in 1977. *Id.*

[9] *See* 33 U.S.C. § 1342. EPA's NPDES Home page can be found at http://cfpub.epa.gov/npdes/.

[10] CWA § 402 requires all point source discharges from mining operations be authorized under an NPDES permit. 33 U.S.C. § 1342. EPA Regional offices have used statutory authority granted by the CWA to regulate all mining activities through the NPDES permits program since the 1970s. *See* NPDES Mining, *supra* note 6, at http://cfpub.epa.gov/npdes/indpermitting/mining.cfm.

[11] 33 U.S.C. § 1342(a).

[12] *See* U.S. Dept. of Agric., *Water and Waste Disposal Programs* (July 2003).

[13] *See EPA Region 8 "Best Professional Judgment" (BPJ) Determination of Effluent Limitations That Represent Best Available Technology Economically Achievable (BAT) for Coalbed Methane (CBM) Activities; Announcement of a Meeting,* 66 Fed. Reg. 46455, 46455 (Sept. 5, 2001) [hereinafter *BPJ & BAT*].

CBM extraction in 2001.[14] The Agency should now complete the process to create uniform regulations for this industry.

This issue requires uniform standards as the many states, developers, and individuals involved in the CBM extraction industry compound the complexity of the situation. Many involved states have agencies with overlapping regulatory power causing patchy responses to similar issues.[15] The groundwater laws in these states are quite fragmented and address CBM water issues inconsistently,[16] which raises additional concerns as dewatering issues increase exponentially in scope and severity.[17] A uniform standard will improve the process for developers and can minimize environmental impacts on water quality and groundwater viability, which are resource issues with no political boundaries. As discussed below, the various solutions, reinjection should be adopted as the best available technology (BAT) standard,[18] and the resulting zero-discharge limit should be incorporated for CBM extraction NPDES permits.

II. CBM OVERVIEW

Decomposed organic material, carbon dioxide, and water are the base elements in the geologic process creating coal.[19] Over millions of years, pressure and heat reconstitute these elements into different varieties of coal[20] and gaseous byproducts.[21] Methane is a byproduct of this process and is formed by the thermal alteration of organic matter or bacterial processes.[22] Within a coal seam, the coal's porosity creates large surface areas to which

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[14] *Id.*

[15] *See* Glenn Graham & Dick Wolfe, *Water Rights and Beneficial Use of Coal Bed Methane Produced Water in Colorado*, at 6 (CO. DEPT. OF NATURAL RES. DIV. OF WATER RES. 2002).

[16] *See id.*

[17] Gary Bryner, *Coalbed Methane Development in the Intermountain West: Producing Energy and Protecting Water*, 4 WYO. L. REV. 541, 557 (2004) (discussing the various states' groundwater laws).

[18] *BPJ & BAT*, 66 Fed. Reg. 46455.

[19] Am. Coal Found., Glossary, http://www.teachcoal.org/glossary.html (last visited May 10, 2006)

> ("Coal is a burnable carbonaceous rock that contains large amounts of carbon. Coal is also a fossil fuel—a substance that contains the remains of plants and animals and that can be burned to release energy. Coal contains other elements such as hydrogen, oxygen, and nitrogen; has various amounts of minerals; and is itself considered to be a mineral of organic origin.").

[20] *Id. See also* Amoco Prod. Co. v. S. Ute Indian Tribe, 526 U.S. 865, 872 (1999) (discussing the length of time and the geologic process variations, these components yield fossil fuels in stages, the first stage is peat with coals of varying carbon content following).

[21] Am. Coal Found., *supra* note 19, at http://www.teachcoal.org/glossary.html.

[22] *See* Coal FAQ, *supra* note 1, at http://www.epa.gov/cmop/faq.html#faq.

the methane adsorbs; releasing the methane from this surface vents the methane.[23] This venting causes the asphyxiation of many miners and indicator canaries, as well as mine explosions due to combustion.[24] Consequently, miners and extractive industries have known about methane for some time, but even with this knowledge, neither the technology for collection nor demand existed to make methane extraction an economically viable industry.

A. The History of CBM Technology

CBM gas production through wells began in the 1970s as a safety measure in underground coal mines to reduce the explosion hazard posed by methane.[25] In 1980, Congress enacted a tax credit for non-conventional fuels production, including CBM, as part of the Crude Oil Windfall Profit Tax Act.[26] In 1984, there were fewer than 100 coal bed wells in the U.S.[27] By 1990, however, with the anticipated expiration of the tax credit, almost 8,000 CBM wells had been drilled nationwide.[28] In 1996, CBM production totaled about 1,252 billion cubic feet, accounting for approximately seven percent of U.S. gas production.[29] According to the U.S. Department of Energy,[30] natural gas demand is expected to increase at least 45% in the next

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[23] *See Greenhouse Gas Emissions*, *supra* note 5, at 92, 99.

[24] Magnus Macfarlane, *An Overview of Health Issues in Mining* 4 (Mining and Energy Research Network 1998), *available at* http://www2.warwick.ac.uk/fac/soc/wbs/research/ccu/mern/working_papers/144_mm.pdf (explaining the toxicity of methane as

> one of the greatest enemies to miners, and present in large underground pockets, which when disturbed will release their contents into the lower pressure of the mine atmosphere. It is generally found in coal mines due to the chemical nature of the surrounding rock and material, and in the past has caused devastating explosions leading to great loss of life and property—it is highly explosive when concentrated. . . . Even if it is not ignited, it can lead to the asphyxiation of miners working in its atmosphere though this is generally more rare. As always both effects are made worse by the confined nature of most underground mines.).

[25] C.H. Elder & Maurice Deul, *Degasification of the Mary Lee coalbed near Oak Grove, Jefferson County, Alabama, by vertical borehole in advance of mining*, U.S. BUR. OF MINES REPORT 7968 (1974).

[26] Pub. L. No. 96-223, 94 Stat. 229 (1980).

[27] J.C. Pashin & Frank Hinkle, *Coalbed methane in Alabama*, 192 Geol. Surv. of Ala. 71 (1997).

[28] *Id.*

[29] U.S. Dept. of Energy (DOE), *U.S. Crude Oil, Natural Gas, Natural Gas Liquids Reserves 1999 Annual Report*, at 34 (1999).

[30] The U.S. Department of Energy Web site can be found at http://www.energy.gov/.

15 years.[31] Therefore, the rate of CBM production should also be expected to increase in response to the growing demand.

In 1950, natural gas accounted for less than six percent of the U.S. energy consumption,[32] and, in 2004, it accounted for 23 percent.[33] As demand for this fossil fuel increases, the technology concurrently develops to extract natural gas. As already established, methane is emitted during fossil fuel production, including releases of significant quantities of methane into the atmosphere. Pressure from mining adsorbs the methane gas onto the surface of the coal, and reducing the pressure can allow the methane gas to escape for collection.[34] The most effective method of decreasing the pressure gradient is to dewater coal seams, which separates groundwater from methane.[35] Thus, once enough groundwater is pumped out, the methane frees from the coal surface and migrates to the soil surface where it is collected and piped to market. This leaves the groundwater on the surface,[36] which often creates a substantial wastewater problem.

