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U.S. EPA Science Advisory Board (1400R)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
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RE: Docket ID No. EPA-HQ-OA-2015-0245

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We appreciate the opportunity to provide comments to the Environmental Protection Agency (EPA) Science Advisory Board Hydraulic Fracturing Research Advisory Panel on the EPA's *Draft Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources*. Clean Water Action is a national organization working in fifteen states on a wide range of health and environmental challenges, with a particular focus on drinking water issues and on oil and gas activities. The Natural Resources Defense Council (NRDC) is a national, non-profit legal and scientific organization with 1.3 million members and activists worldwide and is active on a wide range of environmental issues, including fossil fuel extraction and drinking water protection.

Clean Water Action and NRDC are concerned about the risks which hydraulic fracturing presents to drinking water. It is not clear that current state or federal oversight is sufficient to prevent endangerment of underground sources of drinking water, contamination of surface drinking water sources, stresses on an already-constrained resource and other drinking water and ground water impacts. The findings of this Assessment can greatly inform our understanding of the potential impacts of hydraulic fracturing activity to support updating protections where necessary.

The five stages of the hydraulic fracturing water cycle and the primary and secondary research questions associated with them are appropriate for responding to the charge given to EPA by Congress, though they do not represent the full range of research needed to understand the impacts of hydraulic fracturing on water resources, public health and natural resources. We urge SAB/EPA to be as rigorous and comprehensive as possible in reviewing EPA's latest draft as designed and we believe this is an appropriate and in fact critically needed use of EPA resources.

We urge the Science Advisory Board, hereafter SAB, to consider the following comments in its review of the *Assessment.*

A. Impacts to Downstream Public Water Systems

Findings in the Assessment on drinking water impacts that can affect Public Water Systems (PWS) are significant in that they relate to potential public health risks from drinking water and could impact PWS ability to comply with the Safe Drinking Water Act. We urge the Panel to consider the following in its review:

1. To what extent should EPA be directed to close data and information gaps to more clearly understand potential risks to downstream drinking water sources for PWS?

There are numerous parts of the Assessment in which lack of data and information has hampered EPA's ability to fully address the original research questions. SAB should consider to what extent this lack of information has led EPA to undervalue potential threats to drinking water resources. SAB should also consider recommendations to EPA on how to address this lack of information since it will remain relevant in future research and regulatory activity and impedes the ability of EPA to ensure that its activities are grounded in science.

Given the expansion of hydraulic fracturing activities, documented negative impacts in the Assessment and intense public interest, EPA should provide a more complete explanation for why the Agency experienced such a high data gaps or were resigned to the inability to secure the necessary information in order to offer robust conclusions.

EPA should succinctly identify the barriers, potential bad actors or lack of current policy enabling such data collections to avoid having the scope of the Assessment and its findings intentionally misconstrued by some stakeholders and the public.

2. An Assessment of drinking water impacts should include discussion of potential costs to PWS and their consumers for removing contaminants in their source water that result from hydraulic fracturing activities, particularly wastewater disposal.

The Assessment states that hydraulically fracturing wastewater that is not adequately treated could "increase concentrations of TDS, bromide, chloride, and iodide in receiving waters" and contribute to the formation of cancer causing disinfection byproducts (DBPs) at water treatment and drinking water plants.[1]

SAB should review a recent study which confirms instances of these increased contaminants in downstream waters. McTigue et al. published an article about the occurrence and consequences of bromide in drinking water sources. The study reports that fracking wastewater may contribute to increases in bromide-containing waste upstream of drinking water utilities, and thus to the increase in DBPs detected by the drinking water utilities.[2]

[1] U.S. EPA. "EPA's Full Draft Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources." June 4, 2015 at ES-21.
[2] McTigue, Nancy; Graf, Katherine; Brown, Richard. 2014. Occurrence and Consequences of Increased Bromide in Drinking Water Sources. Environmental Engineering & Technology, Inc.

SAB should also review recent research by the American Water Works Association on bromide removal costs could shed light on the costly complications bromides pose to downstream PWS.[3] The research outlines three mitigation technologies for removing bromide at downstream water treatment plants. Installing any of these technologies results in extensive upfront capital costs, leading to significant monthly rate hikes for consumers.

B. Shallow Fracking

The Assessment noted that 20% of hydraulically fractured wells reviewed occur less than 2000ft from the base of the protected water source.[4] This is a critical threshold. A smaller separation between fracturing and drinking water sources increases the likelihood of groundwater contamination.[5] [6] Fracturing at shallow depths can lead to acute impacts on groundwater because "fractures growing out of the production zone could potentially intercept natural, preexisting fractures" and reach overlying shallow drinking water sources.[7]

An analysis by Jackson et al. (2015) reviewed a wider set of hydraulically fracturing wells and revealed that while the majority of fracked wells are at least a mile deep, shallow fracturing operations are still significant and distributed across 12 states.[8] In particular, Texas had the highest number of shallow fracked wells[9] and three quarters of all wells in California were fracked less than 2000 feet from the surface.[10]

The analysis also reviewed states with shallow hydraulic fracturing activities for specifically tailored regulatory requirements and found little evidence. Of the 12 states with at least 50 shallow hydraulically fractured wells, only 2 states have special requirements or permits. EPA should note that in addition to the inherent risks in frac jobs occurring at shallower depths, most states do not have protective measures in place with respect to the elevated risks.

