

Suggested Topics for Discussion
From Dr. David Dzombak, Chair of EPA Science Advisory Board
(SAB) Hydraulic Fracturing Research Advisory Panel

In Preparation for the Panel's March 7, 2016 Teleconference

U.S. EPA Science Advisory Board
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Suggested Topics for Discussion from Dr. David Dzombak, Chair of EPA Science Advisory Board (SAB) Hydraulic Fracturing Research Advisory Panel, In Preparation for the Panel's March 7, 2016 Teleconference

Purpose: This is a list of topics for discussion from Dr. David Dzombak, Chair of the SAB Hydraulic Fracturing Research Advisory Panel, in preparation for the Panel's March 7 and March 10, 2016 SAB Panel teleconference call. These discussion topics have been compiled, with grouping and some editing for clarification, by David Dzombak from individual Panel member comments associated with the Panel's review of the Panel's February 16, 2016 second draft report entitled *SAB Review of the EPA's draft Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources*. This second draft SAB Panel report has been posted onto the SAB's March 7, 2016 teleconference website at: <http://yosemite.epa.gov/sab/sabproduct.nsf/a84bfee16cc358ad85256ccd006b0b4b/d451dd9ce7752a9285257f17006edb7e!OpenDocument&Date=2016-03-07>

Page and line references noted below refer to the page and line number of the Panel's February 16, 2016 draft report that is available on the above-noted website.

1. Dissenting Opinion from Walt Hufford:

Preamble

In 2009, the U.S. House of Representatives Fiscal Year 2010 Appropriation Conference Committee requested the United States Environmental Protection Agency (EPA or agency) conduct an assessment on the potential impacts to drinking water from the process of hydraulic fracturing. In responding to that request, EPA assigned to the Office of Research and Development (ORD) the task of developing and executing an assessment that not only examined the process of hydraulic fracturing, but also greatly expanded the scope to include the entire life cycle of oil and natural gas development associated with the use, management and protection of water. The ORD held meetings with external stakeholders to gain an understanding of the life cycle processes of exploration and production activities. Subsequently, ORD developed a work plan detailing its proposed investigation of each of the principal areas the agency identified as being relevant to the water life cycle, including: 1) sourcing of water, 2) mixing of water with chemicals/proppant, 3) injection of water/proppant in order to fracture the reservoir, 4) management of the flowback/produced water, and 5) reuse, treatment/discharge and disposal of these waters. Following the development of a draft work plan in 2011, the agency initiated its investigation and has provided updates regarding those efforts.

Early in the process, the EPA designated this effort as a *Highly Influential Scientific Assessment* (HISA). Therefore, it is important that the SAB very carefully consider the wording and structure of our responses to the EPA. Both the draft report issued by the agency in June 2015 and our work in the SAB panel have been scrutinized by external stakeholders. As such, the facts and conclusions in our response to EPA should be based on the body of scientific evidence that has been produced within the agency's draft report and by other external stakeholders who

have continued their work associated with life cycle water use by the oil and natural gas industry. Significant effort has been expended by these external stakeholders (academia, non-governmental organizations, other regulatory agencies and industry) to both identify and mitigate risks dealing with hydraulic fracturing activities. This has included investigations associated with water quality and quantity.

Following the release in June 2015 of the EPA draft report entitled *Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources* the SAB panel was asked to: 1) respond to certain Charge Questions (CQs) that were submitted by the EPA, and 2) provide other feedback associated with the draft report. Responses to these CQs have been developed through “face-to-face” meetings, conference calls, and working group sessions that focused on each CQ. The SAB panel heard from and reviewed comments (both oral and written) from the public as part of our deliberations with over 396 unique comments provided to the SAB. This active participation included a diverse group of individuals representing individual citizens, private property owners, environmental organizations, trade associations and other entities.

This dissent to the SAB draft report focuses on the wording and conclusions of certain sections of our report. As previously stated, it is of utmost importance that our response to EPA be clear and concise to accurately reflect the opinions of the SAB. This opinion provides four main areas of dissent with the draft SAB report and three recommendations. Two of these recommendations support a “major finding” and the third is a recommendation regarding the Pavillion, WY, Parker County, TX and Dimock, PA sites. This dissent is being provided while recognizing and respecting those on the panel who may disagree with the opinions stated herein. Further, this document does not necessarily reflect the views or opinions of Talisman Energy, USA Inc., REPSOL, or any other organization or affiliation and are offered as conclusions resulting from my deliberations. It is in that spirit that these dissenting remarks and recommendations are offered.

Summary:

This dissent to the February 16, 2016 SAB draft report focuses on the wording and conclusions of certain sections of that document. With the designation of the USEPA assessment being classified as a *Highly Influential Scientific Assessment*, the SAB report needs to clearly and concisely reflect the opinions of the SAB. The structure provided by the agency and the SAB team provides an ability for panel members to provide dissenting opinions, which will be used by the Chartered SAB and the EPA in finalization of their final document.

This dissent provides four main issues and three recommendations with the current draft SAB report. These are:

- 1) The conclusion by the EPA in the June 2015 draft Assessment report stating “*We did not find evidence that hydraulic fracturing mechanisms have led to widespread, systemic impacts on drinking water resources in the United States*” is accurate, clear, concise, unambiguous, and supportable with the facts EPA has reviewed.

- 2) A determination by the SAB panel in listing the two prospective case studies that were not completed by the EPA as a “major finding” is not warranted.
- 3) The three proposed “major findings” associated with chemical mixing in the SAB draft report associated with CQ 3 do not rise to the level for such determination based on the subsequent efforts in disclosure and transparency that have transpired since initiation of the EPA assessment.
- 4) The apparent concurrence by the SAB panel regarding the presumed data gaps and uncertainties, as stated repeatedly in the June 2015 EPA draft Assessment Report is not supported. The EPA should discuss the technological challenges in using the various data base systems which states have developed for their unique regulatory requirements. In many cases the database systems are not electronic or in digital format. While these formats pose challenges to evaluate, the limitations of the data is on a technical accessibility issue – not a substantive issue.
- 5) The EPA should provide a comprehensive review of the regulatory processes in place dealing with the HFWC and how these regulations have evolved over the past few years to address the expansion of oil and natural gas operations, the application of hydraulic fracturing in developing this resource, and how best management practices have been implemented.
- 6) The EPA should expand the Assessment Report to educate external stakeholder on private potable well issues including; maintenance, monitoring, interpreting laboratory results, understanding “background” conditions.
- 7) The SAB can recommend EPA provide an update to the ongoing work associated with Pavillion, WY, Parker County, TX, and Dimock, PA, but should not suggest this recommendation as a determination by the SAB that oil and natural gas operations have impacted potable water wells at these sites.

