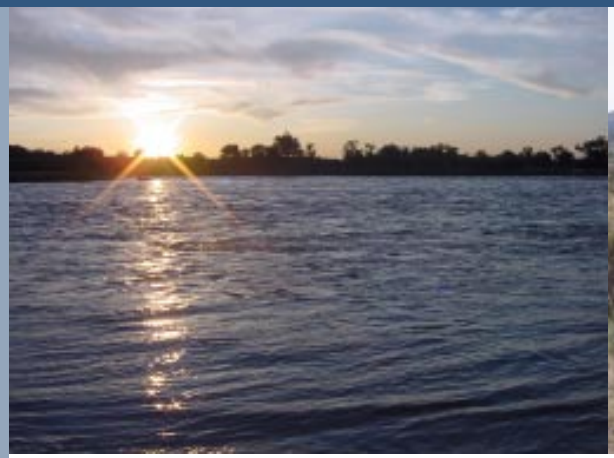
Doing It Right®

a framework for managing coal bed methane wastewater



NORTHERN PLAINS
RESOURCE COUNCIL

"Once again, Northern Plains has set the standard for Doing It Right by commissioning this comprehensive study on a responsible approach to methane wastewater management."

- THOMAS SCHNEIDER,
PETROLEUM ENGINEER & MONTANA PUBLIC SERVICE COMMISSIONER

INTRODUCTION

It's time to restore the balance between protecting the things that make southeastern Montana a good place to farm, ranch, and raise a family, and development of our energy resources.

Southeastern Montana has a long history of farming and ranching and is a great place to raise a family and enjoy the outdoors. Unfortunately, development of coal bed methane unnecessarily threatens the things that allow family farms and ranches and fish and wildlife to thrive. An estimated 77,000 methane wells will be drilled in Montana and Wyoming in the next decade. Along with the wells will come billions of gallons of high-sodium wastewater. Current wastewater disposal practices are needlessly destructive:

- Untreated methane wastewater is piped directly onto farm and ranch land or into rivers and streams.
- Millions of gallons of water are pumped from the ground. The majority is wasted, depriving farmers, ranchers, and future generations of critical water sources for drinking and domestic use.

According to the environmental impact statement for Montana's methane development, farmers and ranchers face a groundwater drought that could last for several generations from the practice of draining aquifers for methane drilling. This will result in the loss of wells, natural springs, seeps, and wetlands in a region that receives less than 12 inches of rain each year. In addition, high-sodium methane wastewater can damage pastures, hay meadows, and irrigation water, making it difficult for farmers and ranchers to raise alfalfa and other crops.

RESTORING THE BALANCE

It's time to restore the balance between protecting the things that make southeastern Montana a good place to farm, ranch, and raise a family, and development of our energy resources. To that end, Northern Plains Resource Council retained Jim Kuipers, a respected mining engineer, to investigate practical and affordable solutions to methane wastewater challenges. Kuipers has 25 years experience with mining and oil and gas projects and is widely respected for his expertise in wastewater disposal, reclamation, and financial assurance. Kuipers assembled a study team with over 65 years combined experience in oil and gas, mining, reclamation, and related fields.

STUDY CONCLUSIONS

- It is both practical and affordable to return coal bed methane wastewater to the ground by way of reinjection or shallow injection so the water is available for future generations.
- If site-specific studies demonstrate there are no suitable geologic formations in which to inject the water, removing harmful salts and other minerals from wastewater prior to discharge would cost pennies on the dollar and prevent damages to land and water.

The State of Montana must stand up for southeastern Montana's family farmers and ranchers by requiring methane companies to return water back to the ground so it's available for future generations or treat the water to remove pollutants prior to discharge.

Current practices both lower the water table and contaminate irrigation water, threatening to destroy the balance that has allowed family-owned farms and ranches to thrive for over a century.

WHAT'S AT STAKE

Southeastern Montana's alfalfa meadows, prairie rivers, and sagebrush flats are home to hundreds of family-owned farms and ranches. Small towns dot the landscape, sustained by the trade of wheat, cattle, and alfalfa. This region has stood the test of time. The challenges posed by hot summers, harsh winters, and recurrent drought are met with proud resilience and scrappy ingenuity.