The latest report from the California Council on Science and Technology (CSST) on well stimulation techniques including hydraulic fracturing states it even more clearly:

"Shallow hydraulic fracturing presents a higher risk of groundwater contamination, which groundwater monitoring may not detect. This situation warrants additional scrutiny. Operations

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[3] *American Water Works Association.* Cost of DBP Mitigation Associated with Bromide Discharges from Power Plants. Presented to Office of Information and Regulatory Affairs Office of Management and Budget. August 3, 2015.

[4] U.S. EPA. "EPA's Full Draft Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources." June 4, 2015 at 6-34.

[5] Jackson, R.B.; Vengosh, A.; Carey, J.W.; Davies, R.J.; Darrah, T. H.; O'Sullivan, F.; Petron, G. The environmental costs and benefits of fracking. *Ann. Rev. Environ. Resour.* 2014, 39, 327-362.

[6] Digulio, D. C.; Wilkin, R. T.; Miller, C.; Oberley, G. *Investigation of Ground Water Contamination near Pavillion, Wyoming (*Draft Report); U.S. Environmental Protection Agency, 2011.

[7] U.S. EPA. "EPA's Full Draft Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources." June 4, 2015 at 6-37.

[8] Jackson, R.B.; Lowry, E.R.; Pickle, A.; Kang, M.; Digulio, D.; Zhao, K. The Depths of Hydraulic Fracturing and Accompanying Water Use Across the United States. *Environmental Science & Technology.* 2015, B.

[9] *Id.*

[10] California Council on Science and Technology. 2015. *An Independent Scientific Assessment of Well Stimulation in California, Volume II, Potential Environmental Impacts of Hydraulic Fracturing and Acid Stimulations. p. 406.*

with shallow fracturing near protected groundwater could be disallowed or be subject to additional requirements regarding design, control, monitoring, reporting, and corrective action..."[11]

In order to reflect the findings in the latest research, SAB should request that EPA appropriately highlight shallow hydraulic fracturing as a high-risk activity with increased likelihood of contamination and impacts on drinking water. States with shallow fracturing are widespread but have sparse protections. As hydraulic fracturing and other unconventional oil and gas development continues to increase across the country, so too will the number of shallow fracturing events and which, as EPA notes, will "in turn, lead to increased opportunities for impacts on drinking water resources."[12]

C. Pits

Chapter 8 of the Assessment on wastewater treatment and disposal contains national level estimates of produced water that have since been updated. An analysis by John Veil for the Ground Water Protection Council reported onshore wells – both conventional and unconventional – **in the 31 states reviewed generated 20,555,884,000 barrels of wastewater in 2012,** the year with the most recent data available. This is slight uptick in produced water from the last report in 2007. But notably the report provides the first ever national estimates for produced water disposed of in pits and impoundments - "3.6% was evaporated, primarily in several arid western states, from onsite ponds and pits" [13] totaling 691,142,000 barrels of wastewater.[14]

EPA's Assessment reports that spills and leaks from on-site pits and impoundments have resulted in large spills of up to 57,000 gallons of fluid with impacts to ground and surface waters.[15] The Assessment includes independent studies on pits and analysis of state spill databases. Not included is a Clean Water Action report from 2014, exposing the oil industry in California for disposing a large portion of its wastewater in 432 open and unlined pits throughout the Central Valley. These pits are designed for percolation, in which the toxic wastewater seeps into the soil – "a practice that inherently presents a risk of degrading any nearby and connected water resources."[16] The report found that the risks to groundwater from these open and unlined pits are so great that the method of wastewater should be banned – this conclusion is consistent with other research in California.