Topic #1 from Walt Hufford: Dissenting Opinion #1: Major Finding of “no widespread, systemic impacts on drinking water resources within the United States”

The first (January 7, 2016) draft of the SAB report provided the following text regarding this conclusion:

The SAB has concerns regarding the clarity and adequacy of the 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 are presented ambiguously within the Executive Summary and are 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 hydraulic fracturing mechanisms have led to widespread, systemic impacts on drinking water resources in the United States. The SAB finds this statement does not clearly describe the system(s) of interest (e.g., groundwater, surface water) nor the definitions of “systemic,” “widespread” or “impacts.” The SAB is concerned that this statement does not reflect the uncertainties and data limitations described in the body of the Report associated with such impacts. The statement is ambiguous and requires clarification and additional explanation.

The SAB recommends that the EPA revise the major statements of findings in the Executive Summary and elsewhere in the draft Assessment Report to be more precise, and to clearly link these statements to evidence provided in the body of the draft Assessment Report.

The second (February 16, 2016) draft of the SAB report provides the following text regarding this conclusion (See cover letter, p. 2, lines 13 through 21):

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 there mechanisms have led to widespread, systemic impacts on drinking water resources in the United States”. The SAB finds that this statement does not clearly describe the system(s) of interest (e.g., groundwater, surface water) nor the definitions of “systemic,” “widespread”. The SAB agrees that the statement has been interpreted by member of the public in many different ways and concludes that the statement requires clarification and additional explanation.”

The statement by the EPA in the draft Assessment Report issued in June, 2015 is clear, unambiguous, concise, and does not need to be changed or modified. The statement provides a “holistic” conclusion of the life cycle process of water used by the industry. While the report could have articulated the agency’s statistical assessment more clearly, there has not been any facts or evidence demonstrating a systemic or widespread impact to existing drinking water resources or other water resources that may not meet the current criteria of a drinking water

resource. If a systemic or widespread issue had been identified, the EPA and the state regulatory agencies would have quickly responded to such findings. In the absence of such documented events, the conclusion is clear that no systemic, widespread impact to drinking water resources is occurring. To suggest otherwise, undercuts the work and dedication by the employees of those federal and state agencies who are charged with environmental protection. The draft EPA reports estimates approximately 30,000 wells are drilled each year in the United States. Only a very small percentage of those wells have had an operational issue that may have impacted drinking water resources. Even among this small percentage, the identified impacts to drinking water resources have primarily been associated with surface spills, well construction, and well cementing – not hydraulic fracturing.

The SAB panel is correct in highlighting that localized impacts should not be discounted nor marginalized. Moreover, the SAB correctly identified that an aspect of the draft Assessment Report dealing with the actual “impact” of a spill requires further clarification. A casual reader of the draft report is left to question if impacts from all spills or releases are *permanent* or *temporary*. The agency should expand the discussion around the actual timing of “impacts” to the local environment. In many cases, including the ones referenced within the report, it is clear there is no long term demonstrated impact associated with a release. The major conclusion by EPA in their June 2015 draft Assessment Report stating “*no widespread, systemic impacts on drinking water resources in the United States*” is accurate, unambiguous, and supportable with the facts EPA has reviewed.

Topic #2 from Walt Hufford: Dissenting Opinion #2: Major Finding associated with prospective case studies

In the 2011 draft work plan the agency contemplated a series of case studies. These studies would provide “in-field” assessments of locations “pre” and “post” hydraulic fracturing (used holistically) operations. Five locations were selected on sites where an observation of an alleged impact was considered attributable to hydraulic fracturing activities. These were referenced as “retrospective” sites. Two additional locations were proposed, referred to as “prospective” sites. EPA contemplated installing a number of observation wells and other monitoring equipment prior to the initiation of drilling or fracturing at these locations. The goal of the prospective studies was to evaluate groundwater conditions prior to, during, and post drilling/fracturing to determine if any changes in water conditions could be observed.

The Executive Summary (p.2, lines 13 through 18) of the February 16, 2016 draft SAB report states:

The SAB is also concerned that the EPA had planned to but did not conduct various assessment, field studies, and other research, and the SAB recommends that the EPA delineate these planned activities within the draft Assessment Report and discuss why they were not conducted. The SAB concludes that the lack of prospective case studies as originally planned by the EPA and described in the research Study Plan (U.S EPA, 2011) is a major limitation of the draft Assessment Report”.

This dissent specifically counters the statement that the lack of the prospective case studies is a major limitation of the draft Assessment Report. When the agency contemplated doing this work EPA recognized the complex legal interaction that would be required to develop a work plan, interact with an oil and natural gas operator, including the property and mineral owners who had pre-existing contractual agreements in place who also needed to participate in and approve this work, execute the plan and report on the conclusions of those assessments. After considerable efforts by both the agency and the industry, the EPA made a specific decision to not complete the prospective studies. Here are two links that provide some details of those efforts and context around the complexities associated with conducting these studies:

<https://foiaonline.regulations.gov/foia/action/public/view/request?objectId=090004d2802dadeb>

It is reasonable to assume that had these case studies concluded that “no-impact” was observed, one group of stakeholders would have highlighted those results while the other group would express that two sites would not be enough information to draw those conclusions. Of course, the opposite is true if the agency reported they did observe an impact.

Extensive work has been ongoing for years by stakeholders in academia, regulatory agencies, industry and other experts to determine the condition of groundwater and whether oil and natural gas activities have caused an impact to this resource. There are numerous reports from these groups documenting the lack of widespread, systemic impacts on water resources by the oil and natural gas industry. To suggest that the agency did not execute the two prospective case studies as a major finding implies that the results of the extensive scientifically defensible (i.e. peer reviewed) studies completed by others is not adequate or accurate. The implication from the

SAB's draft report characterizing this is a major finding and deficiency advances a position that the agency's work and subsequent conclusions are therefore "qualified" by not implementing these two prospective studies.

When all of the data is considered, it is clear the prospective cases studies would have contributed to the body of evidence regarding the potential impacts to drinking water resources associated with the HFWC, however this component of the EPA work study was addressed by other investigations conducted independently from the EPA assessment. Consequently, a designation by the SAB panel in listing the two prospective case studies as a "major finding" is not warranted.

Topic #3 from Walt Hufford: Dissenting Opinion #3: Major Finding associated with Chemical Mixing Stage in the HFWC (Charge Question 3)

The Executive Summary (p.11, lines 6 through 14) of the February 16, 2016 draft SAB response states:

There are three major findings that the EPA should present in this chapter of the draft Assessment Report:

- (1) There is significant uncertainty regarding which hydraulic fracturing chemicals are currently in use.*
- (2) There is significant uncertainty regarding the identity of chemicals used in particular hydraulic fracturing operations, and this uncertainty is compounded by limited knowledge about on site storage of hydraulic fracturing chemical(s)*
- (3) There is significant uncertainty regarding the frequency, severity, and type of hydraulic fracturing-related spills and their associated impacts.*

It is appropriate for the SAB draft report to note that the EPA used “dated” information from FracFocus. This section provides a dissent from the recommendation in the February 16, 2016 draft SAB report that the three items listed above rise to the level of a “major” finding.