With just 8-12 inches of rain a year, landowners rely on access to clean, mountain-fed irrigation water and groundwater to prosper. Farmers and ranchers draw from the Tongue, Powder, and Little Powder rivers, along with Rosebud Creek, to irrigate over 40,000 acres of crops. With water so scarce, groundwater is the sole source of drinking and stock water for most families.

COAL BED METHANE DEVELOPMENT

Thick veins of coal lie beneath nearly every farm, ranch, and town in the region. On the surface of the coal are molecules of methane gas, held in place by water pressure from coal seam aquifers. Remove the water, and the methane detaches from the coal, pools together, and rises to the surface. An average methane well pumps between 5 and 20 gallons of water per minute over its 10-year life span. A midrange estimate of 18,300 coal bed methane wells in Montana will pump 480 billion gallons of groundwater from southeastern Montana's coal seam aquifers, lowering the region's aquifers by up to 600 feet. This will dry up critical water wells, natural springs, and seeps.

METHANE WASTEWATER: A POLLUTANT

As water percolates through the ground, it leaches out salts, arsenic, cadmium, ammonia, and other pollutants. Methane wastewater can come from as deep as 700 feet and generally contains high concentrations of dissolved salts and other pollutants, making it unsuitable for irrigation.

Methane wastewater is considered a pollutant under the U.S. Clean Water Act because of its potential to harm plants, soils, and fish. Currently, most methane wastewater in Montana and Wyoming is discharged into rivers and impoundments or sprayed directly onto the ground. These practices lower aquifers - drying up wells and springs - and contaminate snowpack-fed irrigation water. As such, current practices threaten to upset the balance that has allowed family-owned farms and ranches to thrive for over a century.

This study represents the first technical, peer-reviewed analysis of solutions to coal bed methane wastewater management problems.

KEY FINDINGS

The Kuipers study represents the first technical, peer-reviewed analysis of solutions to coal bed methane wastewater management problems. Initial findings were released for a 60-day peer review in August 2004. After analyzing comments and additional information, the team finalized the study documents, which are available at www.northernplains.org. The study's recommendations point the way toward more responsible coal bed methane development practices that are both practical and affordable.

KEY FINDINGS

- The most harmful disposal options for coal bed methane wastewater are direct discharges to rivers, streams, unlined impoundments, and soils. These disposal options unnecessarily put irrigation and drinking water, fisheries, and soils at risk.
- It is practical and affordable to return methane wastewater to aquifers – either by reinjecting it into the aquifer from which it came or by injecting it into other shallow aquifers so the water is available for future use. Reinjection and injection are proven technologies and absolutely affordable given current and foreseeable gas prices.
- In cases where it is technically impossible to return methane wastewater to the ground, treating all water prior to discharge is feasible via a number of treatment technologies - particularly reverse osmosis - and affordable for the industry.

POLICY RECOMMENDATIONS

In order to eliminate the discharge of pollutants to our waterways, the U.S. Environmental Protection Agency and states of Montana and Wyoming must adopt technology-based pollution limits in accordance with the Clean Water Act's mandate that industries use the *best available technology* to eliminate the discharge of pollutants into our waterways:

- Zero Discharge. No discharge of pollutants to surface water. Companies could achieve this mandate by reinjecting wastewater back into the aquifer from which it came or by injecting it into other shallow aquifers.
- Treatment: If a company demonstrates that returning all or a portion of the wastewater to the ground is not technically feasible, the company would be required to treat 100% of the water prior to discharging it to achieve this fallback standard.

STUDY TEAM

- Jim Kuipers, a mining engineer with 25 years experience with mining, oil and gas, and environmental projects, is widely respected for his expertise in wastewater disposal, reclamation and closure, and financial assurance.
- Walter R. Merschat is a petroleum geologist specializing in exploration and environmental geochemistry with over 30 years international experience. Merschat has worked extensively for oil and gas companies. In recent years, he has focused his work on mitigation of coal bed methane impacts in response to increased drilling throughout the U.S.
- Dr. Tom Myers is a hydrologic consultant renowned for his expertise in groundwater modeling, water balance, groundwater contamination, and permit review under the National Environmental Policy Act. Dr. Myers holds a Ph.D. in hydrology/hydrogeology from the University of Nevada. He has completed several peer-reviewed groundwater models examining impacts of mine dewatering on regional aquifers for the U.S. Bureau of Land Management.
- Kimberly MacHardy, an associate geologist with Kuipers and Associates, specializes in soil geology. MacHardy has several years experience providing technical and research assistance.