B. The CBM–Groundwater Problem

It is difficult to comprehend the scale of the wastewater problem without tangible numbers. In January 2003, the Bureau of Land Management[37] (BLM), Montana Department of Environmental Quality[38] (MDEQ), and Montana Board of Oil and Gas[39] (MBOGC) issued a Final Environmental Impact Statement[40] (FEIS) for the Powder River Basin Oil and Gas Project.[41] The Powder River Basin FEIS assesses construction of

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31 DOE Office of Fossil Energy, *Environmental Benefits of Advanced Oil and Gas Exploration and Production Technology, Office of Fossil Energy* 8 (1999).
32 DOE, *Annual Energy Review*, Report No. DOE/EIA-0384, at 9 (2004).
33 *Id.*
34 *See Greenhouse Gas Emissions*, *supra* note 5, at 92–93.
35 *Id.* at 93.
36 *Id.*
37 The U.S. Department of the Interior's Bureau of Land Management Web site can be found at http://www.blm.gov/nhp/index.htm.
38 The Montana Department of Environmental Quality Web site can be found at http://deq.mt.gov/.
39 The Montana Board of Oil and Gas Web site can be found at http://bogc.dnrc.mt.gov/.
40 An Environmental Impact Statement is a detailed written statement required by the National Environmental Policy Act, 42 U.S.C. §§ 4321-4347 (2000), § 102(2)(C) whenever an action may have a significant effect on the quality of the human environment. *See* 42 U.S.C. § 4332(2)(C); 40 C.F.R. § 1508.11 (2005); *see generally* 40 C.F.R. § 1502.
41 Dept. of the Int., *Statewide Oil and Gas Final Environmental Impact Statement and Proposed Amendment to the Powder River and Billings Resource Management Plans* (NPS Dec. 17, 2002) [hereinafter *PRB FEIS*]. *See also* 68 Fed. Reg. 2569 (Jan. 17, 2003), *available at* http://www.epa.gov/fedrgstr/EPA-IMPACT/2003/January/Day-17/i1081.htm.

over 26,000 CBM wells in the Powder River Basin (PRB), a 16-county area primarily in southeastern Montana.[42] The FEIS also identifies an average water production rate of 2.5 gallons per minute (gpm) over the typical 20-year production lifespan for a CBM well.[43] However, this rate is expected to vary dramatically throughout the 20 years of production.[44] Thus, a single well would produce, on average, over 26 million gallons of water during production.[45] In this 16-county area, at the conclusion of methane production from the 26,000 wells, the CBM industry will have extracted 676 trillion gallons of groundwater.[46] Again, the PRB is only a single area of CBM extraction; this type of extraction is occurring throughout the western United States.[47] The PRB 16 counties, encompassing an area of 28,131,785 acres, receive between 12 and 16 inches of rain per year, on average,[48] but this amount of water would submerge the area in over 73 feet of water. This quantity of water would inundate Montana's entire 145,552 square miles[49] in over 22 feet of water. This demonstrates the scale of the CBM groundwater disposal problem.

1. Characteristics of the CBM-Extracted Groundwater

The CBM-extracted groundwater is of low quality,[50] further exacerbating the disposal problem. Specifically, the chemical composition of most of the groundwater resulting from CBM extraction makes human consumption of the water unlikely without treatment, and the surface application of the water destroys the viability and productivity of the soils. Such water contains excess salt, which as a groundwater contaminant can be described by its sodium absorption ratio (SAR), a description of the amount of excess sodium in relationship to calcium and magnesium.[51] The Ninth

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[42] *See PRB FEIS, supra* note 41.
[43] *Id.* at 4-8.
[44] *Id.* (discussing the typical water production rate as highest in the first years, but as dewatering continues to lower the pressure, the water production also decreases).
[45] *Id.*
[46] *Id.*
[47] Bryner, *supra* note 17, at 524 (discussing that New Mexico, Utah, Colorado, Wyoming, and Montana will play a significant role in meeting the United States' demand for natural gas and the increasing demand will exert pressure to find and develop more sources, especially in the west).
[48] *PRB FEIS, supra* note 41, at 3-6.
[49] Mont. Dept. of Commerce, Montana Quick Facts, http://ceic.commerce.mt.gov/MTQuickFacts.htm (last visited May 30, 2006).
[50] *See PRB FEIS, supra* note 41, at 4-8.
[51] Edward Goldsmith & Nicolas Hildyard, *The Social and Environmental Effects of Large Dams*, ch. 11 (Wadebridge Ecological Centre 1984) (describing salinity of soil and SARs).

Circuit focused on these two characteristics in ruling that CBM-extracted water is distinctly different from surface water.[52] Interestingly, salinity and sodicity, the amount of salt in groundwater and the SAR of groundwater respectively, are synergistic factors and create more severe impacts than either alone.

High salinity makes water unavailable to plants and accumulates in the root zone of soils.[53] Saline water intensifies the effect upon the plants because as the salts increase in concentration in the roots, an increasingly proportional amount of water is required to flush the salts from the soil before the soil will be hospitable for plant growth.[54] Flushing the soils with water containing any salts aggravates the problem. Discharging water with a high salt content into surface water or applying it to the land causes the accumulation of salt in the soils and fundamentally changes the vegetation profile.[55] As the concentration of salt in the soil increases, the native, salt-intolerant vegetation dies off leaving stream banks exposed and unprotected against erosion.[56] The amount of discharged wastewater intensifies the effects of erosion, causing permanent changes in the stream channels.[57] Further, the loss of native plants creates the opportunity for the invasion of weed species and is a serious consequence of CBM wastewater discharge.[58]

As identified by the Ninth Circuit, the total dissolved solids[59] (TDS) measures the salinity of water.[60] The mean TDS for the Tongue River (the major discharge water for the CBM extraction in southeastern Montana)[61] is 475 mg/L, whereas mean TDS for the CBM wastewater is 1,400 mg/L.[62]

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[52] N. Plains Res. Council v. Fidelity Exploration and Dev. Co., 325 F.3d 1155, 1158 (9th Cir. 2003) (identifying that, prior to disposal, natural state CBM wastewater contains "suspended solids, calcium, magnesium, sodium, potassium, bicarbonate, carbonate, sulfate, chloride, and fluoride . . . aluminum, arsenic, barium, beryllium, boron, copper, lead, iron, manganese, strontium, and radium.").

[53] V.A. Kovda, *Arid Land Irrigation and soil fertility: Problems of Salinity, Alkalinity, Compaction*, at 216 (Oxford 1977).

[54] *Id.*

[55] *Id.* at 218.

[56] *Id.* at 216.

[57] *See* Goldsmith & Hildyard, *supra* note 51, at ch. 11.

[58] *Id.*

[59] TDS is a water quality parameter defining the concentration of dissolved organic and inorganic chemicals in water. After suspended solids are filtered from water and water is evaporated, dissolved solids are the remaining residue. *Id.*

[60] *N. Plains Res. Council*, 325 F.3d at 1158.

[61] *See* Montana Fish Wildlife & Parks, Tongue River Reservoir, http://fwp.mt.gov/lands/site_283967.aspx (last visited May 30, 2006).