The industry has made significant progress in transparency associated with the products used during the hydraulic fracturing process. For years, industry worked with both legislative members and regulatory authorities in advancing a disclosure platform that is now a regulatory requirement used in 20 states, and is referenced by other states as an acceptable disclosure data system. Approximately 90% of the constituents used in the hydraulic fracturing process are itemized in the FracFocus data system. In many cases the other constituents not detailed in the FracFocus data system can be assessed, under certain circumstances and guidelines, which respect both the service company’s confidentiality while protecting human health and the environment. It is important to distinguish here between public access to information and regulatory access. FracFocus is designed to present information on fracturing fluids in an easily accessible public format and significant improvements to the database has been made providing increased functionality of that system. The FracFocus dataset should not be confused with the authority of the regulatory agencies to require more detailed information, including proprietary information, for regulatory use. While confidentiality limits on the agencies may limit their authority to disclose certain information, it is clear the agencies can obtain the information when necessary. The SAB panel has commented on the dynamic nature of the industry and the challenges EPA faced in finalizing a five year long assessment that would report on “dated” information that may be years old, as illustrated with the FracFocus analysis. The SAB is correct in requesting the EPA update their review and discussion of FracFocus which should include the additional information provided to the docket.

Regarding the on-site storage of hydraulic fracturing chemicals, it is important to know that these materials are staged for a very brief period of time (during the rigging up and injection process) and are normally on site for less than 14 days for a well to be hydraulically fractured. The number of days these chemicals are on site is dependent on the number of wells that will be

fractured, the depth of the well, and the number of stages being fractured. Moreover, spill containment is provided for these materials while they are on site. Spill containment consists of mats, pads and other materials specifically designed to contain the material in the event a release occurs. The goal of spill containment is to mitigate the potential for any material from contacted soil, or water. Regulations are in place to provide regulatory agencies and emergency responders with documentation detailing the chemicals that are stored on site.

Regarding spills and associated impacts, the June 2015 EPA draft Assessment Report should be revised to discuss more details related to spills. While infrequent, most spills are actually contained in the well pad's "containment". These spills are reported to the regulatory agencies who will respond appropriately based on the severity of the spill event. These spills have no environmental impacts to soil or waters as the material is contained within the containment barrier. In cases where spills are "off containment" the state regulatory agencies work with the oil and natural gas operator to determine the extent of the impact and subsequent requirements associated with monitoring and/or remediation. Each "off – containment" spill is unique as the impact to the environment is dependent on the amount of material spilled, the type of material, the response time to initiate remedial actions, weather conditions, geology, hydrogeology, soil types, topography, and media impact (soils, groundwater, surface water).

Consequently, the three "major findings" in the Chemical mixing section of the February 16, 2016 SAB draft report are not accurate and do not rise to the level of a major finding.

Topic #4 from Walt Hufford: Dissenting Opinion #4: Data limitations and uncertainties

Both the January 7, 2016 and February 16, 2016 draft SAB response (See cover letter, p. 2, lines 25 through 27 of the 2/16/16 draft SAB Panel Report) states:

[T]he SAB also recommends that the EPA discuss the significant data limitations and uncertainties, as documented in the body of the draft Assessment Report...

As it relates to water, the February 16, 2016 draft SAB response (See Executive Summary, p. 4, lines 29 through 30) states:

[T]he SAB agrees there are important gaps and uncertainties in publically available data on sources and quantities of water used in hydraulic fracturing.

There is significant data generated and submitted to the various regulatory agencies which have jurisdictional authority over the Hydraulic Fracturing Water Cycle (HFWC) activities. In many cases, these submittals are not electronic in nature, have voluminous attachments (maps, diagrams, laboratory data, engineering data), and are warehoused in the regulatory agency's data rooms. The June 2015 draft EPA report consistently referenced the lack of available data and communicated a sense of uncertainty in their conclusions based on that observation. Factually, the data exist and are available for review. The EPA may have found the datasets problematic (from a user point of view), given that many regulatory programs are not digitized or electronic in nature and cannot accept electronic submittals. Each state has different regulatory reporting requirements which are unique to and meets the needs of those states. Moreover, some regions in a state may have slightly different reporting expectations. The fact that the EPA found these databases problematic should not be relied on in formulating limitations and uncertainties. The agency had ample time to work with the regulatory agencies to evaluate the information in the database systems (electronic or paper) in reaching their conclusions. Further, the public has access to a majority of those database systems. Under the Freedom of Information Act (FOIA) the public can request to review any publically held submittal to the regulatory agency. While some files may not be available for public review for legal reasons (i.e. enforcement actions, litigation, confidential business information), the amount of information available associated with HFWC is extensive. Any suggestion that data is generally unavailable or insufficient leads to misconceptions that the data does not exist.

It is appropriate for the SAB to request that EPA revise its June 2015 draft Assessment Report to provide recommendations on how the various regulatory agencies could improve the database management systems which would allow for greater transparency and use by external stakeholders. Further, several states have already, or are in the process of, updating their data base systems to provide for electronic submittals. These improvements should be highlighted by the agency as a systematic improvement by the states in efficient execution of their regulations and in providing enhanced data availability to external stakeholders.

The SAB should consider the following revision regarding data limitations and uncertainties:

“The SAB notes EPA’s reference to gaps and uncertainties in publically available data which was used in developing the conclusions of the June 2015 draft Assessment Report. The SAB recommends the EPA provide clarifications regarding the different data bases, and make recommendation on how these data bases could be improved to provide for greater efficiency and transparency to external stakeholders”.

Topic #5 from Walt Hufford: Recommendation #1 regarding Proposed Major Finding – Need for discussion of regulatory agencies role in the HFWC process

Regulations provide an important structural framework in which the oil and natural gas industry operates. The various regulatory agencies and the requirements codified by those agencies provide controls, reporting requirement and enforcement actions to insure the industry is meeting the required expectations for developing these resources. Regulations cover the entire HFWC of the industry and normally involve multiple agencies including Federal, State and local authorities, as appropriate. Early in the development of the 2011 draft work plan by ORD, stakeholders met with the EPA in an effort to encourage the agency's inclusion in their report a discussion on the regulatory frameworks in place for oil and natural gas development. These requests to ORD were rejected as the agency elected to focus on the scientific data.

Consequently, the draft EPA report provides the casual reader with numerous potential possibilities in which a release/spill could impact drinking water resources but provides no substantive information on what regulatory framework exists to minimize these potential impacts. Stakeholders who do not work within the industry or regulatory communities are left with significant questions on what regulatory requirements are in place, the role of various agencies (Federal, State and Local levels), and how the regulatory requirements have changed over the past several years associated with HFWC activities.

Given the HISA determination of the EPA report being identified as a “highly influential” document, it remains appropriate that the EPA revise the draft report to educate stakeholders about the regulatory processes in place and how these regulatory agencies have responded to the increased oil and natural gas activity. Significant regulatory changes have occurred since 2010 which address the entire life cycle of water used by the oil and natural gas industry. The SAB has recognized the importance of discussing regulations in the latest version (Feb. 16, 2016) of its draft report. The EPA should provide a comprehensive discussion and explanation of the regulatory regimes including the work by organizations such as the Interstate Oil and Gas Compact Commission, State Review of Oil, Natural Gas, and Environmental Regulations (STRONGER) and the Groundwater Protection Council (GWPC).

