UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
RESEARCH AND DEVELOPMENT

March 5, 2013

MEMORANDUM

SUBJECT: Request for an SAB Consultation on the *Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources: Progress Report*

FROM: Fred S. Hauchman, Director ***/Signed/***
Office of Science Policy (8104R)

TO: Edward Hanlon, Designated Federal Officer
EPA Science Advisory Board Staff (1400R)

This is to request that the Science Advisory Board (SAB) provide a consultation on the EPA Office of Research and Development's (ORD) *Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources: Progress Report.*[1] The report describes the status of research currently underway to identify whether hydraulic fracturing may impact drinking water resources, and if so, under what conditions.

Background

The EPA began developing the *Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources* (subsequently referred to as the "Study Plan") in 2010 and engaged the SAB twice during its development. In March 2010, the SAB's Environmental Engineering Committee reviewed an initial research scoping document that proposed both potential research questions and research approaches. In their comments to the agency, the Committee endorsed a lifecycle approach for the Study Plan. The Committee recommended that initial research be focused on potential drinking water impacts, case studies be included as part of the study, and stakeholders be engaged throughout the research process.

In February 2011, the EPA released the draft Study Plan, which identified research questions and activities focused on water use in hydraulic fracturing. For the purposes of this study, the hydraulic fracturing water cycle includes five stages: water acquisition, chemical mixing, well injection, flowback and produced water, and wastewater treatment and disposal. The draft Study Plan was reviewed by the SAB's Hydraulic Fracturing Advisory Panel. The SAB panel found the research approach described in the draft Study Plan to be appropriate and comprehensive, and the panel also provided several suggestions for improving the study.[2] Furthermore, the SAB concluded that the EPA had identified the necessary tools in its overall research approach to

[1] http://epa.gov/hfstudy/pdfs/hf-report20121214.pdf
[2] http://yosemite.epa.gov/sab/sabproduct.nsf/0/2BC3CD632FCC0E99852578E2006DF890/$File/EPA-SAB-11-012-unsigned.pdf

assess the potential impacts of hydraulic fracturing on drinking water resources. The EPA revised the draft Study Plan in response to the SAB's feedback and released a final Study Plan in November 2011.[3]

Scientists from the EPA are in the process of carrying out the research activities detailed in the final Study Plan. In December 2012, the EPA released a progress report to describe the current status of the research underway. A draft report that will synthesize results from ongoing research and include a thorough literature review is expected at the end of 2014.

Specific Request

ORD requests that the SAB *ad hoc* Hydraulic Fracturing Advisory Panel provide a consultation from individual expert members of the Hydraulic Fracturing Advisory Panel regarding the *Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources: Progress Report.* The specific Charge Questions are attached. Comments from individual panel members of the SAB *ad hoc* panel will be considered as the EPA works toward releasing its draft synthesis report in late 2014.

Questions regarding this request should be directed to Cindy Roberts at roberts.cindy@epa.gov or (202) 564-1999. We appreciate the efforts of the SAB to prepare for the upcoming consultation on the Progress Report, and we look forward to the discussing these questions with the *ad hoc* panel.

Attachment

[3] http://epa.gov/hfstudy/HF_Study__Plan_110211_FINAL_508.pdf

Charge Questions

The EPA's *Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources* is organized by the five stages of the hydraulic fracturing water cycle. Primary and secondary research questions, developed for each stage, provided a basis for the development of the research projects summarized in the *Progress Report*. Each primary research question is supported by secondary research questions, as described in Chapter 2 of the *Progress Report*. Research projects, described briefly in Table 1 and in more detail in Chapters 3-7, were designed to provide results to help answer one or more of the secondary research questions. Tables 2-6 identify the relationships between the research projects and the applicable secondary research questions. Results from the research projects underway will be synthesized in a report of results that will answer the research questions using the available information. The charge questions below correspond to specific research projects under the five phases of the hydraulic fracturing water cycle.