[62] *N. Plains Res. Council*, 325 F.3d at 1158.

This substantial difference likely will devastate the soil productivity for any land or stream in which CBM wastewater is discharged.

Sodicity results from the ratio of sodium to calcium and magnesium and is measured by the sodium absorption ration, or SAR.[63] Sodicity destroys the soil composition by causing the soil particles to unbind and disperse.[64] The dispersal and dissipation of soil destroys the soil structure and prevents it from properly draining water.[65] This exacerbates the problems of salts in soils because the sodicity prevents water drainage, and, thus, prevents the flushing of those salts from the root zone. For example, the average SAR of the CBM wastewater was 40 to 60 times greater than that of the receiving water in the Powder River Basin.[66] Ultimately, the Powder Rover Basin FEIS projects the long-term consequences of CBM wastewater land application or irrigation as "anaerobic, waterlogged, saline/sodic soil, which would be difficult to reclaim."[67] These impacted soils would also be subject to increased erosion, leading to increased sedimentation in streams and harm to riparian vegetation and habitats.[68] The application of this wastewater to the land surface could lead to fundamental changes in the soils causing erosion, detrimental changes to the vegetation profile, and negative impacts on aquatic and terrestrial wildlife, habitat, water quality, and stream morphology.

2. Reinjection and Injection

Reinjecting[69] the groundwater into the aquifer mitigates the severity of the above consequences because it returns unaltered water to the same subsurface location.[70] Specifically, it minimizes some of the surface impacts

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[63] *See* Goldsmith & Hildyard, *supra* note 51, at ch. 11.

[64] *Id. See also N. Plains Res. Council*, 325 F.3d at 1158.

[65] *Id.*

[66] *Id.*

[67] *PRB FEIS, supra* note 41, at 4-138.

[68] *Id. See also* Goldsmith & Hildyard, *supra* note 51, at ch. 11.

[69] Reinjection technology is one of the far-reaching ways of dealing with groundwater. The process involves "reinjecting" fluids back into the ground in order to deal with a number of groundwater issues: recharging depleting aquifers, disposing of sewage and industrial waste, dealing with irrigation and stormwater runoff, flood prevention, mining, and remediating contaminated groundwater. *See* Herman Bouwer, *Systems for Artificial Recharge of Groundwater*, at 1-3 (Am. Society of Civil Engineers 1988).

[70] "It should be noted that reinjection implies putting water back into the original aquifer it came from, i.e. the coal seam in CBM, whereas injection merely implies putting water into the ground." *See* Nikos Warrence & James W. Bauder, *Reinjection Technology—Process and Applications, Including Disposal of Coal Bed Methane Product Water* (2003), *available at* http://waterquality.montana.edu/docs/methane/reinjectiontech.shtml.

of extracted groundwater application on the land surface because it eliminates the problem of surface disposal and its subsequent consequences.[71] Further, reinjection minimizes the subsurface concerns of aquifer dewatering and land subsidence by replacing the groundwater and returning structural integrity to the sub-strata. The major criticism of reinjection is the potential degradation of connected aquifers.[72] However, because this process returns the water to the original aquifer from which it was extracted, this should limit contamination concerns. Further, all reinjection must comply with the Safe Drinking Water Act[73] (SDWA) and its regulation of underground injection of wastes and wastewater through the Underground Injection Control[74] program.[75]

Slightly different from reinjection is injection, which injects the water into a different aquifer and raises slightly different concerns.[76] Specifically, without knowing the aquifer hydroconnectivity, the movement of injected water is unknown and could degrade or contaminate aquifers with different ion concentrations.[77] Per the Underground Injection Control[78] (UIC) permitting program,[79] injection concerns for contamination of drinking

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[71] *Id.*

[72] *Id.*

[73] Pub. L. No. 93-523, 88 Stat. 1660 (1974); 42 U.S.C. §§ 300f–300j-26.

[74] *See infra* note 78 for an explanation of the Underground Injection Control (UIC) Program.

[75] 42 U.S.C. § 300h-1(a) (requiring the Administrator or states to establish a state underground injection control program to assure the protection of underground drinking sources from the underground injections).

[76] *See* Underground Injection Control program, What is the UIC Program?, http://www.epa.gov/safewater/uic/whatis.html (last visited May 30, 2006)

> ("Underground injection is the technology of placing fluids underground, in porous formations of rocks, through wells or other similar conveyance systems. While rocks such as sandstone, shale, limestone appear to be solid, they can contain significant voids or pores that allow water and other fluids to fill and move through them. Man-made or produced fluids (liquids, gases or slurries) can move into the pores of rocks by the use of pumps or by gravity. The fluids may be water, wastewater or water mixed with chemicals. Injection well technology can predict the capacity of rocks to contain fluids and the technical details to do so safely.").

[77] *Id.*

[78] *See* EPA, Underground Injection Control Program, http://www.epa.gov/safewater/uic.html (last visited May 30, 2006)

> ("The UIC Program works with state and local governments to oversee underground injection of waste in order to prevent contamination of drinking water resources. Some of the wastes the UIC program regulates include: Over 9 billion gallons of hazardous waste every year; Over 2 billion gallons of brine from oil and gas operations every day; Automotive, industrial, sanitary and other wastes that are injected into shallow aquifers.").

[79] 42 U.S.C. § 300h-3(a).

water should be mitigated. While injection is a viable secondary method of CBM wastewater disposal, the EPA should prioritize reinjection as the preferred method of disposal because of the lessened contamination concerns.[80]

A further concern of reinjection or injection occurs in situations where developers use fracturing fluids to increase coal seam permeability.[81] These fracturing fluids often contain chemical solvents, which are "potentially toxic and unpalatable components."[82] These fluids contaminate the groundwater pumped out of the coal seam, which creates concerns for contamination of surface or sub-surface waters.[83] Reinjection and injection artificially recharge aquifers, thus introducing these solvents into groundwater.[84] Especially where hydrologic connectivity remains unknown, the chemicals can permeate and contaminate an unknown number of aquifers. Any proportion of the population consuming contaminated water will be exposed to these fracturing fluids.[85] Hydraulic fracturing raises serious concerns for water contamination, but this analysis only addresses CBM extraction that does not contaminate extracted water with fracturing

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[80] *See, e.g.*, Warrence & Bauder, *supra* note 70

(" Injection of CBM product clearly works and is being done in the southwest and southeast U.S., but until now there has not been sufficient incentive for industry to look into reinjection into the producing coal seam. Within the Powder River Basin, concern about drying up of ephemeral springs and wells, which can potentially still occur even if water were to be injected into a different formation, will hopefully lead to an increased research and hopefully understanding of the physical and economic feasibility of CBM reinjection. In any event, before addressing specific applications of reinjection, the physical process and various sorts of injection wells will be explained.").

[81] Graham & Wolfe, *supra* note 15, at 3.

[82] LETTER FROM LARRY SVOBODA, DIRECTOR NEPA PROGRAM EPA REGION 8, TO CHARLES RICHMOND, FOREST SUPERVISOR GRAND MESA UNCOMPAHGRE, AND GUNNISON NATIONAL FORESTS (Dec. 7, 2005) (detailing the EPA Region 8 Office's comments on the Draft Environmental Assessment for the Spaulding Peak Natural Gas Exploration and Development Area Wide Plan Grand Mesa) (on file with author).