Topic #6 from Walt Hufford: Recommendation #2 regarding Proposed Major Finding – EPA needs to discuss potable water well construction, maintenance and education of water well results to the public

The February 16, 2016 draft SAB response (See cover letter, p. 1, lines 39 through 41) states that the SAB agreed 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.” It is recommended that the SAB provide a major finding that the agency include a comprehensive discussion associated with private potable water wells in the EPA report. The SAB heard from numerous individuals during the public participation process regarding private wells. Several of these individuals commented they did not understand the laboratory results of their water samples nor how those constituents (metals, organics, inorganics, and gases) could be in their water supply. Many expressed concerns about using their water, even if laboratory analytical results indicated that the water met primary drinking water standards.

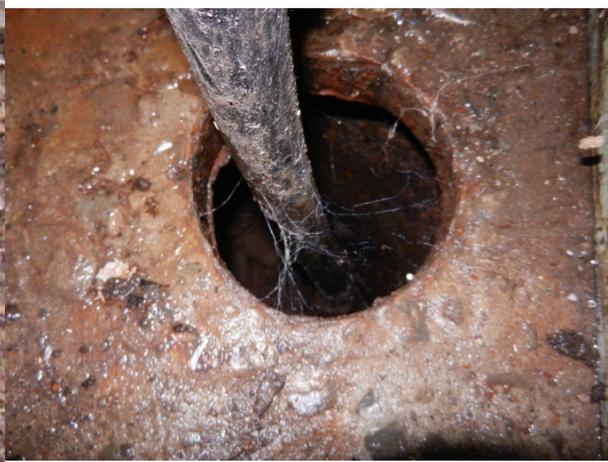
The February 16, 2016 SAB draft response document (See cover letter, p. 4, line 47, and p. 5, lines 1 through 6) states:

A major public concern is the appearance of contaminated or degraded drinking water wells in areas where hydraulic fracturing occurs. Since naturally occurring contaminates and degraded 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 is used in order to better understand the impacts of hydraulic fracturing-related spills and leaks. The scientific complexity of baseline sampling and data interpretation should be described.

Each of the cases repeatedly raised to the SAB by the public associated with Pavillion, WY, Dimock, PA, and Parker County, TX involve private water wells within their respective investigations. Given the HISA designation of the EPA Assessment Report and the public’s interest in understanding how private potable wells may be impacted by oil or natural gas operations or by other means, it seems reasonable that the agency would focus on this exposure route.

From one perspective, conducting “pre-drill” sampling by the oil and natural gas industry of potable wells prior to drilling for oil and natural gas has benefited property owners, the regulatory communities, academia, and industry. The volume of data collected from shallow ground water has never been so extensive than the sampling conducted over the past five years by the industry. More importantly, the pre-drill sampling effort has provided “first-hand” opportunities to observe how individuals source water in some of the regions where oil and natural gas operations are active. Included below are photographs of unsafe private water wells and other sources of water (i.e. springs, hand dug pits) where individuals source water for their residences. All of these locations were near oil and natural gas operations. In limited cases, some individuals are storing chemicals or processing wildlife immediately adjacent to their open water supply.

3/2/16 Suggested Topics for Discussion for the March 7, 2016 Panel Teleconference, from Dr. David Dzombak,
Chair of SAB Hydraulic Fracturing Research Advisory Panel





While some water wells have experienced issues associated with oil and natural gas activities, specifically involving “stray gas migration”, most property owners do not understand the importance of potable water well construction, maintenance, and monitoring. In many cases, oil and natural gas operators respond to inquiries from private water well owners who have questions associated with their potable wells having no nexus with the HFWC.

Our role within the SAB is to evaluate the facts and conclusions of the EPA effort in evaluating the potential impacts to drinking water from oil and natural gas operations. We can concur with the results provided by the agency, disagree with the facts or conclusions, and recommend areas where additional efforts should be made in order to protect human health and the environment. A tangential benefit of the work conducted by the agency should conclude that potable well construction is an important part in the overall protection of drinking water resources. While the

draft June 2015 EPA draft Assessment Report focused on the HFWC, potable water wells continued to be a focal point of exposure as evidence by the public participation. The EPA could significantly advance education of the public, policy makers and thought leaders on the importance of proper potable water well construction, siting and maintenance as a compliment to the work completed in the June 2015 draft Assessment Report.

An example of what could be provided is in the link below. This work by Dr. Joe Bowden, Michael Matheson (CDS Environmental Services, LLC) and Anza Environmental (graphics and design) provides an excellent resource that can be easily understood by the public.

<http://epa.ohio.gov/Portals/0/general%20pdfs/HowWellDoYouKnowYourWaterWell.pdf>

Topic #7 from Walt Hufford: Recommendation #3 regarding Comments associated with investigations in Pavillion, WY, Parker County, TX and Dimock, PA

Page 13, lines 27 through 35, of the February 16, 2015 draft SAB report states:

The SAB also recommends that the Agency include and explain the status, data on potential releases, and findings if available, for the EPA and state investigations conducted in Dimock, Pennsylvania, Pavillion, Wyoming, and Parker County, Texas, where hydraulic fracturing activities are perceived by many members of the public to have caused impacts to drinking water resources. Examination of these high-visibility, well known cases is important so the public can more fully understand the status of investigations in the 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.

The SAB heard testimony from several different property owners associated with the three sites reference above. The SAB was not asked, and has not reviewed, the details associated with these three sites where voluminous information has been generated. Moreover, these sites are involved in active litigation. As such, the SAB should exercise caution in the drafting of our response document back to EPA relating to these three sites to be clear that we do not suggest or imply that the HFWC activities in those areas caused or contributed to observed/perceived conditions present in a litigant's water well. It is further suggested that any reference to these sites be part of a "general" comment instead of being included within a section of the report (i.e. well injection stage in the HFWC) which would imply the SAB considers this section as relevant to these three cases. Further, while there may be scientific reasons in which the EPA could engage in these locations, each state has jurisdictional authority and is currently actively involved with these cases.