WATER DISPOSAL

While rare in the Powder River Basin, returning wastewater to the ground is the most common disposal method for wastewater from oil and gas development nationwide. Over 90% of onshore oil and gas wastewater is injected – either into the aquifer from which it was taken or into other suitable formations. In contrast, wastewater from methane development in Montana and Wyoming's Powder River Basin is largely discharged untreated into unlined impoundments, rivers and streams, or directly onto the ground. Below is a brief summary of pros and cons of available disposal options for methane wastewater:

- Untreated Discharge to Impoundments: Piping untreated methane wastewater into impoundments is relatively cheap but involves substantial impacts. These include: Saline seeps, contamination of rivers and shallow aquifers, and a build up of salt and other minerals as wastewater evaporates. Impoundments built in streambeds (a common practice) hold back the flow of rain water and snowmelt, interfering with downstream landowners' water rights.

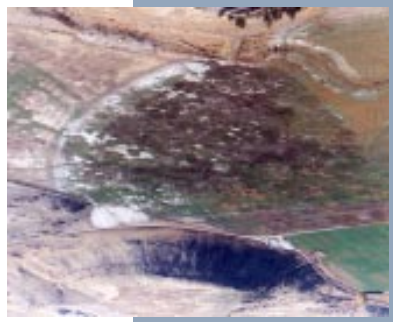
- Untreated Discharge to Waterways: While piping wastewater into waterways is the cheapest option, it involves substantial, long-term impacts. The salts and other pollutants in methane wastewater can degrade freshwater and render it useless for irrigation and aquatic life.

- Direct Discharge to Soils: Spraying wastewater on the ground, otherwise known as "land application," is relatively cheap but involves substantial, long-term impacts. The high concentration of sodium relative to calcium and magnesium found in most methane wastewater damages soil structure and results in the loss of crops and other vegetation.

- Industrial Uses: Possible industrial uses include dust suppression, stock watering, fire protection, and animal waste management. In practice, very little methane wastewater is used for these applications because it is either not of suitable quality, not in demand, or not located in the vicinity of industrial needs.

- Treatment: While more expensive than direct discharge to rivers or impoundments, treatment is ultimately affordable. Treatment can prevent damage to soils and rivers and streams. Reverse osmosis is the most common treatment technology for methane wastewater and can successfully remove 95 to 99% of pollutants, including dissolved salts.

- Returning wastewater to the ground: Returning wastewater to the ground - either by reinjecting it into the formation from which it originated or injecting it into another suitable formation - can prevent damage to soils, plants, and waterways and is the only disposal option that addresses the lowering of regional aquifers. It is less costly than treatment and absolutely affordable.



Left-hand Photos (from top): *1. Land application in the Youngs Creek drainage, a tributary of the Tongue River just south of the Montana/Wyoming border, shows salt accumulation, dead vegetation, and wastewater flowing from a field into the drainage. 2. Untreated discharge of wastewater into the Tongue River by Fidelity Exploration and Production Company in southeastern Montana. 3. Impoundment leaking methane wastewater in intermittent tributaries of Youngs Creek south of the Montana-Wyoming border.*

THE BOTTOM LINE

While affordable, returning coal bed methane wastewater to coal seam aquifers or treating it prior to discharge involves more up-front costs than discharging wastewater onto the ground or into rivers and streams. And while these additional costs are affordable, they can serve as a disincentive to responsible development: A company that pays to treat its wastewater is to some degree less competitive than another company that avoids the cost.

Congress designed the U.S. Clean Water Act to prevent less responsible companies from gaining a competitive advantage by polluting. The Act does this by requiring an entire industry to meet the bar achievable by the best performing company in the industry and by requiring the use of the best affordable technologies. As the following cost analysis demonstrates, returning wastewater to the ground or treating it prior to discharge is affordable and should be required. These figures are based on financial information provided by methane industry officials to the U.S. Environmental Protection Agency and takes into account standard operating and capital costs in the Powder River Basin.

