



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C. 20460

OFFICE OF THE ADMINISTRATOR
SCIENCE ADVISORY BOARD

August 11, 2016

EPA-SAB-16-005

The Honorable Gina McCarthy
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, D.C. 20460

Subject: SAB Review of the EPA's draft Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources

Dear Administrator McCarthy:

The EPA Science Advisory Board (SAB) is pleased to transmit its response to a request from the U.S. Environmental Protection Agency (EPA) Office of Research and Development (ORD) to review and provide advice on scientific charge questions associated with the EPA's draft *Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources (External Review Draft, EPA/600/R-15/047, June 2015)*. The draft Assessment Report synthesizes available scientific literature and data on the potential impacts of hydraulic fracturing for oil and gas development on drinking water resources, and identifies possible operational events during the life cycle of hydraulic fracturing for oil and gas operations that could result in impacts to drinking water.

The SAB was asked to comment on the EPA's statements on the goals, background and history of its Assessment; on the EPA's analyses regarding the water acquisition, chemical mixing, well injection, flowback and produced water, and wastewater treatment and waste disposal steps of the hydraulic fracturing water cycle (HFWC); on the EPA's analysis of chemicals used or present in hydraulic fracturing fluids; and on the EPA's synthesis of science on potential impacts of hydraulic fracturing on drinking water resources as presented in the Assessment's Chapter 10 and Executive Summary. The specific charge questions to the SAB Hydraulic Fracturing Research Advisory Panel (SAB Panel) from the EPA are provided as Appendix A to the SAB report.

2015 for public comment and review by the SAB Panel operating under the auspices of the chartered SAB.

In general, the SAB finds the EPA's overall approach to assess the potential impacts of HFWC processes for oil and gas production on drinking water resources, focusing on the individual stages in the HFWC, to be comprehensive but lacking in several critical areas. The SAB also finds that the agency provided a generally comprehensive overview of the available literature that describes the factors affecting the relationship of hydraulic fracturing and drinking water, and adequately described the findings of such published data in the draft Assessment Report. However, the SAB has concerns regarding various aspects of the draft Assessment Report, including concerns regarding several major findings presented within the draft that seek to draw national-level conclusions regarding the impacts of hydraulic fracturing on drinking water resources. The SAB has recommendations for changes to text in the draft Assessment Report and for follow-on activities to address gaps. Also included, as Appendix B, is a dissenting view from four of the 30 members of the SAB Panel regarding the broader SAB Panel's viewpoint on one of the EPA's major findings.

The SAB's key findings and recommendations are summarized below.

Clarity of and Support for Major Findings: The SAB has concerns regarding the clarity and adequacy of support for several major findings presented within the draft Assessment Report that seek to draw national-level conclusions regarding the impacts of hydraulic fracturing on drinking water resources. The SAB is concerned that these major findings as presented within the Executive Summary are ambiguous and appear inconsistent with the observations, data, and levels of uncertainty presented and discussed in the body of the draft Assessment Report. Of particular concern in this regard is the high-level conclusion statement on page ES-6 that "We did not find evidence that these mechanisms have led to widespread, systemic impacts on drinking water resources in the United States." The SAB finds that the EPA did not support quantitatively its conclusion about lack of evidence for widespread, systemic impacts of hydraulic fracturing on drinking water resources, and did not clearly describe the system(s) of interest (e.g., groundwater, surface water), the scale of impacts (i.e., local or regional), nor the definitions of "systemic" and "widespread." The SAB observes that the statement has been interpreted by readers and members of the public in many different ways. The SAB concludes that if the EPA retains this conclusion, the EPA should provide quantitative analysis that supports its conclusion that hydraulic fracturing has not led to widespread, systemic impacts on drinking water resources. Twenty-six of the 30 members of the SAB Panel concluded that the statement also requires clarification and additional explanation (e.g., discuss what is meant by "any observed change" in the definition of "impact" in Appendix J, and consider including modifying adjectives before the words "widespread, systemic impact" in the statement on page ES-6). Four members of the SAB Panel concluded that this statement is clear, concise and accurate.

The SAB recommends that the EPA revise the major statements of findings in the Executive Summary and elsewhere in the final Assessment Report to clearly link those statements to evidence provided in the

and describe the different databases that contain such data and the challenges of accessing them, and make recommendations on how these databases could be improved to facilitate more efficient investigation of the data they contain.

The final Assessment Report should make clear that while the hydraulic fracturing industry is rapidly evolving, with changes in the processes being employed, the Assessment necessarily was developed with the data available at a point in time.