2. Comment on widespread, systemic impacts

- A) A few Panel members noted the following concerns regarding the following sentences in the cover letter, Page 2, lines 15 through 21 of the 2/16/16 draft Panel 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 this statement does not clearly describe the system(s) of interest (e.g., groundwater, surface water) nor the definitions of “systemic” and “widespread”. The SAB agrees that the statement has been interpreted by members of the public in many different ways, and concludes that the statement requires clarification and additional explanation.”*
- 1) “I support the EPA’s draft Assessment Report's conclusion that there is no systemic or widespread risk to drinking water from hydraulic fracturing. If the Panel feels they need clarification on widespread of systemic, I suggest we use Webster's dictionary definitions. I feel strongly that the committee saw localized impacts that stem from poor well construction or poor construction coupled with localized geological conditions. There was no evidence to support hundreds or thousands of contamination problems, nor patterns of problems within a single area, which is what one would have expected to find if there were widespread or systemic problems related to hydraulic fracturing.”
 - 2) A Panel member suggested adding the following redline to the last sentence of the above italicized text: *“The SAB agrees that the statement has been interpreted by members of the public in many different ways, and concludes that the statement requires clarification and additional explanation **to put the three well-known public issue areas (i.e., Dimock, Pavillion and Parker County) into perspective to the total number of U.S. hydraulically fractured wells.”***
- B) Page 42, lines 28 through 37, of the 2/16/16 draft Panel report, notes the following: *“The EPA should summarize efforts made to review spill files from the states on each of these cases to determine what “post remedial sampling” was conducted. At the same time, the EPA cites Gross et al. (2013), which examined the Colorado Oil and Gas Conservation Commission (COGCC) spill database for a year’s time in 2010-2011. Gross et al. (2013; reference [4]) noted below under the ‘additional types of data sources to consider’ section of this response to charge question 3) write in the abstract: ‘We analyzed publically available data reported by operators to the COGCC regarding surface spills that impacted groundwater. From July 2010 to July 2011, we noted 77 reported surface spills impacting the groundwater in Weld County, which resulted in surface spills associated with less than 0.5% of the active wells.’”*
- A Panel member noted the following regarding the above sentences:
“This would appear to be a classic example of a lack of precision in wording and conclusions that got pushed up the line. Many would say that 77 cases of groundwater contamination in one county over one year is some evidence of a widespread, systemic problem, contrary to the well-noted conclusions of EPA.”

3. Use of the term “impact” in the EPA’s draft Assessment Report, and in the SAB’s draft Advisory Report:

A Panel member noted the following concerns regarding this topic:

“The EPA’s draft Assessment Report and the SAB’s draft Advisory Report both use the word “impact” with apparently different meanings in different locations. Further, the use does not appear in line with the definition in the glossary in the EPA’s draft Assessment Report. As an example, in the summary statement wherein “widespread, systemic impacts” is referenced, it is not clear that EPA intended this use of “impact” to mean as defined in the glossary “Any observed change in quality or quantity of drinking water resources, regardless of severity....”. In SAB panel report impact appears in several places to connote a significant adverse effect, rather than “any” effect.”

4. General Comment regarding changes to the draft Assessment Report:

A few Panel members noted some concern about how the draft SAB report presented recommended changes to the draft Assessment Report.

One Panel member noted the following:

“In places (e.g., p. 55) we are recommending “changes to the draft Assessment Report.” Since the **draft** report has already been completed and we aren’t recommending that EPA produce a second draft, this wording seems a little awkward in some places. Perhaps we should reword some of these to indicate that the **final** Assessment Report should include more discussion, additional analysis, etc.”

Another Panel member noted the following:

In several places (e.g. page 26, lines 6, 17, 22, 23, and 41) we refer EPA's "draft Assessment Report," whereas in other places (see line 29) we refer to the "Assessment Report" without using "draft" as a qualifying adjective. Need we be consistent with this? In several places the term "the agency" is used, whereas in other places "the Agency" is used. Should we be consistent and should we use the capitalized form, "Agency"?

5. General Comment regarding recommendation for EPA Office of Research and Development to conduct a field visit to a hydraulic fracturing site:

A Panel member noted the following:

“I would like to suggest that the ORD representatives and/or any contractor involved in rewriting this document visit a field during a fracturing job. I don't feel it is necessary for the Panel/committee to do this, but strongly feel that the recipient of all our comments needs a proper understanding of what goes on in the field. For example, you use the word 'containment'. Without a picture or,ever having seen site containment, I wonder how this will all turn out in the revised draft, even if the committee adopts that

comment. Pictures would add so much for the public, particularly since this is such a high impact study.

There are so many points in the document where best practices should have been included and explained. Perhaps the easiest way to convey that now would simply be to educate those who are re-writing the document.”

6. SAB advice on what the EPA should include in its final Assessment Report, vs. SAB advice for the EPA to conduct in future activities:

A Panel member noted the following:

“In some places e.g., p. 4 of the Executive Summary, referring to longer-term activities, we say “EPA ... may”. I am concerned that this or similar wording could be misconstrued, such that some readers might think we are implying that we are granting EPA permission to consider a given recommendation for the longer term. That is clearly not our intent, so we might want to revise the wording in those places where such an interpretation is grammatically possible. Perhaps we can say things like “EPA may wish to consider these recommendations as recommendations for the longer-term,” or “The SAB considers these as recommendations for the longer term.”

Another Panel member noted the following concerns regarding this topic:

“a. It is unclear whether a subsequent report will be produced by the EPA that will contain the critical recommended information, after the EPA finalizes its draft Assessment Report. Absent that, there could be potential misinforming views on many topics considered as needing important revisions available for substantial periods until such a new evaluation and report is undertaken.

b. It would be helpful to reach agreement that all of the future recommended activities are warranted given the time separation from finalizing the EPA Draft and the undertaking of new activities and a new report to address the recommendations.

c. There are some confusing and conflicting recommended time frames for activities that SAB recommends to be conducted. As one of several examples we propose the “EPA should describe best practices” as a future activity, whereas else were we indicate existing best practices be described to finalize the draft document to help guide the public and policy makers in decision making.”

7. Specific comment regarding longer-term future activity:

Page 33, lines 32 through 38 note the following: “*Second, the EPA should consider further exploring and describing how water acquisition and associated potential impacts on lowered streamflow and water table experiencing regional water-level decline could affect the quality of drinking water, and assess whether such impacts would be short-term (e.g., a few days)- or long-term (e.g., weeks or months). For example, if streamflow is reduced, the draft Assessment Report should describe what might be the effects on chloride or total dissolved solids in streamflow, and*

how this might affect water supply and treatment costs. The recommendations in this paragraph may be considered longer-term future activity.”

Regarding the last sentence of the above paragraph, a Panel member had two separate comments:

“It would not take much time or effort for EPA to better address this topic in the Assessment Report. Can we say: “This issue should be addressed in greater detail in the Assessment Report, but to avoid undue delay in publishing the Assessment Report, the SAB recommends that EPA conduct a more thorough study of this issue, including a detailed economic analysis, as a long-term future activity.”

“I’m troubled by use of the word “may” here and elsewhere, as it might be interpreted to imply that we are giving EPA permission, which I am confident is not our intent. Can we say “To expedite completion of the Assessment Report EPA may wish to consider the recommendations in this paragraph as recommendations for longer-term future activity.”?”

8. Best management practices:

In the cover letter, Page 4, lines 38 through 43, and in the Executive Summary Page 6, lines 12 through 26, note the following:

“Best Management Practices: The SAB recommends that the agency describe best management practices used by industry regarding operations associated with each stage of the HFWC, in order to better inform the public on available processes, methods and technologies that can minimize hydraulic fracturing potential impacts to drinking water resources. The EPA should also discuss state standards and regulations implemented with the aim of improving hydraulic fracturing operations, and the evolution of oilfield and state regulatory practices that are relevant to HFWC activities.”

A Panel member suggested adding an additional sentence after the last sentence of the above paragraph:

“Perhaps we should say, here or earlier in this para.: ‘Although EPA’s report is not intended as a guide to best management practices, management practices significantly affect potential impacts on water quantity and quality, and as noted earlier management practices are rapidly evolving.’”