The California Council on Science and Technology in its recent report echoed that sentiment:

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[11] *Id.* at 35.
[12] U.S. EPA. "EPA's Full Draft Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources." June 4, 2015 at 6-55.
[13] Veil, J; *U.S. Produced Water Volumes and Management Practices in 2012.* Ground Water Protection Council. April 2015, 45.
[14] *Id.* 42.
[15] U.S. EPA. "EPA's Full Draft Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources." June 4, 2015 at 7-32.
[16]http://cleanwateraction.org/files/publications/ca/CA%20Oil%20and%20Gas%20In%20the%20Pits%20Facesheet.pdf

"Operators currently dispose of wastewater from hydraulically fractured wells in percolation pits and also likely have occasionally injected wastewater contaminated with stimulation chemicals into protected groundwater. These practices should stop."[17]

SAB should request EPA add a section specifically dedicated to the heightened threats that wastewater disposal in pits poses to drinking water resources. The CSST report revealed that almost 60% of all wastewater created by hydraulically fracturing in California is managed at some point in open pits.[18] Toxic fluids that are not evaporated in our air seep into soil and could potentially lead to groundwater contamination. When the third largest oil producing state in the country is managing the majority of its fracking wastewater with this haphazard and outdated method, EPA's Assessment should more prominently feature the glaring threats it poses to the groundwater of residents living in the state with the eighth largest economy in the world.

D. Unconventional Extraction vs Conventional Extraction

Additional Research on Risks from Wastewater Sent to POTWs

The Assessment describes the risks wastewater from hydraulically fracturing sent to Publically Owned Treatment Works (POTWs) poses to downstream drinking water quality and the water treatment mechanisms. Constituents contained in this water "have the potential to pass through unit treatment processes commonly used in POTWs and can be discharged into receiving rivers."[19] Further, the high salt contents can "disturb POTW biological treatment processes."[20]

As such the SAB should refer to Clean Water Action and Environmental Integrity Project's comments on EPA's proposed rule, *Effluent Limitations Guidelines and Standards for the Oil and Gas Extraction Point Source Category*, which reiterates the high risks wastewater poses to both sewage treatment plants and drinking water quality and supports EPA's recently proposed zero discharge standard:

"EPA has taken the appropriate course of action in requiring a zero-discharge standard for UOG facilities discharging to POTWs, given that UOG [unconventional] wastewater contains a number of constituents that POTWs are unable to process or remove and that may lead to the formation of dangerous byproducts.

The zero-discharge standard is a commonsense rule that provides regulatory clarity to the oil and gas industry. EPA should not deviate from the zero-discharge requirement as this is the limitation is based on the best available technology, in line with the purposes of the CWA, and the only way to ensure the protection of public health and the environment."[21]

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[17] California Council on Science and Technology. 2015. *An Independent Scientific Assessment of Well Stimulation in California, Summary Report, An Examination of Hydraulic Fracturing and Acid Stimulations in the Oil and Gas Industry*. p. 1.
[18] California Council on Science and Technology. 2015. *An Independent Scientific Assessment of Well Stimulation in California, Volume II, Potential Environmental Impacts of Hydraulic Fracturing and Acid Stimulations.* pp. 98-102.
[19] U.S. EPA. "EPA's Full Draft Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources." June 4, 2015 at 8-33.
[20] *Id.*
[21] Clean Water Action and Environmental Integrity Project comments on EPA's *Effluent Limitations Guidelines and Standards for the Oil and Gas Extraction Point Source Category.* Submitted July 17, 2015. Accessible at http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OW-2014-0598-0977

Conventional and Unconventional Wastewater Poses Similar Threats to Drinking Water

The Assessment confirms that hydraulic fracturing is used in both conventional and unconventional formations. We agree when the Assessment's states "conventional and unconventional flowback and produced water content are often similar with respect to the occurrence and concentration of many constituents."[22] Likewise, we agree with the Assessment's description of some of the risks produced water poses to drinking water resources.

The Environmental Defense Fund's comments on EPA's proposed rule, *Effluent Limitations Guidelines and Standards for the Oil and Gas Extraction Point Source Category*, contains analysis on the volumes of, and pollutants and concentrations in wastewater generated from both unconventional and conventional formations.[23] The comments include the similarities and unknowns with various examples. One example is a description of a recent study:

"A recent study published in Environmental Science & Technology examined both conventional and unconventional wastewater samples.[24] Samples of Appalachian conventional produced waters were found to contain high chloride, bromide, iodide, and ammonium levels – the same pollutants of concern identified by EPA in unconventional oil and gas wastewaters. The researchers also found no difference between conventional and unconventional produced waters with respect to halides (such as iodide) and ammonium concentrations."

SAB should revise the Assessment to note that there are inherent risks associated with wastewater produced by a oil and gas wells due to the constituents brought to the surface and the ways the wastewater is managed, regardless of if hydraulic fracturing was utilized.

E. Executive Summary and Press Release

The Executive Summary does not faithfully summarize the results of the study and must be revised to accurately convey the study's findings. Specifically, the following statements misrepresent the level of certainty with which EPA can identify impacts on drinking water resources:

"We did not find evidence that these mechanisms have led to widespread, systemic impacts on drinking water resources in the United States. Of the potential mechanisms identified in this report, we found specific instances where one or more mechanisms led to impacts on drinking water resources, including contamination of drinking water wells. The number of identified cases, however, was small compared to the number of hydraulically fractured wells."[25]

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[22] U.S. EPA. "EPA's Full Draft Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources." June 4, 2015 at 7-47.