Recognition of Local Impacts: The SAB finds that the EPA's initial goal of assessing the HFWC using national-level analyses and perspective was appropriate. However, the final Assessment Report should also recognize that many stresses to surface or groundwater resources associated with stages of the HFWC are often localized in space and temporary in time but nevertheless can be important and significant. For example, the impacts of water acquisition will predominantly be observed locally at small space and time scales. These local-level impacts, when they occur, have the potential to be severe, and the final Assessment Report needs to better recognize the importance of local impacts. In this regard, the SAB recommends that the agency should include and critically analyze the status, data on potential releases, and any available findings from the EPA and state investigations conducted in Dimock, Pennsylvania; Pavillion, Wyoming; and Parker County, Texas, where many members of the public have stated that hydraulic fracturing activities have caused local impacts to drinking water resources. Examination of these high-visibility cases is important so that the reader can more fully understand the status of investigations in these areas, conclusions associated with the investigations, lessons learned, if any, for the different stages of the hydraulic fracturing water cycle, what additional work should be done to improve the understanding of these sites and the HFWC, plans for remediation, if any, and the degree to which information from these case studies can be extrapolated to other locations.

Prospective Case Studies: The SAB is concerned that the EPA had planned to but did not conduct various assessments, field studies, and other research, and the SAB recommends that the EPA delineate these planned activities within the final Assessment Report and discuss why they were not conducted or completed. All but two Panel members find the lack of prospective case studies as originally planned by the EPA and described in the research 2011 Study Plan is a limitation of the draft Assessment Report.

Probability and Risk of Failure Scenarios: To help the reader understand the most significant failure mechanisms associated with the various stages in the HFWC, the EPA should clearly describe the probability, risk and relative significance of potential hydraulic fracturing-related failure mechanisms, and the frequency of occurrence and most likely magnitude and/or probability of risk of water quality impacts associated with such failure mechanisms. For example, the agency should include additional major findings associated with the higher likelihood of impacts to drinking water resources associated with hydraulic fracturing well construction, well integrity, and well injection problems. These findings should discuss factors and effects regarding the severity and frequency of potential impacts from poor cementation techniques, hydraulic fracturing operator error, migration of hydraulic fracturing chemicals,

Chemical Toxicity and Hazard: The agency should compile toxicological information on constituents (e.g., chemicals, dissolved compounds and ions, and particulates) employed in hydraulic fracturing in a more inclusive manner, and not limit the selection of hydraulic fracturing constituents of concern to those that have noncancer oral reference values (RfVs) and cancer oral slope factors (OSFs) that were peer reviewed only by a governmental or intergovernmental source. The agency should use a broad range of toxicity data, including information pertinent to subchronic exposures from a number of reliable sources cited by the SAB in addition to those used in the draft Assessment Report to conduct hazard evaluation for hydraulic fracturing constituents. As the agency broadens inclusion of toxicological information to populate missing toxicity data, the EPA can expand the tiered hierarchy of data described in the draft Assessment Report to give higher priority to constituents with RfVs without excluding other quality toxicological information that is useful for hazard and risk assessment purposes.

Also, an important limitation of the agency's hazard evaluation of constituents across the HFWC is the agency's lack of analysis of the most likely exposure scenarios and hazards associated with hydraulic fracturing activities. To help prioritize future research and risk assessment efforts, the agency should identify the most likely exposure scenarios and hazards and obtain toxicity information relevant to these exposure scenarios. The EPA provides a wide range of possible scenarios along the HFWC, but more emphasis is needed on identifying the most likely durations and routes of exposures of concern so that the EPA can determine what toxicity information is most relevant and focus its research and monitoring efforts on the most important and/or likely scenarios. The SAB concludes that the selection of likely scenarios should be based on consideration of findings in prospective and retrospective site investigations, as well as case studies of public and private wells and surface water supplies impacted by spills or discharges of flowback, produced water or treated or partially treated wastewater from HFWC operations. Furthermore, the EPA developed a multi-criteria decision analysis (MCDA) approach to analyze hydraulic fracturing constituents and identify/prioritize those of most concern. In light of the limitations described in the SAB's response to Charge Question 7, and given that the EPA applied this approach to very few constituents, the EPA should explicitly state that these MCDA results (based only on constituents with RfVs) should not be used to prioritize the constituents of most concern nationally, nor to identify future toxicity testing research needs.

Characteristics of HF Fluids: For the sake of clarity, the final Assessment Report should distinguish between hydraulic fracturing constituents injected into a hydraulic fracturing well vs. constituents that come out of the hydraulic fracturing well in produced fluids, and between those constituents and potential impacts unique to hydraulic fracturing oil and gas extraction from those that also exist as a component of conventional oil and gas development, or those constituents that are naturally occurring in the formation waters of the production zone. The agency should also clarify whether constituents identified as being of most concern in produced water are products of the hydraulic fracturing activity, initial flowback, or later-stage produced water, or are constituents of concern derived from oil and gas production activities that are not unique to hydraulic fracturing activity or are naturally occurring in the formation water. This will help inform the reader about the different characteristics of HFE injection

(i.e., that the risk to drinking water supplies from this stage of the HFWC is not substantial) is not supported or linked to data presented in the body of the draft Assessment Report. The EPA should revise its interpretation of these limited data. In addition, Chapter 8's summary of water quality characteristics of hydraulic fracturing wastewaters from various sites clearly indicates that spills or discharges of inadequately treated hydraulic fracturing wastewater could result in significant adverse impacts on drinking water quality.