9. Background and pre-existing baseline chemistry:

In the cover letter, Page 4, lines 45 through 47, and Page 5, lines 1 through 6, note the following:

“Baseline Water Quality Data: The EPA should also include additional discussion on background and pre-existing baseline chemistry of surface and groundwater in order to better understand the impacts of hydraulic fracturing-related spills and leaks. A major public concern is the appearance of contaminated or degraded drinking water wells in

areas where hydraulic fracturing occurs. Since naturally occurring contaminants and degraded 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 is used in order to better understand the impacts of hydraulic fracturing-related spills and leaks. The scientific complexity of baseline sampling and data interpretation should be described.”

Page 16, lines 21 through 23, note the following: *“The draft Assessment Report should also include additional discussion on background and pre-existing baseline chemistry of surface and groundwater in order to better understand the impacts associated with flowback and produced water.”*

A Panel member noted the following concerns regarding this topic:

“If there are insufficient case histories for these discussions, it should be noted or recommended that additional studies should be performed.”

Another Panel member noted the following concerns regarding this topic:

“I think the wording and clarity of this paragraph can be significantly improved. I suggest the following alternate wording to this paragraph on page 4 of the cover letter and to the paragraph on p. 16:

Baseline Water Quality Data: The EPA should also include additional discussion of baseline sampling as a tool for assessing the impacts of hydraulic fracturing on surface and groundwater quality, which is a major public concern in areas where hydraulic fracturing occurs. The scientific complexity of baseline sampling and data interpretation should be clearly and thoroughly described. Although baseline sampling is simple in concept, it can be very difficult to obtain meaningful results in practice. Concentrations of naturally occurring contaminants, including methane, aromatic hydrocarbons, radionuclides, and disinfection by-product precursors, can vary significantly, both temporally and spatially, especially in surface water and in groundwater drawn from shallow and/or alluvial wells. Water quality can be significantly influenced by hydrological events (rainfall, flooding, drought), by water acquisition for purposes other than hydraulic fracturing, and by spills or discharges or chemicals not associated with hydraulic fracturing. Obtaining representative samples, characterizing natural variations in water quality, properly collecting (and preserving and storing) samples for the analytes of interest, accurately determining the concentrations of the analytes of interest, and correctly interpreting the data can be challenging tasks.”

10. Data limitations:

In the Executive Summary, Page 4, lines 41 through 44 note the following: *“Throughout the draft Assessment Report, within discussions for each stage of the HFWC, the EPA notes that there are data limitations that prevented the EPA from doing analyses that the EPA desired to*

conduct. Within these discussions, the EPA should outline the level of data that the EPA would desire in order for it to conduct an appropriate assessment of that topic area.”

A Panel member noted the following concerns regarding this topic:

“We should be more specific. This could be said about most of the report, but since we are bringing up under the topic of chemicals of concern, we ought to explicitly state what sort of data limitations we are talking about, e.g., the identity of the chemicals, their physical chemical properties, their toxicity, routes of exposure, some or all of the above, or?”

11. Comment regarding advice on non-drinking sources of water:

In the Executive Summary, under the ‘Data Needs Regarding Chemicals of Concern’ discussion, Page 4, lines 46 through 47 note the following:

“Third, the EPA draft Assessment Report should expand on the discussion of the evolution and utilization of technologies that are being used to facilitate reuse of produced water or other non-drinking sources of water.”

Page 33, lines 40 through 47, and page 34, lines 1 through 2, note the following:

“Third, the reuses of wastewater and produced formation water are described in the draft Assessment Report, and the EPA should expand on the discussion of the evolution and utilization of technologies that are being used to facilitate reuse of produced water or other non-drinking sources of water. While most geographic areas show a very low percentage of reuse as a source of water for hydraulic fracturing, the reuse percentages in some regions can be high. The EPA should consider exploring and describing within the draft Assessment Report how and why the Garfield County region in Colorado (Piceance Basin) is able to use 100% wastewater for hydraulic fracturing (as indicated in Table 4-1 of the draft Assessment Report). This situation may be due to a combination of the wastewater quality in this area, that the area has been unitized (with all operators sharing infrastructure to produce the fields), and that the area is mature (having been one of the early areas of unconventional oil and gas development).”

A Panel member noted the following concerns regarding this topic:

“Consider deleting the last clause of the above sentence: ‘or other non-drinking sources of water.’? Why are other non-drinking sources of water relevant to EPA’s report, which focuses on impacts on drinking water? Or, if simply a parenthetical comments indicating that similar technologies are being used for other purposes, better to say “... produced water (and other sources of water, such as seawater, brackish water, and wastewater, that have historically been underutilized as sources of water supply). Or, if intended to also suggest substitution of alternate sources of supply, better to say “... use and reuse of produced water and use of other historically underutilized sources of water (e.g., seawater, brackish water, and wastewater) that if used for hydraulic fracturing (or other purposes) could reduce the impacts of water acquisition on drinking water sources.”

Regarding the above sentences, a Panel member suggested rewriting the above sentences as follows:

“Third, reuse of wastewater and produced formation water are described in the draft Assessment Report, and the EPA should expand on the discussion of the evolution and utilization of technologies being used to facilitate reuse of produced water **and use of other historically underutilized sources of water (e.g., seawater, brackish water, and wastewater) that if used for hydraulic fracturing (or other purposes) could reduce the impacts of water acquisition on drinking water sources.** While most geographic areas show a very low percentage of reuse as a source of water for hydraulic fracturing, the reuse percentages in some regions can be high. The EPA should consider exploring and describing within the draft Assessment Report how and why the Garfield County region in Colorado (Piceance Basin) is able to use 100% wastewater for hydraulic fracturing (as indicated in Table 4-1 of the draft Assessment Report). This situation may be due to a combination of **a dry climate**, the wastewater **quantity and** quality in this area, that the area has been unitized (with all operators sharing infrastructure to produce the fields), and that the area is mature (having been one of the early areas of unconventional oil and gas development).”

12. Stresses to Water Resources:

In the Executive Summary, page 9, lines 5 through 6 (also on page 31, lines 28 through 29, and page 32, lines 28 through 29), note the following: “*Stresses to surface or groundwater resources associated with water acquisition and hydraulic fracturing are localized and temporary in time.*”

A Panel member suggested adding the following clause to the end of the sentence: “but can be important and significant notwithstanding.”

13. Regulatory framework surrounding water withdrawals:

In the Executive Summary, page 9, lines 8 through 15 note the following:

“The SAB finds that water withdrawals for hydraulic fracturing can contribute significantly to groundwater depletion, particularly in arid environments. Further, the SAB concurs with the EPA’s findings that water withdrawals for hydraulic fracturing are capable of altering the flow regimes of streams, even in regions of rainfall abundance, and 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. While the SAB concurs with these findings, the agency should include additional clarifications in the draft Assessment Report on the regulatory frameworks in which the HFWC activities are managed that aim to minimize the potential for these negative impacts.”