[23] Environmental Defense Fund comments on EPA's *Effluent Limitations Guidelines and Standards for the Oil and Gas Extraction Point Source Category.* Submitted July 17, 2015. Accessible at http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OW-2014-0598-0975

[24] Harkness, J., Dwyer, G., Warner, N.R., Parker, K. Mitch, W.; Vengosh, A. (2015) Iodide, Bromide, and Ammonium in Hydraulic Fracturing and Oil and Gas Wastewaters: Environmental Implications. Environmental Science & Technology, 49(3), 1955-1963, DOI:10.1021/es504654n.

[25] U.S. EPA. "EPA's Full Draft Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources." June 4, 2015 at ES-6, 10-1.

Although the report goes on to say that this finding may truly represent a lack of impacts or could be due to lack of data and impacts, those statements are overshadowed by the conclusion above. The emphasis on the first finding – the lack of evidence of widespread impacts – is not supported by the underlying findings in the main body of the report. The report itself places much greater emphasis on EPA's inability to determine with any certainty the frequency of impacts due to a lack of available data, as discussed in detail below.

In addition, the statement regarding the number of identified cases of impacts relative to the number of hydraulically fractured wells conveys false accuracy. This statement implies that EPA assessed the probability that a hydraulically fractured well will be associated with impacts to drinking water, which EPA did not do. EPA did not systematically investigate the water quality near every single hydraulically fractured well in the United States, nor does it claimed to have done so for even a statistically significant sample of wells. Later in the report EPA makes clear that it cannot even determine a definitive count of the number and location of hydraulically fractured wells. As such, EPA's statement regarding the number of cases of impacts versus the number of fractured well is highly misleading.

EPA's ability to find evidence of impacts – let alone evaluate the frequency of those impacts – was seriously thwarted by a lack of available data. This fact is confirmed repeatedly throughout the main body of the report[26], e.g.:

"There are several uncertainties inherent in our assessment of hydraulic fracturing water use and potential effects on drinking water quantity or quality. The largest stem from the lack of literature and data on this subject at local scales, and the question of whether any impacts would be documented in the types of literature we reviewed."(p.4-50)

"Due to a lack of data, we generally could not assess future cumulative water use and the potential for impacts in most areas of the country , nor could we examines these in combination with other relevant factors (e.g., climate change, population growth)"(p. 4-51)

"However, due to a lack of available data, little is known about the prevalence and severity of actual drinking water impacts." (p. 5-42)

"The data contain few post-spill analyses, so ground water contamination may have occurred but have not been identified." (p. 5-46)

"There was no reported sampling of soil or ground water to determine whether or not chemicals migrated into the soil." (5-69)

"The lack of information regarding the composition of chemical additives and fracturing fluids, containment and mitigation measures in use, and the fate and transport of spilled fluids greatly limits our ability to assess potential impacts to drinking water resources." (p. 5-73)

"There is a lack of baseline surface water and ground water quality data. This lack of data limits our ability to assess the relative change to water quality from a spill or attribute the presence of a contaminant to a specific source." (p.5-74)

[26] *Id.* pages as noted.

“There are documented chemical spills at fracturing sites, but a lack of available data limits our ability to determine impacts.” (p. 5-74)

“There are other cases in which production wells associated with hydraulic fracturing are alleged to have caused drinking water contamination. Data limitations in most of those cases (including the unavailability of information in litigation settlements resulting in sealed documents) make it impossible to definitively assess whether or not hydraulic fracturing was a cause of the contamination in these cases.” (p. 6-53)

“Subsurface monitoring data (i.e., data that characterize the presence, migration, or transformation of fluids in the subsurface related to hydraulic fracturing operations) are scarce relative to the tens of thousands of oil and gas wells that are estimated to be hydraulically fractured across the country each year (see Chapter 2).” (p. 6-56)

“These limitations on hydraulic fracturing-specific information make it difficult to provide definitive estimates of the rate at which wells used in hydraulic fracturing operations experience the types of integrity problems that can contribute to fluid movement.” (p. 6-56)

“Although it is collected in some cases, there is also no systematic collection, reporting, or publishing of empirical baseline (pre-drilling and/or pre-fracturing) and post-fracturing monitoring data that could indicate the presence or absence of hydraulic fracturing-related fluids in shallow zones and whether or not migration of those fluids has occurred.” (p. 6-56)

“Given the surge in the number of modern high-pressure hydraulic fracturing operations dating from the early 2000s, evidence of any fracturing-related fluid migration affecting a drinking water resource (as well as the information necessary to connect specific well operation practices to a drinking water impact) could take years to discover.” (p. 6-56)

