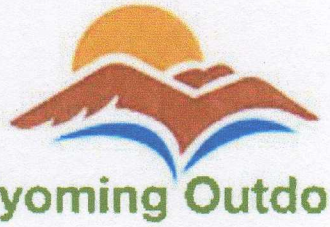




October 11, 2013

Wyoming Oil and Gas Conservation Commission
2211 King Blvd
P.O. Box 2640
Casper, WY 82602
Phone No. 1-307-234-7147
Fax No. 1-307-234-5306

Dear Supervisor Black,

Please accept these comments from the Wyoming Outdoor Council and Environmental Defense Fund. The Wyoming Outdoor Council is Wyoming's oldest environmental advocacy organization. In much of our work, we advocate for policies that provide for Wyoming's energy development coupled with the necessary consideration and protection of public health and our state's inimitable and irreplaceable land and water resources. EDF's mission is to preserve the natural systems on which all life depends. Guided by science and economics, we find practical and lasting solutions to the most serious environmental problems.

As stated in our previous comments on the draft rule, we are very pleased to see the Commission moving forward with a state groundwater testing rule. We would also like to thank the Commission for taking into consideration our earlier suggestions during the informal public comment period.

It is clear that this rule can provide the state, industry, and Wyoming residents important information about baseline groundwater quality and monitoring data as oil and gas development proceeds. With its adoption, this rule will further establish Wyoming as a leader on management of oil and gas operations and the protection of water resources. We commend the work that has been done in this effort and, while we do feel some improvements are needed, we offer our strong support for the general approach outlined in the rule.

On the whole, we agree that the rule would create a strong, scientifically-valid groundwater testing program. The Wyoming draft rule's statewide applicability, use of a radial approach without an artificial cap on the number of wells tested, ability to rely on the experienced

technical staff of the WOGCC and their understanding of local hydrogeological conditions in reviewing and approving testing plans, and the use of a required Sampling and Analysis Protocol (SAP) are of special importance. In particular, Wyoming's proposed SAP, to our knowledge, is currently the most detailed guidance provided by any state regarding how private wells should be sampled. And, it should be noted, the Wyoming rule does this all without costing operators any more than what they will need to spend to comply with other states' less rigorous programs.

**Suggested Improvements**

The proposed rule's general approach is a strong one, but there are two issues that should be improved as the Commission moves toward finalizing the program. These are both issues that were added to the proposed rule at the request of industry following the informal public comment phase. In both cases, and absent further improvement from the Commission, the additions could weaken what is otherwise a strong approach to assessing potential groundwater impacts from oil and gas development.

1. **Dissolved Methane**

   In Chapter 3, Section 46, Paragraph I, the WOGCC's rules includes a dissolved methane level to trigger further scientific analysis of groundwater to detect possible impacts from oil and gas development. While this level had been set at 1 mg/l in the initial draft rule presented last summer, it was changed to 10 mg/l in the current proposed rule at the request of industry following the informal public comment period. This should not be confused with the separate 10 mg/l level to trigger immediate notification of landowners and regulators provided for in Chapter 3 Section 46 Paragraph j. Setting both of these triggers at 10 mg/l is a major flaw in the proposed rule that can and should be fixed. Please see the letter submitted to the Commission by Robert Puls, PhD. and attached to these comments for further discussion of this issue.

   Weakening the scientific analysis trigger by a factor of 10 provides inadequate protection for the public. Setting the trigger at such a high level would fail to ensure that potential water contamination caused by drilling is caught quickly and the state's ability to act proactively would therefore be lost. Both the Colorado Oil and Gas Conservation Commission's rule and the Colorado Oil and Gas Association's voluntary program include a 1 mg/l level to trigger further scientific analysis, while even Colorado's separate groundwater testing rule for areas of the state with coal bed methane development includes a 2 mg/l analysis trigger. A weak 10 mg/l initial trigger has the potential of subverting one of the key purposes of the groundwater testing program – to better understand potential drilling impacts as quickly as possible so that they may be addressed expeditiously.