RETURNING WATER TO THE GROUND

- At $2.50 per thousand cubic feet (MCF) of methane gas, methane companies enjoy a 40% return on investment. Returning all of the wastewater to the ground would reduce the return to 34%.* A 34% return translates into $2 in profits for every $5 spent.
- At $5.00 per MCF, methane companies enjoy a 233% return on investment. Returning the wastewater to the ground would reduce a gas producer's return to 223%. A 223% return means $11 in profits for every $5 spent.**

WATER TREATMENT

- At $2.50 per MCF of methane gas, companies enjoy a 40% return on investment. Treating all of the wastewater would reduce the return to 30%. A 30% return equates to $1.50 in profits for every $5 spent.
- At $5.00 per MCF of methane gas, companies enjoy a 233% return on investment. Treating the methane wastewater would reduce the return to 217%. A 217% return equals $10.85 in profits for every $5 spent.**

THE BOTTOM LINE

The average methane gas price in 2001 was $4.12/MCF. Since then, gas prices have steadily risen to today's prices of $5 and $6/MCF. With these prices, returning the water to the ground and water treatment - both proven technologies widely used throughout the United States - reduce a methane gas company's return on investment by a small fraction and still result in substantial tax and royalty revenues for state coffers in Montana and Wyoming. Best of all, these technologies would prevent many of the most damaging impacts associated with methane development, including dewatered aquifers, polluted fresh water, and damaged soils.

**In comparison, a grocery chain might expect a 7-10% return on investment. An average savings account might yield 1.5%.*

***With respect to tax revenues, even if methane gas prices drop to $1.75/MCF, Montana would still receive $200 million in state and federal tax revenues and Wyoming would receive $3.4 billion if methane companies are required to return their wastewater to the ground. With treatment, Montana would receive $43 million in state and federal taxes while Wyoming would receive $3.3 billion.*

MOVING FORWARD

The Kuipers study demonstrates that Montana and Wyoming can reap the benefits of coal bed methane development while protecting the things that allow farmers and ranchers to thrive. It is the first technical, peer-reviewed analysis of solutions to coal bed methane wastewater management problems and is intended as a tool for state and federal officials to ensure coal bed methane development is done right. Based on the Clean Water Act's guidelines for pollution prevention, the study proposes the following framework for management of coal bed methane wastewater in Montana and Wyoming:

DEFAULT STANDARD: ZERO DISCHARGE

No discharge of pollutants into rivers, streams, or native soils and vegetation would be allowed from any coal bed methane operation in the Powder River Basin of Montana and Wyoming, subject to the fallback option. To reach zero discharge, methane operators can utilize the following management options, both of which are proven and affordable:

- Return water to the aquifer from which it was taken; or
- Put the water into other shallow aquifers that are available for continued future use.

THE ROAD TO DOING IT RIGHT®

This two-tiered framework demonstrates that we can prevent damage to rivers and streams and allow Montana and Wyoming to avoid a multi-generational groundwater drought while still enjoying the financial benefits of methane drilling.

We have a clear choice: We can allow coal bed methane developers to continue to drain drinking water sources and damage pastures, hay meadows, and irrigation water. Or, we can require them to return the water back to the ground or remove harmful salts, with either option costing pennies on the dollar.

FALLBACK OPTION: REMOVE POLLUTANTS

A coal bed methane operator that demonstrates it is technically unfeasible to return some or all of the wastewater to the ground would qualify for the fallback option and be required to remove 95-99% of the pollutants. This is possible via reverse osmosis, the most common water treatment technology for coal bed methane wastewater and is proven effective at reaching this standard.

"Stillwater Mining Company successfully removes over 90% of the pollutants from its wastewater - all while providing over 1,200 jobs in Montana. We should expect nothing less from the coal bed methane industry."

-PAUL HAWKS, MELVILLE RANCHER AND NEGOTIATOR FOR THE "GOOD NEIGHBOR AGREEMENT" WITH STILLWATER MINING COMPANY

"We found is that in most cases, it's both practical and affordable to return coal bed methane wastewater back into aquifers. Otherwise, the most responsible alternative is to treat the water prior to discharge."

- JIM KUIPERS, MINING ENGINEER AND STUDY LEAD

YOU CAN HELP!

The most important thing you can do to make sure coal bed methane is developed responsibly is join NORTHERN PLAINS RESOURCE COUNCIL. We hold government and industry accountable to existing laws and educate the public about methane development problems and ways to solve them.

- ❑ General ($35)
- ❑ Family ($50)
- ❑ Rough Rider ($100)
- ❑ Rider of the Big Sky ($500+)
- ❑ Living Lightly ($15)

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"They confound the common view that ordinary citizens are powerless in the face of industry."

- BILLINGS GAZETTE

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