[83] *Id.* (commenting that the Environmental Assessment (a concise public document for which a federal agency is responsible and which serves to briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact, 40 C.F.R. § 1508.9) conducted by the Forest service for this area was insufficient for failing to consider the impacts of fracturing fluid contamination in water).

[84] *See* Warrence & Bauder, *supra* note 70.

[85] Interview with Dr. Theo Colborne. President, The Endocrine Disruption Exchange Inc., in Denver, Colo. (Dec. 21, 2005) (explaining that on the Western Slope of Colorado some people are suffering from exposure to 2-Butoxyethanol (2-BE or ethylene glycol monobutyl ether), a fracturing fluid solvent, contaminated water, and symptoms including neurological and hematological effects).

fluids. Where chemical solvents are used in the fracturing process, any introduced contaminants should be removed from the wastewater prior to disposal, regardless of the disposal method. Where hydraulic fracturing fluids are not used, the preferred method of disposal for the CBM wastewater should be reinjection.

III. CWA REGULATION OF CBM WASTEWATER

"The first principle of the [Clean Water Act] is, as we have seen, that it is unlawful to pollute at all."[86] Adopting a "zero-discharge limit" for CBM water is the only standard entirely in compliance with this principle of the CWA,[87] as it does not allow pollution of the navigable waters of the Nation. Congress adopted the CWA to restore and maintain the integrity of the nation's waters;[88] its first national goal of the CWA is "that the discharge of pollutants into the navigable waters be eliminated."[89] While the CWA regulates the pollution of the Nation's waters by making the discharge of pollutants illegal, it specifies a permitting system to account for and control the discharge of pollutants from point sources. NPDES permits allow point sources to discharge pollutants so long as the discharges comply with the requirements of the permit.[90] The CWA also requires the EPA to create effluent limitations to control the introduction of contaminants.[91]

Effluent limitations cannot become legal obligations for CBM water dischargers until an agency issues a NPDES[92] permit that incorporates those limitations.[93] The CWA defines a point source as "any discernable, confined and discrete conveyance . . . from which pollutants are or may be

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[86] Natural Res. Def. Council v. United States, 822 F.2d 104, 123 (D.C. Cir. 1987) (referring to CWA, 33 U.S.C. §§ 1251–1387, goals of which was to make U.S. waterways fishable and innumerable by 1983, *id.* at § 1251(a)(2)), and to achieve zero discharge of pollutants to waterways by 1985, *id.* at § 1251(a)(1)).

[87] The goals of CWA included achieving total elimination of discharging pollutants into the waterways by 1985. *See* 33 U.S.C. § 1251(a)(1). By the end of the 1980s, "zero discharge" changed from a technical description of 100% wastewater recycling to a "goal." *Id.*

[88] *Id.*

[89] *Id.*

[90] *Id.* at § 1342(a)(1) (requiring the Administrator must also prescribe conditions for the permits to assure compliance with other sections of the Act).

[91] *Id.* at § 1342(a)(2) (stating, "The Administrator shall prescribe conditions for such permits to assure compliance with the requirements of paragraph (1) of this subsection, including conditions on data and information collection, reporting, and such other requirements as he deems appropriate.").

[92] *See generally* 33 U.S.C. § 1342.

[93] Am. Paper Inst., Inc. v. EPA, 996 F.2d 346, 349 (D.C. Cir. 1993).

discharged."[94] As a discrete source releases CBM wastewater into surface waters, it is a point source within this definition. Thus, assuming the wastewater is a pollutant, the CBM dischargers are subject to the requirements of the NPDES program.

The Ninth Circuit Court of Appeals held that "the unaltered groundwater produced in association with methane gas extraction, and discharged into the river, is a pollutant within the meaning of the CWA."[95] The Court found three reasons for concluding that this wastewater was a pollutant. First, the groundwater is an industrial waste, which is specifically included in the CWA's definition of pollutant.[96] Secondly, it is water derived from gas extraction and is, therefore, produced water (as defined by the EPA and 33 U.S.C. § 1362(6)(B)), even though the extraction process adds no pollutants to the water.[97] Finally, the wastewater is a pollutant under the CWA because the addition of wastewater to surface waters impacts water quality, which violates the anti-degradation policy.[98] Essentially, the definition of whether or not something is a pollutant depends on the impact of the discharged water on the receiving water, and not on the additives to the discharged water.[99] Thus, any discharged water that lowers the receiving water's quality is a pollutant within the definition of the CWA. The Supreme Court validated this definition by denying writ of certiorari in the *Northern Plains Resource Council* case,[100] which comports with the holding in *Weyerhaeuser v. Costle*.[101] The *Weyerhaeuser* court found that the only consideration in establishing pollutant limitations is the impact on receiving water.[102] As CBM wastewater does not satisfy the requirements for classification as either toxic or conventional, EPA should regulate it as a

[94] 33 U.S.C. § 1362(14).
[95] *N. Plains Res. Council*, 325 F.3d at 1157.
[96] *Id.* at 1161.
[97] *Id.*
[98] *Id.* at 1162.
[99] *See id. See also* Miccosukee Tribe of Indians of Fla. v. S. Fla. Water Mgmt. Dist., 541 U.S. 95, 96 (2004) (holding that NPDES permits were required for point sources even where that source does not generate pollutants, upholding the 11th Circuit's holding); Dubois v. U.S. Dept. of Agric., 102 F.3d 1273, 1297 (1st Cir. 1996) (discussing that transfers of waters that would not occur naturally constituted discharges requiring NPDES permits); Catskill Mountains Chapter of Trout Unlimited, Inc. v. City of New York, 273 F.3d 481, 492 (2d Cir. 2001) (discussing that an artificial diversion of water from a reservoir satisfies the statutory definition of the addition of a pollutant form a point source when that water is introduced into another creek).
[100] *N. Plains Res. Council*, 325 F.3d 1155.
[101] 590 F.2d 1011 (D.C. Cir. 1978).
[102] *Id.* at 1044 (finding that a regulatory breakdown had occurred in the regulation of thermal pollution where the receiving water's capacity was considered in setting effluent limitations).

non-conventional pollutant.[103] As such, a point source discharger of CBM wastewater will be required to obtain a permit under the NPDES program for the discharge of CBM wastewater to comply with CWA.

A. National Pollution Discharge Elimination System

As mentioned above, to regulate the discharge of pollutants by point sources, Congress created the NPDES permitting program.[104] The Supreme Court interpreted this permit system as "transform[ing] generally applicable effluent limitations and other standards including those based on water quality into the obligations . . . of the individual discharger."[105] Furthermore, once the permitting agency promulgates the standards, CWA requires limits to be included in all NPDES permits and, thus, make the standards legally enforceable against permit holders.[106] Specifically, NPDES permits issued for the discharge of pollutants must meet "all applicable requirements under §1311."[107] Currently, the CBM industry must obtain a NPDES permit to discharge wastewater, but the EPA has not promulgated national standards or guidelines for those discharges.