   For these reasons Dr. Puls has recommended the following for the Wyoming program and we concur with his expert advice:

"It is appropriate for additional analysis, including compositional analysis and carbon isotopic analyses to determine the source of the gas when methane concentrations in water are found at an elevated level. This level should be set no higher than 2 mg/L. It should be noted that a trigger of 2 mg/L is also consistent with what the state of Colorado requires in the special case of coal bed methane formations. If levels are found to be greater than 10 mg/L, all parties including the water well owner, regulators and the health department should be notified and mitigation measures enacted. If greater than 28 mg/L, immediate action must be taken to remedy the situation."

2. **Master Plans**

The draft rule was also amended at the request of industry to allow developers to seek approval for "master plans" that would cover multiple wells over potentially large geographic areas. If these plans are simply a way to better coordinate the required testing protocols with a company's drilling program, to improve data management, or to seek efficiencies in submittals to the WOGCC, this could be positive. However, these master plans should in no way undermine the strong, well-by-well approach taken in the larger rule. Mandating that at a minimum these plans are open for public review could help address some of these issues. Please see the suggested clarifications below:

Chapter 3, Section 46, paragraph L

The operator may submit a master groundwater baseline sampling, analysis and monitoring plan for a geographic area of development. The Supervisor may approve the operators plan if, *after public notice, at least a 30 day public comment period, and review of public comments,* the Supervisor determines that the plan meets or exceeds the intent of Chapter 3, Section 46 Groundwater Baseline Sampling Analysis and Monitoring, *Appendix K Sampling and Analysis Procedures for the Wyoming Oil and Gas Conservation Commission Groundwater Baseline Sampling Analysis and Monitoring Program, and that the plan is consistent with the core purpose of the Groundwater Baseline Sampling and Analysis and Monitoring Program, to quickly establish baseline groundwater quality conditions around all new oil and gas well locations and to promptly monitor water quality in the vicinity of the oil and gas wells before and after drilling and completion activities have concluded. Once approved, all master plans will be subject to the same enforcement capabilities as the rule itself.*

**Other Issues**

Lab Capacity: We have heard some concern with the capacity of analytical labs to handle the volume of work anticipated to be created by Wyoming's proposed groundwater testing program. There are a number of national and regional National Environmental Laboratory Accreditation Program (NELAP) accredited labs capable of performing the required

analyses. After checking with industry contacts, we are confident that there is adequate capacity to do the work contemplated under the Wyoming rule generally, and specifically that there is adequate capacity to perform the needed dissolved methane isotopic analysis work at a 1 - 2 mg/l trigger level.

Further Public Notice of the Rule: The improvements we have suggested above to the dissolved methane and master plan provisions should not necessitate a re-noticing of the rule and will not in any way hamper the Commission from making these needed changes and then proceeding with the final rule at their anticipated date of consideration by the WOGCC (November 12, 2013). Because these changes are within the scope of what was originally noticed and more generally within the scope of what was contemplated, we do not believe the changes we advocate are substantive to the extent the rule-making needs to be restarted. Nor are we aware of any legal requirement in the Wyoming Administrative Procedure Act that would require further delay in this instance.

**Appreciation for Changes Since the Initial Draft Rule**

As we indicated above, we appreciate the Commission's consideration of our earlier comments during the informal public comment period in developing the current version of the proposed rule. In particular we note two changes that have been made in response to our earlier comments. First, in Chapter 3 Section 46 Pargraph f "scientific standards" has been added to the list of reasons for updating Appendix K. We appreciate this change in response to our earlier comments. Second, in Chapter 3 Section 46 Pargraph m it has been clarified that there is neither a presumption for or against liability. Again, we appreciate this change in response to our earlier comments.

**Conclusion**

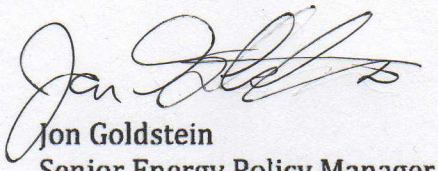
We offer our sincere appreciation to the Commission and to Governor Mead and his staff for the efforts they have made in developing this rule. We urge that the suggestions we offer in this document be given careful consideration for the sake of Wyoming's residents and our continued national status as leaders in energy development.

We look forward to continuing our involvement in this process as Wyoming moves toward implementation of an effective, scientifically-valid groundwater testing rule.