The EPA uses FracFocus 1.0 as the primary source of information on the identity and frequency of use of constituents in hydraulic fracturing processes, and the SAB expresses concern that the FracFocus database may not be sufficient. Although the agency acknowledged limitations of the FracFocus data, the EPA can do more to address these limitations by characterizing available toxicology data on proprietary constituents, and by using information provided in updated versions of FracFocus on chemical class, type, mass and concentration.

Baseline Water Quality Data: The EPA should discuss the importance of background and preexisting chemistry of surface and groundwater in developing a better understanding of whether impacts from drilling and completion activities can be identified. A major public concern is the appearance of contaminated or degraded drinking water in wells in areas where hydraulic fracturing occurs. Since naturally occurring contaminants and degraded drinking water in wells can occur from issues not related to hydraulic fracturing, the EPA should also include additional discussion on how background and pre-existing baseline chemistry of surface and groundwater data are used to better understand the impacts of hydraulic fracturing-related spills and leaks. The scientific complexity of baseline sampling and data interpretation should be clearly and concisely described.

Approach for Assessing Water Quality and Quantity Impacts: The SAB provides several suggestions to improve the agency's approach for assessing the potential that the hydraulic fracturing water cycle processes for oil and gas production may change the quality or quantity of drinking water resources. While the draft Assessment Report comprehensively summarizes available information concerning the sources and quantities of water used during HFWC operations from surface water, groundwater, and treated HFWC wastewaters, the SAB finds that the potential for water availability impacts on drinking water resources is greatest in areas with high hydraulic fracturing water use, low water availability, and frequent drought. The SAB notes, but did not independently confirm, the EPA conclusion that there are important gaps in the data available to assess water use that limit understanding of hydraulic fracturing potential impacts on water acquisition.

Definition of Proximity: The final Assessment Report should discuss the agency's rationale for selecting a one-mile radius to define proximity of a drinking water resource to hydraulic fracturing operations, and the potential need to consider drinking water resources at distances greater than one mile from a hydraulic fracturing operation. The EPA should present more information regarding the vertical distance between surface-water bodies and the target zones being fractured, the depths of most existing and potential future water supply aquifers compared to the depths of most hydraulically fractured wells

removal of disinfection by-product precursors in addition to bromide. The agency should describe the basis for nationwide estimates of hydraulic fracturing-related wastewater production, various aspects of hydraulic fracturing-waste disposal, the locations of hydraulic fracturing-related wastewater treatment and disposal facilities relative to downstream public water supply intakes and wells, the impacts of water recycling on pollutant concentrations and their potential impacts on drinking water quality should spills of recycled water occur, and trends in hydraulic fracturing-related wastewater disposal methods and their potential impacts on drinking water resources.

Best Management Practices and the Applicable Regulatory Framework: To better inform the readers on available processes, methods and technologies that can minimize hydraulic fracturing's potential impacts to drinking water resources, the SAB recommends that the agency describe best management practices used by industry at each stage of the HFWC. The EPA should also discuss: (1) federal, state and tribal standards and regulations implemented with the aim of minimizing the potential impacts to drinking water resources associated with hydraulic fracturing operations, and (2) the evolution of oilfield and federal, state and tribal regulatory practices relevant to HFWC activities. The EPA may develop these summaries as a longer-term future activity.

Accessibility of the Assessment to a Broad Audience: The SAB recommends that the draft Assessment Report be revised to make it more suitable for a broad audience. It is important that the Assessment Report, and especially the Executive Summary, be understandable to the general public. The SAB makes specific recommendations about opportunities to define terms, provide illustrations, and clarify ambiguities.

In the enclosed report, the SAB provides a number of specific recommendations to improve the clarity and scientific basis of the EPA's analyses within the EPA's draft Assessment Report, as well as recommendations that the agency may consider longer-term activities to conduct after finalization of the Assessment Report.

The SAB appreciates the opportunity to provide the EPA with advice on this important subject. We look forward to receiving the agency's response.

Sincerely,

/Signed/

Dr. Peter S. Thorne
Chair
Science Advisory Board

/Signed/

Dr. David A. Dzombak
Chair
SAB Hydraulic Fracturing Research Advisory Panel