Water Acquisition

1. *Water Quality.* As described in Section 3.1, the EPA is gathering information on the volumes and sources of water used for hydraulic fracturing (including recycling efforts) and will use this information to review published literature to assess whether these types of water withdrawals may impact local water quality.
    a. **What spatial and temporal scales should be considered for this analysis to best characterize the impacts, if any, on the quality of water used as a source of drinking water?**
    b. **Please identify the most important water quality characteristics that should be considered.**
2. *Water Availability.* Section 4.3 describes research to evaluate the extent to which water withdrawals may affect the short- and long-term availability of water in areas where hydraulic fracturing is conducted. The EPA is modeling two different areas of the country with three different future scenarios to examine how the availability of water resources, the characteristics of oil- and gas-containing formations, the level of hydraulic fracturing well deployment and hydraulic fracturing management activities may impact water availability. The watershed modeling is being conducted in the Susquehanna River Basin in the eastern United States and in the Upper Colorado River Basin in the western United States. **What spatial and temporal scales should be considered for this analysis to best characterize the impacts, if any, on the availability of water used as a source of drinking water?**

Chemical Mixing

The EPA is assessing whether on-site spills and leaks of hydraulic fracturing fluid may impact drinking water resources by examining data found in state spill databases and compiling information on chemicals used in hydraulic fracturing fluids. Appendix A lists approximately 1,000 chemicals reportedly used in hydraulic fracturing fluids between 2005 and 2012.

1. The composition of hydraulic fracturing fluids is dependent on location- and well-specific factors (e.g., well depth and length, geologic properties), which leads to variability in the identity and volumes of chemicals used for hydraulic fracturing. Information on fluid composition is being gathered as part of the service company data

analysis (Section 3.3), well file review (Section 3.4), and FracFocus analysis (Section 3.5). The service company data analysis is expected to provide general information about the types and composition of fluids used by nine companies across the country (see pages 41-42 for a more detailed description of the type of information available). In contrast, both the well file review and the FracFocus analysis are expected to provide well-specific information on chemicals used for hydraulic fracturing (see pages 53 and 60, respectively).

   a. **Given the data sets available, what information on fluid composition, factors affecting composition, and/or trends in composition of hydraulic fracturing fluids[4] may be most useful for identifying potential impacts to drinking water resources across the United States?**
   b. **What key historical changes or current trends, if any, in hydraulic fracturing fluid composition should be considered as the EPA assesses the chemicals listed in Appendix A?**

2. In response to stakeholder suggestions, the EPA is considering whether a subset of the chemicals listed in Appendix A or other hydraulic fracturing-related chemicals could be identified as hydraulic fracturing "indicator" chemicals. In this case, the EPA defines an "indicator chemical" as a chemical already present in hydraulic fracturing fluids or wastewater and not a chemical that is added to track fluid migration. **What criteria should be considered when identifying indicator chemicals, and why?**

Well Injection

Research underway for this water cycle stage is focused on identifying conditions that may be associated with the subsurface migration of gases and fluids to drinking water resources through man-made (e.g., production wells or induced fractures) or natural pathways (e.g., natural faults or fractures).

1. Lawrence Berkeley National Laboratory, in consultation with the EPA, is conducting numerical modeling of six possible subsurface fluid migration scenarios (page 63 and Figures 14-19). The scenarios are modeled after the Marcellus Shale, a deep, low-permeability formation where horizontal drilling and hydraulic fracturing are used to release natural gas. This approach is being used to evaluate mechanisms by which it may be physically possible for upward migration of fluids, including gases, to occur; identify factors (e.g., permeability, formation pressure, injection pressure, etc.) that affect fluid transport; and assess potential impacts on drinking water aquifers in cases of fluid migration. **Given that hydraulic fracturing occurs at different depths and in different types of rock formations, please comment on how to best use results from these simulations to answer the research questions listed in Table 26 (page 62).**
2. For this study, the phrase "well integrity" is used to describe the extent to which an oil and gas production well isolates the wellbore from surrounding geologic strata (and vice versa) and is dependent on well construction and operation practices. The EPA's study is assessing the effectiveness of current well construction practices through the well file review (Section 3.4), subsurface migration modeling studies (Section 4.1) and

[4] For this charge question, the EPA is referring to the overall composition of the hydraulic fracturing fluid and not to changes made to the fluid composition during hydraulic fracturing.

retrospective case studies (Chapter 7). As part of the well file review, the EPA asked oil and gas operators for information on well construction and operation practices, including:

- Daily drilling and completion records describing the day-by-day account and detail of drilling and completion activities
- Mud logs displaying shows of gas or oil, losses of circulation, drilling breaks, gas kicks, mud weights, and chemical additives used
- Caliper, density, resistivity, sonic, spontaneous potential, and gamma logs
- Casing tallies, including the number, grade, and weight of casing joints installed
- Cementing records for each casing string, which are expected to include the type of cement used, cement yield, and wait-on-cement times
- Cement bond logs, including the surface pressure during each logging run, and cement evaluation logs, radioactive tracer logs or temperature logs, if available
- Pressure testing results of installed casing
- Up-to-date wellbore diagram

Section 3.4.4 briefly describes the data set and the types of results the EPA expects to produce from the information described above. The results may then be used to identify construction and operation practices that could lead to impacts on drinking water resources. **Please comment on other ways the information listed above may be used to characterize the effectiveness of well construction and operation practices at protecting drinking water resources.**

Flowback and Produced Water

The EPA is assessing whether on-site spills and leaks of flowback and produced water (collectively referred to as "hydraulic fracturing wastewater") from handling and storage may impact drinking water resources by compiling information on the composition of this wastewater and examining data found in state spill databases.

1. Appendix A lists chemicals detected in flowback and produced water (Tables A-3 and A-4). Sources of this information include reports from the New York State Department of Environmental Conservation and the Marcellus Shale Coalition as well as data found in well files. The composition of hydraulic fracturing wastewater, however, is reported to vary across the United States. **Please identify specific data or literature on the composition of flowback and produced water in other areas of the country.**
2. Spills and leaks of hydraulic fracturing wastewater are being considered as potential sources of drinking water contamination at two retrospective case study locations, in Washington County, Pennsylvania, and Wise County, Texas (Sections 7.5 and 7.6, respectively). Results from these case studies may provide limited information on how spills or leaks may impact drinking water resources. To gain a better understanding of hydraulic fracturing-related spills, spill data are being compiled from selected state and federal databases, including Colorado, New Mexico, Pennsylvania, Texas, Wyoming, and the National Response Center (Section 3.2). These data will be combined with spill information submitted by oil and gas operators (Section 3.4) and hydraulic fracturing service companies (Section 3.3) to create a reference table of hydraulic fracturing-related spills. The reference table will be analyzed for trends in the causes and volumes of hydraulic-fracturing related spills. In most cases, spill information found in the databases does not indicate whether or not reported spills impacted drinking water resources.

Please suggest ways for the EPA to use these or other data to more comprehensively assess how spills or leaks may impact drinking water resources.

Wastewater Treatment and Waste Disposal

In some areas of the country, hydraulic fracturing wastewater may be treated at publicly owned treatment works or centralized waste treatment facilities prior to discharge to surface waters. This provides an opportunity for chemicals in the effluent to be transported downstream to public water supply intakes. To evaluate the potential for chemicals that reach these intakes to impact drinking water quality, the EPA is investigating the efficacy of common wastewater treatment processes at removing selected components of flowback and produced water.

1. Hydraulic fracturing wastewater contains a mixture of chemicals injected as part of the fracturing fluid and chemicals present in the oil and gas producing formation (e.g., hydrocarbons, brines). The complex matrix associated with hydraulic fracturing wastewater often makes identifying and quantifying chemicals difficult. The EPA is currently able to detect and quantify selected anions, cations, and metals in the wastewater and is considering modifying analytical methods for detecting selected organics in the wastewater (Section 5.4). **Please provide recommendations for other specific chemicals that are of interest from a wastewater treatment and/or drinking water treatment perspective.**
2. Treatment, disposal and recycling practices for hydraulic fracturing wastewater are rapidly changing. Oil and gas producers are accelerating efforts to reuse and recycle hydraulic fracturing wastewater in some regions in order to decrease costs associated with procuring fresh water supplies, wastewater transportation, and offsite treatment and disposal. These changes may have implications for wastewater treatment and disposal through publicly owned treatment works or centralized waste treatment facilities that discharged treated wastewater to surface waters. For example, recycling may decrease the volume of wastewater being sent to wastewater treatment facilities, but may also create more concentrated waste streams. **What key trends in wastewater management, if any, may affect the volume and/or composition of hydraulic fracturing wastewater being treated and discharged to surface water?**