Sincerely,

Amber L. Wilson

Amber Wilson
Environmental Quality Coordinator
Wyoming Outdoor Council



Jon Goldstein
Senior Energy Policy Manager
Environmental Defense Fund

October 11, 2013

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2211 King Blvd
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Dear Supervisor Black,

Please accept these comments concerning the Wyoming Oil and Gas Conservation Commission's consideration of a statewide ground water testing rule. These comments are submitted on behalf of the Environmental Defense Fund and the Wyoming Outdoor Council and will also be attached to their formal written comments on this matter.

The expert opinions expressed herein are based upon my 25-plus years of technical ground water experience as Senior Research Scientist, Branch Chief, Director of Research, and Laboratory Director of the Ground Water and Ecosystems Restoration Division at the U.S. Environmental Protection Agency's (EPA) Robert S. Kerr Environmental Research Center in Ada, Oklahoma and currently as the Director of the Oklahoma Water Survey and Associate Professor at the University of Oklahoma, College of Atmospheric and Geographic Sciences (resume attached.) I hold a B.S. in Soil Science and Natural Resources from the University of Wisconsin, a Masters in Forest Resources from the University of Washington, and a Ph.D. in Soil and Water Science from the University of Arizona.

**Methane in Ground Water**

**I. Action levels for dissolved methane in ground water**

While debate rages over the potential transport of fracking compounds to ground water, there is no scientific debate concerning the potential for methane transport. Transport of methane has been clearly documented in many locations. Therefore, it is not a question of if methane can impact ground water resources in areas with oil and gas drilling, but rather the questions should be, if methane is present, at what concentration should it be a concern? At what concentration should an immediate warning be issued to the homeowner? And, at what concentration should mitigation measures be taken and by whom?

There are at least two ways of answering these questions. One is from the perspective of examining at what level a dissolved methane concentration requires further study into its cause (stray gas from hydrocarbon production or naturally occurring.) The other is from the standpoint of human health and safety from explosive risk.

It is appropriate that a lower level be chosen in the first instance (efforts to discern the cause of the elevated methane level). This information will help get out ahead of the problem so that if a stray gas issue is found, attempts may be made to correct the leak before explosive levels are encountered. Dissolved methane can also be a strong indicator of well integrity problems that, if left unaddressed, can mean groundwater supplies are

potentially at risk for contamination from the full range of chemicals that are used downhole and the naturally occurring materials that are brought up from the formation in flowback and produced water. An initial dissolved methane testing level that is set at a protective and low level will therefore serve to both protect the public from undue explosive risk and from potential groundwater pollution from the entire suite of possible oil and gas related contaminants.

However, to date, state guidance has varied widely on sampling for methane in ground water. About the only thing they agree on is that the solubility of methane in water is approximately 28 mg/L depending on atmospheric pressure, that it should be sampled for in any ground water baseline assessment and follow-up monitoring program, and that the primary hazard is one of fire and explosion in terms of human health.

A 2001 U.S. Department of Interior Office of Surface Mining Reclamation and Enforcement report is often cited regarding the 10 mg/L threshold for warning occupants and indication of the need for additional investigation.[1] The report offers little scientific basis for this level other than "The recommended action levels are based on site-specific information, application of scientifically valid methodology, and the exercise of common sense". However, the report continues and states "There may be occasions when the investigator will determine that a potentially harmful situation may later develop and immediate action is required even though recorded methane concentrations are below the recommended action levels."

The state to address this issue most recently, Colorado, has set this action level at 1 mg/l in its statewide rule. This is also the level set by the Colorado Oil and Gas Association (COGA) in their voluntary testing program. Meanwhile, even in Colorado's separate groundwater testing rule applying to areas with Coal Bed Methane (CBM) development, this dissolved methane trigger for further isotopic analysis is set at 2 mg/l.

Given the rapid increase in reports of methane migration near oil and gas operations across the U.S., it is generally acknowledged that there can be substantial variability in methane concentrations. This can be due to spatial and temporal factors as well as sampling methodology. It is strongly recommended that new programs for state water quality baseline assessment and follow-up monitoring build on prior observations and experiences, and use response protocol that are more protective of human health.

It should be noted that finding methane in the 1 to 2 mg/L range in ground water is commonly feasible, and not inconvenient, for certified labs. Current common laboratory methods (RSK 175) provide detection limits of 0.026 mg/L.