“Because some components of hydraulic fracturing fluid are proprietary chemicals, and subsurface reaction products may be unknown, prior knowledge of the identity of analytes may not be available. Consequently, studies may be limited in their ability to determine the presence of either unknown or proprietary constituents contained in flowback or produced water simply because of the lack of knowledge of the identities of the constituents.” (p. 7-14)

“Of the volume of spilled flowback and produced water, 16% was recovered for on-site use or disposal, 76% was reported as unrecovered, and 8% was unknown. The potential impact of the unknown and unrecovered volume on drinking water resources is unknown.” (p. 7-33)

“A key parameter that is unknown is the number of crashes which impact drinking water resources, so definitive estimates of impacts to drinking water resources cannot be made.” (p. 7-39)

“Despite various studies, the total number of spills occurring in the United States, their release volumes and associated concentrations, can only be roughly estimated because of underlying data limitations.” (p. 7-45)

“Extensive characterization of produced water is typically not part of spill response, and therefore the chemicals, and their concentrations, potentially impacting drinking water resources are not usually known.” (p. 7-46)

"These unauthorized discharges represent both documented and potential impacts on drinking water resources. However, data do not exist to evaluate whether such episodes are uncommon or whether they happen on a more frequent basis and remain largely undetected." (p. 8-20)

"In addition, unauthorized discharge of wastewater is a potential mechanism for impacts on drinking water resources. Descriptions of several incidents and resulting legal actions have been publicly reported. However, such events are not generally described in the scientific literature, and the prevalence of this type of activity is unclear." (p.8-58)

"Unauthorized discharges of hydraulic fracturing wastewaters have been documented; such discharges could potentially impact drinking water resources, but estimates of the frequency of occurrence cannot be developed with the available data." (p.8-68)

"Monitoring of surface waters, even screening with a simple TDS proxy such as conductivity, would be needed to help assess how often hydraulic fracturing activities (including spills or discharges of wastewater) affect receiving waters; such data are lacking except for some studies in the Marcellus Shale region." (p. 8-73)

"There are several notable uncertainties in the chemical and toxicological data that limit a comprehensive assessment of the potential health impacts of hydraulic fracturing on drinking water resources." (p. 9-37)

"This assessment used available data and literature to examine the potential impacts of hydraulic fracturing for oil and gas on drinking water resources nationally. As part of this effort, we identified data limitations and uncertainties associated with current information on hydraulic fracturing and its potential to affect drinking water resources. In particular, data limitations preclude a determination of the frequency of impacts with any certainty. There is a high degree of uncertainty about whether the relatively few instances of impacts noted in this report are the result of a rarity of effects or a lack of data." (p. 10-17)

This last statement in particular, while conveying the same basic information as the Major Findings section of the Executive Summary, communicates it in a starkly contrasting manor. Appropriately, this latter statement focuses on the uncertainty inherent in drawing any firm conclusions about the frequency of impacts to drinking water from hydraulic fracturing, due to a lack of available data. This crucial point is lost in the Executive Summary.

EPA's press statement announcing the release of the draft study even further mischaracterizes the findings of the study. This misleading statement from the Executive Summary, "We did not find evidence that these mechanisms have led to widespread, systemic impacts on drinking water resources in the United States,"[27] is inaccurately summarized as, "Hydraulic fracturing activities have not led to widespread, systemic impacts to drinking water resources."[28] The loss of the crucial caveat that EPA did not find <u>evidence</u> of impacts completely changes the meaning of this finding.

[27] *Id.* at ES-6, 10-1.
[28] U.S. Environmental Protection Agency. (2015) EPA Releases Draft Assessment on the Potential Impacts to Drinking Water Resources from Hydraulic Fracturing Activities [Press Release].

The consequences of EPA's failure to accurately communicate its science are not trivial. Most members of the general public will likely only hear of this study through stories in the popular press. Numerous such stories included the wholly inaccurate statement from EPA's press release highlighted above.[29] As such, the general public may be seriously misinformed about the results of this study. Those members of the public, policymakers, or others who go further to read the Executive Summary will still be misled as to major conclusions of the study if the draft report is finalized without revisions.

In sum, we request that EPA:

1. Revise the Major Findings and Conclusions sections of the Executive Summary and Synthesis to accurately and faithfully convey the findings of the study, in particular by:
   a. Emphasizing and making clear that EPA cannot say with any certainty how widespread or systematic impacts to drinking water from hydraulic fracturing are, due to a lack of available data, and;
   b. Clarifying that EPA did not perform a statistical analysis of the number of cases of drinking water impacted by fracturing activities versus the number of fracturing activities.
2. Retract the news release dated 06/04/2015 announcing the release of the draft study and issue a correction that accurately conveys the findings of the study and the revised Executive Summary.