Where EPA does not promulgate standards, the state NPDES permitting agencies are left to establish effluent limitations at their discretion.[108] As the CBM industry spans much of the western United States, issuing national standards would ensure uniformity across the industry. EPA-issued effluent limitations would preempt any state standards for the wastewater.[109] Once EPA has issued general guidelines for CBM wastewater, the NPDES permit

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[103] *See* 33 U.S.C. § 1362(13) (defining toxic pollutant as "pollutants, or combinations of pollutants, including disease-causing agents, which after discharge and upon exposure, ingestion, inhalation or assimilation into any organism . . . will . . . cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions . . . or physical deformations, in such organisms or their offspring."); *Id.* at § 1314(a)(4) (requiring the EPA to identify and publish conventional pollutants, which includes, but are not limited to "biological oxygen demanding, suspended solids, fecal coliform, and pH.").

[104] *Id.* at § 1342. *See also* EPA, National Pollutant Discharge Elimination System (NPDES), http://cfpub.epa.gov/npdes/ (last visited May 30, 2006).

[105] EPA v. Cal. *ex rel.* State Water Res. Control Bd., 426 U.S. 200, 205 (1976).

[106] *Am. Paper Inst., Inc.*, 996 F.2d at 350 ("[R]ubber hits the road when the state-created standards are used as the basis for specific effluent limitations in NPDES permits.").

[107] 33 U.S.C. § 1342(a)(1)(A).

[108] *Id.* at § 1342(b) (delegating to states, should the state desire it, the administration of the NPDES permit program); *id.* at § 1342(c) (suspending the Federal program upon the Administrator's approval of the state program). The states primarily involved with CBM extraction, Colorado, Wyoming, Montana, and New Mexico, have assumed responsibility for the permitting program. NPDES, *supra* note 104, at http://cfpub.epa.gov/npdes/.

[109] 33 U.S.C. § 1342(b).

would specify those effluent limitations for the individual discharger.[110] In establishing effluent limitations, the CWA specifically requires that EPA consider the "age of equipment and facilities involved, the process employed, the engineering aspects of the application of various types of control techniques, process changes, the cost of achieving such effluent reduction, non-water quality environmental impact . . . and such other factors as the Administrator deems appropriate."[111] Of these factors, none should preclude the adoption of a zero-discharge limit for CBM wastewater. The industry is new, and the age range of the facilities should not substantially affect implementing reinjection technology. The various types of control techniques are limited because of the sheer magnitude of the water produced. Further, the advantages of not discharging should encourage the adoption of a zero-discharge limit.

Of the foregoing factors, consideration of the cost of achieving effluent reduction raises the greatest concerns because it appears to allow EPA to conduct cost-benefit analysis of the effluent reduction when establishing BAT guidelines. However, "[s]o long as the required technology reduces the discharge of pollutants, our inquiry will be limited to whether the Agency considered the cost of technology, along with the other statutory factors, and whether its conclusion is reasonable."[112] Interestingly, as technology has developed, the cost of compliance makes reinjection very profitable.[113] The remaining factors could raise minimal concerns in adopting this standard; however, the advantages of zero-discharge outweigh these concerns. Most importantly, a zero-discharge standard complies with the first goal of the CWA by preventing the discharge of pollutants into navigable waters.[114] Thus, EPA should promulgate a zero-discharge limit for CBM wastewater

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[110] *Weyerhaeuser Co.*, 590 F.2d at 1020 ("The statute contemplates a very close correlation between the general effluent limitations promulgated by EPA and the specific discharge authorizations allowed each mill by the permit-issuing agency.").

[111] 33 U.S.C. § 1314(b)(2)(B).

[112] Ass'n of Pac. Fisheries v. EPA, 615 F.2d 794, 818 (9th Cir. 1980). *See also*, Natural Res. Def. Council v. EPA, 863 F.2d 1420, 1426 (9th Cir. 1988) ("To demonstrate economic achievability, no formal balancing of costs and benefits is required."); EPA v. Nat'l Crushed Stone Ass'n, 449 U.S. 64, 71 (1980) (discussing that the effluent reduction benefits need not be considered in comparison to the BAT cost).

[113] *See* J.R. Kuiper et al., *Draft Technology Based Effluent Limitations for Coal Bed Methane-Produced Wastewater Discharges in the Powder River Basin of Montana and Wyoming* (August 2004) (unpublished draft, on file with Northern Plains Resource Council), *available at* http://northernplains.org/files/Final_BPJ_BAT_8_25_04.pdf (projecting a 34% return on a CBM investment).

[114] *See* 33 U.S.C. § 1251(a)(1).

pursuant to the statute using the regulations to establish technology-based NPDES criteria and standards.[115]

Section 125.3(c) of Title 40 of the Code of Federal Regulations sets out the general procedure for establishing effluent limitations for NPDES permits.[116] EPA can set the standards by establishing effluent limitation guidelines (ELGs) for specific effluents on a case-by-case basis for classes and categories of sources under § 1342(a)(1), or through a combination of the two methods.[117] ELGs quantitatively limit the discharge of specific pollutants or contaminants. These apply to NPDES permits issued for any category or subcategory if that discharge includes those pollutants or contaminants. However, because CBM wastewater is the pollutant at issue and the wastewater does not contain any of these specific pollutants in regulated concentrations, current ELGs do not limit the discharge of CBM wastewater. At this point, no permitting agency has promulgated ELGs for the CBM. Additionally, EPA's ELGs for the Oil and Gas Point Source Subcategory do not apply.[118] In the absence of ELGs, the NPDES Administrator must use the technology-based standards as prescribed by 33 U.S.C. § 1311(b).[119] Therefore, the EPA should promulgate the BAT regulations, initiated in 2001, on a case-by-case basis using best professional judgment (BPJ) for CBM wastewater.[120]

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[115] Criteria and Standards for the National Pollution Discharge Elimination System, 40 C.F.R. § 125 (2005).

[116] *Id.* at § 125.3(c) (pursuant to 33 U.S.C. § 1311(b)).

[117] *Id.*

[118] *See BPJ & BAT*, 66 Fed. Reg. at 46455 (explaining that when EPA developed the Oil and Gas ELGs, the agency did not consider CBM because extraction was not significant or widespread, and, as result, EPA has not applied these standards to CBM produced pollutants). As these regulations do not apply, the beneficial use subcategory should not apply to CBM wastewater to avoid obtaining a NPDES permit for discharges. Essentially, the exception applies where the wastewater is of sufficient quality to be used for livestock or other agricultural uses and the water is put to that use, the beneficial use exemption allows dischargers west of the 98th meridian to put the water to that use without a NPDES permit. Oil and Gas Extraction Point Source Category, 40 C.F.R. § 435.50-51 (2005). Further, the quantity of water at issue would likely far exceed the demand.

[119] *Natural Res. Def. Council*, 859 F.2d at 183 ("Section 1342(a)(1) requires EPA, in approving permits in the absence of formally promulgated effluent limitations guidelines, to exercise its best professional judgment (BPJ) as to proper effluent limits.") Thus, when issuing permits according to its BPJ, EPA is required to adhere to the technology-based standards set out in 33 U.S.C. § 1311(b).