I therefore recommend the following as reasonable for the Wyoming Baseline Water Quality Program:

> It is appropriate for additional analysis, including compositional analysis and carbon isotopic analyses to determine the source of the gas when methane concentrations

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[1] Eltschlager, K. K., Hawkins, J. W., Ehler, W. C., & Baldassare, F. (2001). Technical measures for the investigation and mitigation of fugitive methane hazards in areas of coal mining. Pittsburgh, PA. Retrieved from http://www.ntis.gov/search/product.aspx?ABBR=PB2002106133

in water are found at an elevated level. This level should be set no higher than 2 mg/L. It should be noted that a trigger of 2 mg/L is also consistent with what the state of Colorado requires in the special case of coal bed methane formations. If levels are found to be greater than 10 mg/L, all parties including the water well owner, regulators and the health department should be notified and mitigation measures enacted. If a methane concentration greater than 28 mg/L is found, immediate action must be taken to remedy the situation.

**II. Background**

Substantial research presented at the 2012 Ground Water Protection Council Stray Gas Incidence and Response Forum indicates that a continuing problem exists regarding the variability of methane concentrations detected in water across the U.S.[2] These variations can be significant (> 100%). Variations are attributable to temporal variations of methane concentrations in water but more often are due to sampling procedure problems.

Perhaps no basin has been as closely studied on the issue of dissolved methane as the San Juan in southwestern Colorado. In historical data compiled by the U.S. Bureau of Land Management (BLM) and Colorado Oil and Gas Conservation Commission (COGCC) it was found that among multiple samples collected at 397 water well sites in the San Juan Basin there was exhibited an average variability of +/- 54% .[3]

As a part of this work, by 1994, the COGCC and BLM identified and defined 17 environmentally sensitive and relatively populated areas in the Colorado portion of the San Juan Basin where measured dissolved methane concentrations exceeding 1.1 mg/L in domestic groundwater wells appeared to occur in clusters.[4] It is important to note that the BLM and COGCC arrived at this he 1.1 mg/L value on the basis of theoretical considerations for the likelihood of methane exsolving from water in sufficient quantity to reach the lower explosive level in air.[5]

Another significant result of the historic multiple groundwater sampling events conducted in the San Juan Basin is that that this work has led to the methods used to sample and analyze dissolved hydrocarbons gradually became standardized. This was in large part due to complaints regarding both the inability to compare reported results among surveys and inadequate quality control measures.

While the data indicates that there is a great deal of variability in methane testing results, most of this is due to inconsistent testing/sampling methods. Several individuals and companies are working on better sampling methods. While some variability may always

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[2] Ground Water Protection Council. (2012). A White Paper Summarizing the Stray Gas Incidence & Response Forum. Cleveland, OH. Retrieved from http://www.gwpc.org/sites/default/files/stray gas white paper-final.pdf

[3] Bureau of Land Management, & Colorado Oil and Gas Conservation Commission. (1995). 1994 Groundwater monitoring San Juan Basin, La Plata County, Colorado: Comprehensive infill testing including data obtained in the Pine River Fruitland Coal Outcrop investigative study, Final Report with tables and appendices.

[4] Ibid.

[5] Harder, A. H., Whitman, H. M., Rogers, S. M., & U.S. Geological Survey. (1965). Methane in the Fresh-Water Aquifers of Southwestern Louisiana and Theoretical Explosion Hazards (p. 14). Baton Rouge, LA.

exist, the uniform sampling and analysis procedures laid out in Appendix K should go a long way toward minimizing this problem.

**III. Safety and human health concerns**

Studies have not linked ingestion of water containing methane to any short term (acute) or long-term (chronic) health effects, however very little research has been done. The U.S. Centers for Disease Control and Prevention (CDC) has recently been involved in extensive testing of methane in ground water across the U.S.[6]

While not considered an EPA priority or secondary pollutant for public drinking water sources, methane can pose an explosion hazard where the gas builds up. The lower explosive limit established for methane in air is 5%. While the Minnesota Department of Health has found that "Methane concentrations in water of as little as 1 milligram per liter (mg/L) can lead to explosive levels if the gas is allowed to accumulate in a poorly ventilated confined space" and the Ohio Department of Natural Resources in its September 1, 2008, "Report on the Investigation of the Natural Gas Invasion of Aquifers in Bainbridge Township of Geauga County, Ohio" found after extensive ground water sampling (79 samples) following a home explosion in that township that the maximum methane concentration in private wells was only 1 mg/L, this is atypical.[7],[8] An initial stray gas investigation standard of no more than 2 mg/L, a secondary 10 mg/L level requiring mitigation measures and notification of all parties including the water well owner, regulators and the health department and an immediate action level of no greater than 28 mg/L should establish a substantial regulatory regime to mitigate against all risks likely to be encountered.