F. Recommendations for Future Work

EPA's draft report thoroughly highlights data gaps and uncertainties, both within each individual study area and in the synthesis section. This is a strength of the report and will no doubt be of great use to regulators, policy-makers, industry, and the public, among others. The gaps are numerous and fundamental and, as EPA states, "preclude a determination of the frequency of impacts with any certainty."[30]

Missing from the report, however, are recommendations for future work based on these identified gaps and uncertainties. Such a section could help focus researchers, regulators, and others – including the Federal Multiagency Collaboration on Unconventional Oil and Gas Research – on devising means to fill these gaps and perform analysis that EPA was precluded from performing due to such gaps.

EPA's draft report is the first of a kind of this scale and scope to examine the potential impacts to drinking water from hydraulic fracturing. As such, EPA researchers have unique insight into topics on which additional study is most needed. Sharing these insights could be of great benefit to other scientists as well as to the public. We therefore request that EPA add a section to the report making recommendations for future work.

G. Prospective Case Studies

[29] See, e.g. Gold, Russell, and Amy Harder. "Fracking Has Had No 'Widespread' Impact on Drinking Water, EPA Finds." *WSJ*. Wall Street Journal, 4 June 2015. Web. 26 Aug. 2015.; Brady, Jeff. "EPA Finds No Widespread Drinking Water Pollution From Fracking." *NPR*. NPR, 4 June 2015. Web. 26 Aug. 2015.

[30] U.S. EPA. "EPA's Full Draft Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources." June 4, 2015 at ES-22.

A significant gap in the draft report is a lack of discussion regarding the proposed Prospective Case Studies.

EPA's final study plan, published in November 2011, stated that EPA would perform two prospective case studies, in which EPA scientists would have full access to two hydraulic fracturing sites in order to collect baseline data and perform monitoring during and after hydraulic fracturing.[31] This would have been groundbreaking, first-of-a-kind research and indeed was one of the most highly anticipated parts of the study.

EPA's 2012 Progress Report only briefly mentions the Prospective Case Studies, stating that, "The EPA continues to work with industry partners to design and develop prospective case studies. Because prospective case studies remain in their early stages, the progress report focuses on the progress of retrospective case studies only."[32]

EPA's 2015 draft report is completely silent on the topic of the prospective case studies.

EPA has gone to significant lengths to create and open and transparent process surrounding this study, including holding multiple public comment sessions and convening broad stakeholder groups to participate in workshops and meetings. This makes EPA's silence on the prospective case studies all the more troubling.

Given that EPA included the prospective case studies in the Final Study Plan and the significant public interest in this area of research, EPA has an obligation to explain why this work was not completed. We request that EPA add a section to the report discussing the prospective case studies, including any future plans to perform such work.

H. Retrospective Case Studies

In the November 2011 Final Study Plan, EPA proposed to perform five retrospective case studies, evaluating reported impacts to groundwater in areas where hydraulic fracturing is occurring.[33] EPA performed these studies, but chose not to include them in the 2015 draft report, instead publishing them as separate reports not open for public comment. We are troubled by this decision.

Like the prospective case studies, the retrospective case studies were highly anticipated pieces of the larger study. They were also the source of significant controversy, given EPA's decisions to abandon three high-profile water contamination cases suspected to be related to hydraulic fracturing in Pavillion, WY, Parker County, TX, and Dimock, PA and EPA's further decision not to include these incidents in the current study. These decisions created a troubling pattern regarding EPA's scientific work on hydraulic fracturing that we were hopeful the current study would end. EPA's choice to not include the five retrospective case studies in the public comment process indicates that there is perhaps still cause for concern.

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[31] U.S. Environmental Protection Agency, Office of Research and Development. 2011. Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources.
[32] U.S. Environmental Protection Agency. 2012. Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources Progress Report.
[33] U.S. Environmental Protection Agency, Office of Research and Development. 2011. Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources.

The retrospective case studies represent one of the few areas of original field research conducted for this study, which is largely a review and synthesis of existing work. As such, this topic area more than others could benefit from review by and feedback from outside experts. Additionally, the communities in which these investigations took place and who may have been impacted should have the ability to provide public input on the results of these investigations.

EPA's decision to exclude the retrospective case studies from the main report and instead burying them multiple links deep on the study webpage, making them very difficult to find, is confusing and concerning, particularly given EPA's history with scientific field investigations of water contamination suspected to be linked to hydraulic fracturing activities. We request that EPA add the retrospective case studies to the main report and make them open to public review and comment.

I. Migration of Contaminants to Protected Water

In section 6.3.2 of the study EPA evaluates migrations pathways through which injected or native fluids could reach protected water. [34] This includes the results of modeling work performed by researchers at Lawrence Berkeley National Laboratory (LBNL) to investigate potential short term migration of fluids from a hydrocarbon-bearing formation to a shallower zone containing groundwater along a permeable fault or fracture. The time period modeled was from immediately after fracturing to up to two years following fracturing, during the production phase.[35] This is not sufficient to fully determine the potential for migration of fluids along these pathways.