[120] *BPJ & BAT*, 66 Fed. Reg. at 46455.

B. Best Available Technology

Under the interpreting regulation, for pollutants that are not toxic or conventional, EPA sets effluent limitations based upon the best available technology (BAT).[121] This regulation lists the factors the administrator of the permitting program must consider in making BPJ decisions establishing the BAT.[122] Additionally, implementing regulations require EPA to consider the appropriate technology for the category or class of point sources[123] and any unique factor relating to the individual applicant.[124] The CWA expressly requires that regulations adopted be based primarily on classes and categories, and only allows variances for individual plants.[125] In setting these standards, an agency is to rely on the best performing discharger and to consider the most recent technology.[126] Further, "BAT standards impose the highest effluent reduction technology can achieve."[127] Under these regulations, a zero-discharge standard complies because current discharges use this technology[128] and zero-discharge is the highest effluent reduction possible.

BAT standards do not prescribe the specific technology that a polluter must use. Instead, EPA adopts effluent limitations with which the best performer can comply (for CBM a zero-discharge as the standard with which all other polluters must comply).[129] By allowing dischargers to use

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[121] 40 C.F.R. § 125.3(a)(2)(v)(B).

[122] *Id.* at §§ 125.3(d)(3)(i)–(vi). These factors are the same as identified in CWA to determine the best measures and practices for compliance with established effluent limitations. 33 U.S.C. § 1314(b)(2)(B). BPJ analysis discussed *infra.*

[123] A pollutant source that can be treated in a dispersion model as though pollutants were emitted from a single point that is fixed in space. *See* Pacific Northwest National Laboratory, Glossary, http://www.pnl.gov/atmos_sciences/Cdw/Glossary.html (last visited May 30, 2006). An example would be the mouth of a smokestack (or in this Note, the coal seam, emitting CBM). *Id.*

[124] 33 U.S.C. § 1314(b)(2)(B).

[125] E.I. du Pont de Nemours & Co. v. Train, 430 U.S. 112, 128 (1977) (citing 33 U.S.C. § 1314(b)).

[126] *See* Chemical Mfrs. Ass'n v. EPA, 870 F.2d 177, 207-208 (5th Cir. 1989) (discussing that Congress intended these limitations to be based on the performance of the best-performing plant in an industrial field); Kennecott v. EPA, 780 F.2d 445, 448 (4th Cir. 1985) ("The BAT standard reflects the intention of Congress to use the latest scientific research and technology in setting effluent limits, pushing industries toward the goal of zero discharge as quickly as possible. In setting BAT, EPA uses not the average plant, but the optimally operating plant.").

[127] *Natural Res. Def. Council*, 822 F.2d at 110.

[128] Darin & Beatie, *supra* note 3, at 10575 (discussing the current use of technology to reinject wastewater into retrieval or disposal aquifers by CBM developers in Colorado).

[129] *See generally* 40 C.F.R. § 125.

any technology available so long as their effluent discharges do not exceed the standard, the system is inherently flexible. Additional flexibility exists in the system as specific developers may apply for variances from the zero-discharge standard.[130] While this weakens the discharge prohibition, a default rule prohibiting discharge is preferable to a patchwork system where occasional developers do not discharge. Therefore, upon promulgation, reinjection is the actual technology, but the BAT prescribed zero-discharge, with limited flexibility, is the standard with which all CBM wastewater dischargers should comply.

The technology exists to prevent discharge of pollutants into navigable waters, and the zero-discharge BAT standard further complies with the statute. The relevant section states "effluent limitations for categories and classes of point sources . . . shall require application of the best available technology economically achievable . . . which will result in . . . progress toward the national goal of eliminating the discharge of all pollutants."[131] The section further requires the Administrator to require compliance where the "elimination of discharges of all pollutants" and "such elimination is technologically and economically achievable."[132] In adopting this BAT standard, EPA can comply with the statutory mandate and maintain some flexibility to protect dischargers from unreasonable requirements. Where an individual views the imposition of these standards as overly stringent, that party may seek a variance.[133] Ultimately, using BPJ, EPA should set a zero-discharge limitation for CBM wastewater in NPDES permits because the Nation's waters must be protected as the CWA requires and the technology exists to comply with these statutory mandates.

C. *Best Professional Judgment Analysis of Reinjection*

1. Age of Equipment and Facilities Involved

As discussed above, CBM extraction is a relatively new industry, which is exhibiting exponential growth. With a projected 26,000 wells in a single area of production,[134] this industry is in its infancy, but developing fast. Reinjection technology, however, is not speculative and CBM developers

[130] *Id.* at § 125.3(b).
[131] 33 U.S.C. § 1311(b)(2)(A).
[132] *Id.*
[133] *See E.I. du Pont de Nemours*, 430 U.S. at 128 (explaining that § 301(c) of Federal Water Pollution Control Act (the formal name of the CWA, *see supra* note 8) authorizes the EPA Administrator to grant variances for the limitations for any point source for which a permit application is filed after July 1, 1977).
[134] *PRB FEIS*, *supra* note 41, at SUM-18.

currently use it.[135] As the majority of operations have not begun construction, any technology can be implemented. Further, the developers must account for the disposal of CBM wastewater regardless of the regulatory decisions of state or federal agencies. Therefore, EPA should require the industry to adhere to the highest standard available, which also prevents surface water degradation and subsequent clean-up costs.

2. Process Employed

The process employed to achieve zero-discharge would likely require the reinjection of wastewater. Other alternatives satisfying this standard would be the evaporation of trillions of gallons of water, and the limited infiltration to groundwater from percolation.[136] Still other alternatives, direct discharge and land application, will cause discharge into surface waters and will not comply with the zero-discharge BAT standard.[137] With varying depths and availability of aquifers, the specific process required to avoid discharge will change,[138] but the reinjection method should remain constant. As the area of CBM primary production occurs in the very arid west, evaporation is a more viable option, but varies with the season and weather.[139] Percolation will depend on the soil specifics below the holding ponds and can create permit violation problems, as it is difficult to differentiate between recharging groundwater and feeding surface waters.[140] The process can adapt to the conditions of the well site and coal seam even though the reinjection method likely should remain constant.

3. Engineering Aspects of Various Control Techniques

Again, reinjection technology has been used for a significant portion of the CBM industry's existence. However, as the various storage aquifers vary in depth and availability, the engineering of zero-discharge will vary by location.[141] Varying technologies will be required to move the water between the well and the reinjection site, but the movement of CBM wastewater will be an issue regardless of the disposal method. The

[135] *See, e.g.*, Warrence & Bauder, *supra* note 70.
[136] *See* EPA, Methane, Sources and Emissions, http://www.epa.gov/methane/sources.html (last visited May 30, 2006).
[137] *Id.*
[138] *Id.*
[139] *See, e.g.*, Warrence & Bauder, *supra* note 70.
[140] *Id.*
[141] *Id.*

engineering exists to adopt a zero-discharge limit and this supports the EPA in promulgating this BAT standard for CBM wastewater.

4. Process Changes

As the zero-discharge standard would primarily affect future developments, current processes would not dramatically be affected by implementing the standard. Further, reinjection and evaporation are currently used.[142] Implementing zero-discharge should not be prevented, as it is largely a prospective regulation and will guide the development and construction of the CBM industry.