A Panel member noted the following concerns regarding the last sentence of the above paragraph:

“We should say “regulatory, management, and market (or economic) frameworks”.
Water is a managed commodity, and its availability and use depend on more than just regulations.”

14. Water Use database:

In the Executive Summary, Page 10, lines 8 through 10 note the following: “The Panel finds that EPA could improve its use of publicly available databases, including the FracFocus Chemical Disclosure Registry database and the Water Use in the United States database.”

A Panel member noted the following concerns regarding this topic:

“What does this have to do with Chemicals of Concern? Shouldn’t this point be brought up in the context of water acquisition?”

15. Whether current version of FracFocus can provide additional insight into CBI HF chemicals

A Panel member noted the following concerns regarding the following sentence in the Executive Summary on Page 5, lines 17 through 19 of the 2/16/16 draft Panel report: *“In addition, the agency should note that the current version of FracFocus also provides some additional insights into the CBI associated with chemicals used during HF operations.”*

“What type of insight can be gained about CBI from FracFocus? The chemicals are not identified.”

16. Recent seismic event in Oklahoma

A Panel member noted the following concerns regarding the following sentences in the Executive Summary on Page 13, lines 31 through 36 of the 2/16/16 draft Panel report: *“The draft Assessment Report should include some discussion about the ongoing work associated with induced seismicity in HFWC activities and potential impacts on drinking water resources associated with hydraulic fracturing activity. Induced seismicity from well injection for hydraulic fracturing should be distinguished from induced seismicity associated with hydraulic fracturing wastewater disposal via Class II deep well injection. Detailed discussion of induced seismicity from wastewater disposal should be reserved for Chapter 8 which is focused on wastewater treatment and disposal.”*

“The other point I would like to make is related to the most recent seismic event in Oklahoma. If we are going to include comments related to this,, we should also note that the State of Oklahoma restricted saline water injection by 40%, the Tuesday after the

event, which was a 2-day business response time. I think this really underscores how effective the States are in addressing issues.”

17. Use of tracers in hydraulic fracturing:

Page 15, lines 43 through 47, and Page 16, lines 1 and 2, note the following: *“The EPA should significantly expand and clarify the discussion provided in Chapter 7 on the use by industry of tracers for injection fluids, as well as the efforts made by the EPA to develop tracers, and describe how tracers might be an approach that could allow assessment of releases of contamination and interpretation of the source of contamination if it occurs. The agency should summarize what compounds or metals are used currently for chemical and radioactive tracers, the degree to which tracers are used, where tracers are used, what concentrations are in use, and what concentrations are measured for these tracers in the flowback or produced waters.”*

A Panel member noted the following concerns regarding this topic:

“I would like to discuss the need for further expansion on the use of tracers in hydraulic fracturing. Their use is very minimal in hydraulic fracturing and therefore consideration of this topic in the draft Assessment Report does not warrant expansion.”

18. Vertical distance between water bodies and target zones:

Page 28, lines 11 through 13 note the following: *“The EPA should present more information regarding the vertical distance between surface-water bodies and the target zones being fractured, and the depths of most aquifers compared to the depths of most hydraulically fractured wells.”*

A Panel member suggested revising the above sentence to read as follows:

“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, and the increased potential if any for impacts on drinking water quality in plays where the vertical distance between the production zone and a current or future drinking water source is relatively small.”

19. Definitive statements regarding whether some or all hydraulically fractured wells are or are not leaking

A Panel member noted the following concerns regarding the following sentence on Page 13, lines 3 through 6 of the 2/16/16 draft Panel report: *“The draft Assessment Report should not make definitive statements regarding whether some or all hydraulically fractured wells are or are not leaking because the chapter’s conclusions regarding how many hydraulically fractured wells are or are not leaking are not well supported by analyses or other information presented.”*

“I don’t really understand this sentence. The draft assessment report can make some definitive statements about some HF wells that have leaked. I agree the report cannot assess the rate of leakage.”

20. Use of the term “chemicals” when describing constituents in flowback and produced waters

Page 16, lines 4 through 8, note the following: *“The agency should clarify whether compounds identified as being of most concern in produced water are products of the hydraulic fracturing activity, flowback, or late-stage produced water, or are chemicals of concern derived from oil and gas production activities that are not unique to hydraulic fracturing activity. These efforts may require the development of analytical methods.”*

A Panel member noted the following concerns regarding the above sentences:

“The term "chemicals" in line 6 is misleading and ambiguous. To many readers, the term "chemical" implies a manufactured compound and in the context of this sentence that is correct, but not sufficient. Flowback and produced water will also contain dissolved ions -- many of which are naturally occurring in groundwaters and in brines (e.g. bromide -- line 18). These naturally occurring cations and anions need to be included as a distinct item in the list of constituents present in flowback and produced waters.”

21. Statements noting model predictions and results are not evidence

A Panel member noted the following concerns regarding the following sentence on Page 13, lines 37 through 39 of the 2/16/16 draft Panel report: *“In the descriptions of the models for fracture propagation and fluid migration introduced and discussed in this chapter, the EPA should clarify that these model predictions and results are not evidence, and clearly describe the limitations of such models.”*

“I don’t know what this means. The models can be tools to understand systems. I don’t know what this sentence means however.”

22. Water acquisition and streams/wells running dry:

Page 32, lines 15 through 23 (note – similar text also provided on page 34, lines 20-27) note the following: *“The major findings concerning water acquisition for hydraulic fracturing (from surface waters, groundwaters, and treated wastewaters) were generally supported by the information and data presented in the assessment. However, the finding that there were no cases where water use for hydraulic fracturing alone caused a stream or well to run dry is not appropriate in order to determine severity of impacts, since, for example, a stream with substantially decreased water availability, or a well experiencing regional water-level decline as a result of water acquisition, may be impacted. The SAB recommends that the EPA characterize imbalances between water supply and demand, and localized effects, especially water quality*

effects, as affected by many interactive factors. This characterization would provide an improved assessment of impacts and benefits.”

A Panel member suggested revising the above paragraph as follows:

“The major findings concerning water acquisition for hydraulic fracturing (from surface waters, groundwaters, and treated wastewaters) were generally supported by the information and data presented in the assessment. However, the finding that there were no cases where water use for hydraulic fracturing alone caused a stream or well to run dry is **not an appropriate criterion to use to determine occurrence** of impacts, since, for example, a stream with substantially decreased water availability, or a well experiencing regional water-level decline as a result of water acquisition, may be **significantly** impacted. The SAB recommends that the EPA characterize imbalances between water supply and demand, and localized effects, especially water quality effects, as affected by many interactive factors. This characterization would provide an improved assessment of impacts.

The Panel member suggested deleting ‘and benefits’ from the last sentence for the following reasons:

“What benefits? The focus on the Assessment Report is on “impacts,” which may be positive (beneficial) or negative (detrimental). EPA has said little or nothing about the positive benefits of HF on water quality and quantity, so it be better to just leave the wording here neutral (i.e., just “benefits”).”