An initial dissolved methane level of no more than 2 mg/L is a crucial piece of this regulatory regime. Isotopic analysis work done at this concentration of dissolved methane will be vital to investigate the possibility of well integrity problems in proximate oil and gas production wells. If captured early, these stray gas issues can be addressed before more dangerous methane levels or other forms of associated pollution are encountered. A trigger set at this level will act as a first line of defense to alert homeowners, the oil and gas industry and regulators to potential issues that may need to be addressed.

In addition to exposure to fire and explosion hazards, methane migration will affect ground water geochemistry. Therefore, it is possible to test ground water for the expected geochemical changes, some of which can increase concentrations of potentially dangerous products in the ground water system. Geochemical changes due to presence of methane in ground water occur during microbial sulfate reduction. Methane is a known carbon source for microbial sulfate reduction. In this process microbes consume methane, converting sulfate to sulfide, and bicarbonate is produced. When bicarbonate levels increase in the water body the pH, or alkalinity, is expected to rise. This elevated alkalinity, in turn, increases soluble aluminum concentrations in the water. The presence of soluble aluminum shifts the oxidation-reduction potential (ORP) of the medium negative, which

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[6] Ikeda, R., & Centers for Disease Control and Prevention. (2013). Review of Federal Hydraulic Fracturing Research Activities. Testimony. Retrieved October 02, 2013, from http://www.cdc.gov/washington/testimony/2013/t20130426.htm

[7] Minnesota Department of Health. (2013). Methane in Minnesota Well Water. Well Management. Retrieved October 02, 2013, from http://www.health.state.mn.us/divs/eh/wells/waterquality/methanemn.html

then causes insoluble iron oxides (various forms of ferric hydroxide) to be reduced and produces ferrous iron ($Fe^{2+}$) ions; manganese oxide ($MnO_2$) is also reduced and dissolved manganese ($Mn^{2+}$) ions are released. As such, in a sulfate-reducing environment, such as ground water that has been exposed to methane, one would expect to observe concentrations of dissolved sulfide; elevated dissolved iron, manganese, and aluminum; and potentially arsenic because of its strong association with iron oxides.[9] Additionally, one would expect to observe an elevated pH and lower or negative ORP. These conditions have been observed in many wells in NE Pennsylvania where methane leakage from natural sources and poor well construction practices has occurred.[10],[11]

**IV. Conclusion**

Given the discussion of the issues surrounding dissolved methane detection, impacts on water quality, analytical variability and hazard uncertainty above, it is my recommendation that an action level be set requiring additional analysis, including compositional analysis and carbon isotopic analysis to determine the source of the gas, when methane concentrations in water are found at levels no higher than 2 mg/L. If levels greater than 10 mg/L of methane are found, all parties including the water well owner, regulators and the health department should be notified and mitigation measures enacted. If greater than 28 mg/L of methane are found, immediate action must be taken to remedy the situation.

Sincerely,

Robert W. Puls

Robert W. Puls
Director, Oklahoma Water Survey
Associate Professor
University of Oklahoma,
College of Atmospheric and Geographic Sciences

[9] Ford, R. G., Wilkin, R. T., & Puls, R. W. (2007). Monitored Natural Attenuation of Inorganic Contaminants in Ground Water, Vol 2: Assessment for Non-Radionuclides Including Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Nitrate, Perchlorate, and Selenium. EPA/600/R-07/140

[10] Molofsky, L. et al. July 10, 2013. Presentation: Microbially Mediated Association Between Methane and Groundwater Geochemistry. Ground Water Protection Council Stray Gas Incidence and Response Forum.

[11] Pennsylvania Department of Environmental Protection. (2010). DEP Takes Aggressive Action Against Cabot Oil & Gas Corp to Enforce Environmental Laws Protect Public in Susquehanna County. Harrisburg, PA. Retrieved from http://www.portal.state.pa.us/portal/server.pt/community/newsroom/14287?id=10586&typeid=1