5. Cost of Achieving Effluent Reduction

As discussed above, a cost benefit analysis of the technology is not required in determining the validity of a BAT standard. Simply showing that an agency acted reasonably and by statute, considered the cost along with the other factors, and that the promulgation of the zero-discharge standard reduced the discharge of pollutants, should allow the BAT standard to survive a challenge.[143] However, regulations imposing costs prohibitive to the industry probably will not withstand judicial scrutiny.[144]

In anticipation of the promulgation of a zero-discharge BAT standard, an in-depth economic analysis of the various methods of addressing the problem of CBM wastewater in the Powder River Basin was conducted.[145] The study looked at the various methods to dispose of the extracted groundwater and the total cost of extraction.[146] The study concluded that implementing the zero-discharge standard for the Powder River Basin would reduce the return on the investment from 40% to 34% and that this decrease would not likely deter development.[147] Further, should the price of natural gas increase as economists project, the return on the investment would decrease from 233% to 223%.[148] From this analysis, the economic impact of imposing a zero-discharge standard was determined not to impede the CBM

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[142] *Id.*

[143] *Ass'n of Pac. Fisheries*, 615 F.2d at 818.

[144] *See* United States v. Nova Scotia Food Products Corp., 568 F.2d 240, 253 (2d Cir. 1977).

[145] *See* Kuiper et al., *supra* note 113, at 1. This study was prepared for the Northern Plains Resources Council by Kuiper and Associates, an independent consultant, and intended for consideration by EPA, MDEQ, and Wyoming Department of Environmental Quality (WDEQ) in formulating NPDES permits for CBM wastewater discharges. *Id.*

[146] *Id.* at 38.

[147] *Id.*

[148] *Id.*

industry in that case.[149] Accordingly, such a standard should be imposed to protect the waters of the United States.

6. Non-Water Quality Environmental Impacts[150]

The CWA requires EPA, when developing effluent limitations guidelines, to consider a number of different factors. For example, when developing limitations that represent the BAT economically achievable for a particular industry category, EPA must consider factors including the age of the equipment and facilities in the category, location, manufacturing processes employed, types of treatment technology to reduce effluent discharges, cost of effluent reductions, and non-water quality environmental impacts.[151] This last category of consideration most seriously favors a zero-discharge standard. Specifically, such a standard prevents the dewatering of aquifers, damage to plants, soils, stream channels and aquatic life, and land subsidence. Land subsidence resulting from rapid dewatering of aquifers can only be prevented by strengthening soil substrata.[152] Reinjection most effectively prevents subsidence, as the reinjected water, a key structural component of the substrata, strengthens the subsurface.[153]

The dewatering of coal seams raises two major and interrelated concerns: the loss of groundwater and the effects of drawdown on other's water rights. Concerns about unsustainable groundwater removal are worldwide and growing in importance as the rate of removal increasingly exceeds recharge rates.[154] However, the CBM situation is different in that groundwater removed is not for beneficial use, but to mine methane, and the resulting water is an industrial waste.[155] Not only is CBM water extraction unsustainable, it is also wasteful. One result of the massive removal of groundwater is the drawdown effect.[156] For example, the Powder River Basin FEIS predicts that each well will cause a local drawdown of 200 feet

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149 *Id.*

150 Defined as impacts such as air quality and energy requirements. *See* 40 C.F.R. § 403.13.

151 33 U.S.C. § 1314(b)(2)(B).

152 *See, e.g.*, Warrence & Bauder, *supra* note 70.

153 *See* Darin & Beatie, *supra* note 3, at 10578 (discussing that the possibility for land subsidence has not been sufficiently explored by BLM in the approval of the removal of vast amounts of groundwater and that land subsidence of up to 15 feet has been reported as a result of rapid dewatering).

154 *Id.*

155 *Id.*

156 *See* Patrick Faubert, *The Effect of Long-Term Water Level Drawdown on the Vegetation Composition and CO2 Fluxes on Boreal Peatland in Central Finland* 1 (Mar. 2004) (defining drawdown as a lowering of groundwater due to pumping).

and nearby wells and springs could experience a drop in excess of 100 feet.[157] Further, the FEIS predicts wells five miles away to experience a 20-foot drawdown.[158] For people relying on wells in this area, the CBM drawdown of 26,000 anticipated wells associated with the project will significantly affect their access to water for domestic use, livestock watering, or irrigation.[159] Implementing a zero-discharge standard, thus requiring reinjection, should help mitigate both of these consequences of CBM extraction by replacing the water.

The changes to the land surface where CBM wastewater is applied, discharged, or held impacts significantly the environment. The results of applying saline and sodic water to the soils are considerable, as previously discussed.[160] Another method for disposal of the surfaced groundwater is through evaporation and percolation ponds.[161] For every 20 wells, such storage impoundments would require five to six acres.[162] For the 26,000 projected wells, demand would be somewhere between 6,500 and 7,800 acres in the PRB alone to allow water,[163] an increasingly scarce resource, to simply evaporate away. Moreover, serious result of this evaporation is the residual salt crust.[164] The salts and ions contaminating the water are dissolved solids; thus, the pure water evaporates out, which leaves increasingly concentrated contaminants as the water level depletes. Eventually, once the water evaporates, ions previously dissolved are deposited in an alkaline crust at the bottom of retention ponds.[165] Further, these retention ponds will overtake land now utilized for grazing or agriculture. While water-front property increases land value, retention pond land is not quite the same. Where much of the CBM extraction occurs on split estates,[166] the surface landowner will be further encumbered by the

[157] *PRB FEIS, supra* note 41, at 4-65.

[158] *Id.* at 4-64.

[159] *Id.* at 4-65.

[160] *See supra* Part B.1. and accompanying text.

[161] *PRB FEIS, supra* note 41, at 4-7.

[162] *Id.*

[163] *Id.*

[164] *Id.*

[165] *Id.*

[166] Interview with Jack Tuholske, Professor Vermont Law School and Practicing Attorney, in South Royalton, Vt. (June 2005) (explaining that as the lands in the western U.S. were distributed through various governmental Acts, the surface estate was often granted with the mineral rights retained for the government, thus creating a dual-ownership, which, under current interpretation, the mineral rights owner trumps the surface owner when the uses conflict).

mineral-rights owner's needs.[167] Reinjection returns the water to the aquifer from which it came, and prevents the contamination of the surface lands and destruction of delicate soils.

Because the majority of CBM extraction occurs west of the 98th meridian, some argue that the amount of water presents a very real opportunity to turn this almost desert into an oasis of agricultural production.[168] But such an economic opportunity would last only until the gas runs out. The water will be extracted only as long as methane gas is present; as soon as the gas disappears, so does the oasis. Further, these wells are unreliable for long-term production of water.[169] Dewatering of aquifers already raises serious concerns about sustainable use and consumption across the United States. To extract trillions of gallons of water in a region classified as a "semiarid cool steppe, where evaporation exceeds precipitation"[170] with such extravagance confounds logic. Additionally, concerns regarding land surface application as discussed above, make this an untenable option as the costs of treatment required to increase the water quality are higher than reinjection.[171] Without treatment, the application of the water to the land surface will likely cause permanent changes to the soil and vegetation profiles.[172] Accordingly, the severity of the non-water quality impacts should require the promulgation of a zero-discharge standard.