As stated in the study, the researchers did not model the fracturing process itself.[36] However, it is precisely this process that could cause fluids to migrate along the studied pathways. The high pressures exerted during fracturing could potentially provide the force necessary to cause migration of fluids into shallower zones. Moreover, the researchers assumed a constant bottomhole pressure equal to half the initial reservoir pressure.[37] As EPA itself states, "pressure distribution within the reservoir (e.g., over-pressurized vs. hydrostatic conditions) will affect the fluid flow through fractures/faults."[38] By not modeling the time periods during which pressure in the hydrocarbon-bearing reservoir would be greatest, the researchers did not model the highest risk scenarios related to these potential pathways, and therefore the analysis is incomplete.

Indeed, as described in section 6.3.2.3, fractured wells have been documented to communicate with offset wells during hydraulic fracturing, including incidents where fluids from the fractured well intersect offset wells, resulting in surface blowouts.[39] In an experiment performed in the Marcellus Shale to investigate interwell communication during fracturing, an operator injected seven distinct chemical tracers along with each stage of a seven-stage fracture treatment.[40] The chemical tracers from four of the seven stages were detected in the produced water from an offset well located approximately 950 feet away. In addition, the

[34] U.S. EPA. "EPA's Full Draft Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources." June 4, 2015 at 6-31
[35] *Id.* at 6-40
[36] *Id.*
[37] *Id.*
[38] *Id.* at 6-50
[39] *Id.* at 6-42 thru 6-48
[40] Barth, J., et al, 2012, "Frac Diagnostics Key In Marcellus Wells," AOGR, May 2012 issue, http://www.aogr.com/index.php/magazine/frac-facts

chloride concentration of the produced water from the offset well dropped by approximately 50%, indicating mixing with frac water, and took 5 days to return to near-previous concentrations. It is clear that pressures exerted during hydraulic fracturing can result in movement of fluids along permeable pathways. The same mechanisms that cause fluid flow from a fractured well to an offset well could cause fluids to flow along geologic pathways.

As discussed in section 6.3.2.4, only a very small number of studies have modeled the potential movement of fluids along faults or fractures during hydraulic fracturing. This is suspected to be one of the key pathways by which contaminants could reach groundwater, but in fact very little work has been done on this topic to date. This therefore represents a significant data and research gap – one which EPA can and should investigate in this study.

In sum, we request that EPA perform modeling to assess the potential for migration of fluids along induced or preexisting faults or fractures into protected water *during* hydraulic fracturing, and include the results of this work in the final report.

J. Miscellaneous

Section 7.3. Background on Formation Characteristics. This section includes an extremely oversimplified description of sedimentary depositional environments. EPA states, "Generally, shale results from clays deposited in deep, oxygen-poor marine environments, and sandstone results from sand deposited in shallow marine environments (Ali et al., 2010; U.S. EPA, 2004)." This description completely leaves out terrestrial, near-shore, and deep marine sandstone depositional environments and the facies associated with them. This section also omits any discussion of carbonate depositional environments. All of these sedimentary depositional environments are relevant to petroleum geology and by extension the characteristics of produced water. EPA should revise this section to more comprehensively and accurately describe sedimentary depositional environments and formation characteristics relevant to hydrocarbon production.

Section 8.4.1. Underground Injection. In reference to management of produced water, EPA states, "More than 98% of this volume was managed via some form of underground injection, with 40% injected into Class II wells." This should be corrected to read "Class IID wells." Clark and Veil found that, of the 98% of produced water injected underground, approximately 59% was used for pressure maintenance or enhanced oil recovery – i.e. injected into Class IIR wells – and 40% was injected into nonproducing formations for disposal – i.e. injected into Class IID wells.

K. Other EPA Actions

SAB should encourage EPA move forward with a number of important activities related to the protection of drinking water and public health:

EPA Should Expedite Revision to CWT Effluent Limitation Guidelines

EPA should expedite a revision to the relevant Centralized Waste Treatment ELG, thus closing a gap in federal regulation and ensuring that surface waters are not left vulnerable to oil and gas pollution.

It is clear that ELGs relating to CWTs need to be updated to reflect the same threats from oil and gas wastewater that POTWs face. EPA memos indicate that many CWTs cannot adequately treat unconventional wastewater.[41] EPA stated that appropriate limits or pretreatment standards would need to be applied to CWTs because the current guidelines did not evaluate certain pollutants common in oil and gas wastewater, such as radionuclides.[42]

Completing this study will help begin to address critical questions about water quality and public health impacts of discharges from CWTs to POTWs that are not covered in the current rulemaking.

EPA Should Expedite an Update to Coalbed Methane ELGs

EPA should expedite a similar ELG update for coalbed methane extraction. EPA's decision to delist CBM from the definition of UOG was premature and EPA should reconsider this proposal in light of inevitable shifts in gas prices, demand, and costs of wastewater treatment.