D. *Alternative Means to Establish BAT for CBM Wastewater*

1. Region 8 Promulgation

Should EPA Headquarters continue to abdicate from its responsibility, EPA's Region 8[173] could adopt its own BPJ guidelines in establishing BAT standards akin to Region 10.[174] EPA's Region 10 was the first to "incorporate case-by-case effluent limitations purportedly based on BAT and BCT for the offshore oil and gas industry."[175] While Region-specific

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[167] *Id.*

[168] *See* Graham & Wolfe, *supra* note 15, at 6.

[169] *Id.* at 6.

[170] *PRB FEIS supra* note 41, at 3-1.

[171] Kuiper et al., *supra* note 113, at 30.

[172] *See, e.g.*, Warrence & Bauder, *supra* note 70.

[173] *See* EPA, Region 8: Mountains & Plains, http://www.epa.gov/region8/ (last visited May 30, 2006) (EPA Region 8 serves Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming, and 27 Tribal Nations).

[174] *See* EPA, Region 10: the Pacific Northwest, http://www.epa.gov/Region10/ (last visited May 30, 2006) (EPA Region 10 serves Alaska, Idaho, Oregon, Washington, and Native Tribes).

[175] Am. Petroleum Inst. v. EPA, 787 F.2d 965, 971 (5th Cir. 1986).

guidelines could accomplish much the same as national guidelines, it is not sufficient, because Region 8 does not encompass all of the states with extensive CBM extraction.[176] A zero-discharge limit would set a standard of performance that will not become more stringent because the wastewater discharge would not occur. Thus, it would mitigate concerns about a statutory scheme that continues to require dischargers to adopt new and different technology as standards become more stringent[177] should EPA step in and establish national standards at some point.

Furthermore, a Fifth Circuit Court of Appeals, in upholding a zero-discharge limit for sand produced by the oil and gas industry, also noted "BAT is the CWA's most stringent standard."[178] From this, a zero-discharge limit for CBM wastewater would ascribe to the requirements of the BAT program and the mandates of the CWA, and, at minimum, should be established in Region 6[179] and Region 8.

2. State-Specific BAT

Because Congress provided an opportunity to delegate the NPDES permitting program to the states if those states chose to accept the responsibility,[180] delegate states could issue appropriate BAT effluent limitations. Where states choose to issue limits, the state "stand[s] in the shoes of the agency, and thus must similarly pay heed to section 1311(b)'s technology-based standards when exercising their BPJ. Thus . . . States are required to compel adherence to the Act's technology-based standards regardless of whether EPA has specified their content pursuant to section 1314(b)."[181] This option, however, does not establish a uniform standard for the disposal of CBM wastewater and leaves the ultimate problem of millions of gallons of water being discharged across the land surface to individual state discretion. Currently, no cohesion exists in the requirements states impose on the CBM developers; thus, all states are regulating the discharge

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[176] Colorado, Montana, Utah, and Wyoming are within Region 8. However, New Mexico, an additional CBM producing state, is within Region 6. *See supra* note 173.

[177] *Natural Res. Def. Council*, 822 F.2d at 124 ("Considering the nature of the statutory scheme, which pushes all dischargers to achieve ever-increasing efficiencies and improvements in pollution control.").

[178] Texas Oil and Gas Ass'n v. EPA, 161 F.3d 923, 928 (5th Cir. 1998).

[179] *See* EPA, Region 6: South Central, http://epa.gov/region6/index.htm (last visited May 30, 2006) (EPA Region 6 serves Louisiana, Arkansas, Oklahoma, New Mexico, Texas, and 65 Tribes).

[180] *See* 33 U.S.C. § 1342(b).

[181] Natural Res. Def. Council v. EPA, 859 F.2d 156, 183 (D.C. Cir. 1988).

of the wastewater differently. This should spur EPA into making a nationally uniform zero-discharge standard.

E. Anti-degradation

An overriding purpose of the passage of the CWA was to avoid the degradation of the Nation's waters including measures designed to become more stringent over time.[182] The Act also contains provisions to prevent backsliding.[183] These function to not only protect, but improve, the Nation's water quality. From this, EPA should promulgate provisions to prevent any discharge and degradation where the technology is available, and is especially applicable in the CBM-wastewater situation. Implementing this BAT standard provides an opportunity to prevent the degradation of waters, and avoid a type of harm that the CWA was passed to correct. By permitting the discharge of water, the degradation of the receiving waters will occur contrary to this express intent of CWA.[184] EPA and state agencies assuming responsibility for CWA standards have an affirmative obligation to ensure these discharges do not affect existing uses or reduce the receiving water's quality.[185] Where the discharged water overwhelms the assimilative capacity of the stream, anti-degradation concerns can arise even though no violation of guidelines occurs.[186] The water in the west is scarce, and any addition to the surface waters would affect its quality. Thus any standard allowing CBM wastewater discharge will violate this provision of the CWA by lowering water quality.

IV. CONCLUSION

To prevent drowning the western United States in highly saline and sodic groundwater, EPA should promulgate a zero-discharge effluent limitation, per the BAT standards under the CWA, for the CBM extraction industry. This standard should reflect the lowest effluent discharges of the best performing[187] CBM developer. As such, it should direct use of proven, most recent technology[188] to set the highest effluent reduction technology it

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[182] *See* 33 U.S.C. § 1251(a)(1).
[183] *Id.* at § 1342(o).
[184] *Id.* at § 1313.
[185] Sharon Buccino & Steve Jones, *Controlling Water Pollution from Coalbed Methane Drilling: An Analysis of Discharge Permit Requirements*, 4 WYO. L. REV. 559, 580 (2004) (discussing how CWA and its anti-degradation requirements interact to control pollution).
[186] John Veil, *Regulatory Issues Affecting Management of Produce Water from Coal Bed Methane Wells*, Argonne National Laboratory (DOE Office of Fossil Fuel, Feb. 2002).
[187] *Chemical Mfrs. Ass'n*, 870 F.2d at 207–208.
[188] *See Kennecott*, 780 F.2d at 448.

can achieve.[189] Promulgating a zero-discharge standard ascribes to these requirements as well as being the only standard completely in compliance with the elimination of pollutant discharge into the Nation's waters, the primary goal of the CWA.[190] Further, this standard prevents land surface and water quality degradation resulting from disposing of trillions of gallons of low quality groundwater. It also minimizes the excessive drawdown of aquifers and depletion of groundwater sources. As such, EPA should establish this as a prospective- and pollution-preventative standard, as EPA initiated in 2001.[191] A zero-discharge standard for the disposal of CBM-generated wastewater is necessary to protect the "chemical, physical, and biological integrity of [the] Nation's waters."[192]

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[189] *Natural Res. Def. Council*, 822 F.2d at 110.
[190] *See* 33 U.S.C. § 1251(a)(1).
[191] *BPJ & BAT*, 66 Fed. Reg. at 46455.
[192] 33 U.S.C. § 1251(a).