Coalbed methane extraction produces large volumes of wastewater characterized by the presence of numerous contaminants at potentially high concentrations. Inadequate treatment and discharge of these wastes jeopardizes the integrity of surface water, can lead to increased public health risks from drinking water, threatens fish and wildlife and causes other negative environmental impacts.

The Congressional intent underlying the Clean Water Act's Effluent Guidelines and Limitations-setting process included prevention of "pollution havens." Coalbed methane extraction ELG's are necessary and affordable treatments are available to avoid this outcome in places where coalbed methane extraction is occurring.[43]

EPA Should Update ELGs for the Landfill Waste Category which Includes Landfill Leachate

EPA should undergo a similar rulemaking for ELGs governing the discharge of landfill leachate from landfills that currently accept or have historically accepted oil and gas extraction waste. Certain landfills accept waste associated with the extraction of oil and gas – including drill cuttings, drilling muds, produced sand, and produced water – for disposal. Those landfills then often send their leachate to nearby POTWs, which are unequipped to properly treat it. Leachate from landfills accepting waste from oil and gas extraction facilities can contain many of the same pollutants as oil and gas extraction wastewater, and should be subject to the same controls.

EPA Should Take Further Action on Diesel Fuels in Hydraulic Fracturing

The absence of discussion in the draft study of the use of diesel fuels in hydraulic fracturing fluids, and the particular risks that practice presents to protected water sources, is noteworthy. EPA has the responsibility to regulate hydraulic fracturing when diesel fuel is used in the fracturing fluid.[44] In

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[41] EPA, Natural Gas Drilling in the Marcellus Shale NPSED Program Frequently Asked Questions (2011), available at http://www.epa.gov/npdes/pubs/hydrofracturing_faq.pdf.
[42] Id.
[43] *See Docket ID No. EPA-HQ-OW-2010-0824: Comments on Preliminary 2012 Effluent Guidelines Program Plan: Coalbed Methane Extraction and Shale Gas Wastewater Treatment* (comments submitted by nonprofit organizations and other environmental and public health advocacy groups).
[44] 42 U.S.C. 300h (d)

February 2014, EPA released final permitting guidance for diesel fuels hydraulic fracturing.[45] While the guidance documents contain many important protections, those protections are completely unenforceable. This problem was highlighted by a July 2015 report from the EPA Office of the Inspector General (IG), which found problems with EPA's implementation, enforcement and oversight of diesel fuels hydraulic fracturing, stating:

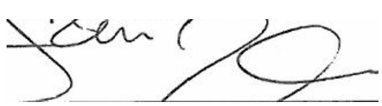
"First, the EPA needs to improve oversight of permit issuance for hydraulic fracturing using diesel fuels, and address any related compliance issues. Evidence shows that companies have used diesel fuels during hydraulic fracturing without EPA or primacy state underground injection control Class II permits. The EPA has also not determined whether primacy states and tribes are following the agency's interpretive memorandum for issuing permits for hydraulic fracturing using diesel fuels."[46]

Our organizations submitted comments on EPA's proposed permitting guidance requesting that EPA ban the use of diesel in hydraulic fracturing fluids or, in lieu of that, begin a formal rulemaking process to develop legally binding regulations for hydraulic fracturing with diesel.[47] In light of the IG's report and the ongoing, unpermitted and therefore illegal use of diesel fuels in hydraulic fracturing fluids, we renew our call for EPA to ban the use of diesel fuels in hydraulic fracturing. If EPA chooses not to ban the use of diesel fuels in hydraulic fracturing, we strongly recommend that the EPA begin a formal rulemaking process to develop legally binding regulation for diesel fuels HF that address the unique environmental and human health risks posed by this practice.

Conclusion

Hydraulic fracturing activities and oil and gas production present a range of risks to human health and the environment, including to drinking water resources. We commend EPA for its work on this extensive scientific investigation into the relationship between hydraulic fracturing and drinking water. Thank you for your consideration of these comments.

Respectfully submitted,



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Natural Resources Defense Council

[45] U.S. Environmental Protection Agency. 2014. Permitting Guidance for Oil and Gas Hydraulic Fracturing Activities Using Diesel Fuels: Underground Injection Control Program Guidance #84.
[46] U.S. Environmental Protection Agency, Office of Inspector General. 2015. Enhanced EPA Oversight and Action Can Further Protect Water Resources From the Potential Impacts of Hydraulic Fracturing. Report No. 15-P-0204.
[47] NRDC et al. 2012. Comments on Permitting Guidance for Oil and Gas Hydraulic Fracturing Activities Using Diesel Fuels—Draft: Underground Injection Control Program Guidance #84. Available at http://docs.nrdc.org/energy/files/ene_12082401a.pdf Accessed 26 August 2015.