The Panel member also noted the following regarding the ‘running dry’ metric:

“Running dry is a great metric to use for the upper end of the “severity” scale. But its use in the report suggests that less severe impacts were either ignored or non-existent (did not occur) if a stream or well did not run dry. If used as a measure of severity, they need to develop and discuss the entire scale, i.e., the range of severity of impacts.”

23. Reinsert paragraph that was deleted from 1/7/16 1st draft Panel report:

P. 34, line 40: A panel member suggested reinserting the following paragraph that was deleted from the Panel’s January 7, 2016 draft report:

“Many of the key findings presented in the draft Assessment Report relied on two publicly available databases toward assessing the sources and quantities of water used in the hydraulic fracturing process. process: a) the FracFocus Chemical Disclosure Registry database, where major limitations include questions regarding data completeness (e.g., including information from all wells in an area), the absence of information considered proprietary for certain chemicals, and lack of information on the identity, properties, frequency of use, magnitude of exposure, and toxicity potential for a substantial number of chemicals; and b) the Water Use in the United States database from the USGS, where major limitations are associated with limitations of the spatial and temporal scale of the

data (e.g., information not available at sub-county scales, and information on water used in hydraulic fracturing reported as part of larger categories of mining water use).”

24. Assessment of abandoned wells:

Page 49, lines 33 through 39, note the following: *“A key aspect of minimizing impacts to drinking water resources from the well injection stage of hydraulic fracturing operations is responsible well construction and operation, and isolation of potable water from hydraulic fracturing operations. To accomplish this, the agency should recognize in the draft Assessment Report that the following activities are required in order to conduct HFWC activities in a responsible manner: inspection, testing and monitoring of the tubing, tubing-casing annulus and other casing annuli; and monitoring and testing of the potable groundwater through which the tubing, tubing-casing annulus and other casing annuli pass.”*

A Panel member noted the following concerns regarding this topic:

“It is also critical to have identified abandoned wells and determined their integrity.”

25. Definitive statements regarding whether some or all hydraulically fractured wells are or are not leaking

A Panel member noted the following concerns regarding the following sentence on Page 53, lines 23 through 25 of the 2/16/16 draft Panel report: *“The SAB also notes that the EPA can reduce uncertainties associated with cement and casing integrity in hydraulic fracturing by examining and assessing more or all of the 20,000 well files referenced in the draft Assessment Report.”*

“Assessing ‘more or all’ of the 20,000 well files doesn’t make sense.”

26. Spatial proximity of wells, and other related information:

Page 54, lines 35 through 40, note the following: *“The EPA should include information regarding the spatial proximity of wells to each other and to water sources and to known geologic faults to help the public better understand the physical situation in which hydraulic fracturing well injection is conducted. In addition, the SAB notes that statistical information on hydraulic fracturing well data summaries is generally not available, and the EPA should provide more information on the three-dimensional nature and aspects of well injection in the HFWC. The recommendations in this paragraph may be considered longer term future activity.”*

A Panel member noted the following concerns regarding this paragraph:

“The EPA should provide more information and a clearer description on the three dimensional nature and aspects of well injection. Also, let’s discuss this whether these recommendations should be considered longer term future activities. We note elsewhere the need for greater clarity on this in the report (not necessarily in future activities).”

27. Rarity of seismic events

Page 59, lines 1 through 3 of the 2/16/16 draft Panel report note the following: *“Although the SAB recognizes that induced seismicity at hydraulic fracturing sites is anticipated to be a rare occurrence, the EPA should have improved documentation and monitoring data from when such events do occur.”*

A Panel member noted the following concerns regarding the above sentence:

“? It’s not rare in Kansas or Oklahoma, though the cause is believed to be deep-well injection for wastewater disposal. Was the intent here to say that “... induced seismicity caused by hydraulic fracturing is anticipated to be a rare occurrence”?”

28. Conflicting SAB advice regarding distinguishing between Flowback and produced water:

Page 61, lines 36 through 42, note the following:

“The SAB notes that the general public usually does not distinguish between hydraulic fracturing flowback and hydraulic fracturing produced water, and recommends that the agency reconsiders its decision to distinguish between these waters within the draft Assessment Report. The EPA should also describe what is meant by produced water and whether this water comes from hydraulic fracturing and/or from non-HF activities. The EPA should also consider moving Chapter 6’s discussion on flowback and produced water to Chapter 7. Further discussion on this topic is provided in Section 3.5.1 of this SAB report.”

Page 68, lines 21 through 45, note the following:

“2) The distinction between flowback and produced waters: The SAB questions the importance of distinguishing between hydraulic fracturing flowback and hydraulic fracturing produced water because in some cases the flowback and produced fluids are mixed in the flow stream very soon after fracturing and in many cases the flowback and produced waters are stored in the same impoundments or containers at the surface. Assuming the agency decides to carry forth the distinction between these waters into the final Assessment Report, the SAB recommends that the EPA describe the differences in composition between flowback and produced waters. Importantly, the EPA should note that produced water over the longer term more closely resembles formation waters, i.e., produced waters represent pre-existing conditions prior to hydraulic fracturing, whereas, in contrast, flowback over the shorter term includes chemicals from injection of hydraulic fracturing fluids (Vidic, R.D., et al., 2013; Haluszczak, L.O., et al., 2013; and Balashov, V.N., et al., 2015).

In terms of distinguishing between flow-back and produced water, it may also help to provide a description of the differences between milli-darcy, microdarcy and nanodarcy permeability rocks to help the reader understand the variability in fluid recovery under

flowback vs produced water phases under these various geologic conditions. In the more porous and permeable rocks, formation or produced water may come to the surface quickly along with flowback water from the actual HF activity. In less porous and permeable rocks, flowback water often precedes the flow of formation water into the borehole. However, these are not clear and unambiguous distinctions. The SAB also recommends that the EPA develop, as a longer-term future activity, additional information on changes in produced water chemistry over time. While this chapter of the draft Assessment Report distinguishes the terms “flowback” and “produced water” to differentiate the terms in relation to overall well flow, the EPA should more clearly acknowledge that such differentiation can be difficult or operational at best. This is important in that releases of produced waters are more likely over time in the production phase of a well (Bair and Digel, 1990).”

Page 69, lines 38 through 42, note the following:

“The SAB recommends that the EPA include more information in Chapter 7 on the length of time it takes to hydraulically fracture a well and the duration of time over which the flowback is likely to return to the surface. The SAB notes that this is a pertinent aspect of the distinction between flowback water and production water because the chemistry of the fluid changes in this time interval.”

A Panel member noted the following concerns regarding this topic:

“We recommend in separate places in the text, that the EPA not distinguish between flowback and produced water, that they not distinguish between them or if they distinguish between them they be explain in temporal terms, and that they better distinguish between them to understand the different potential hazards they pose based on composition.”

Another Panel member noted the following concerns regarding this topic:

“I disagree with the recommendations in this paragraph (on page 61), and in the related paragraph highlighted on p. 68. The public (and many technical folks too) may not distinguish flowback from produced water, or may be confused by these terms or uncomfortable with the ambiguity arising from a sharp demarcation between them. But I think it is important to convey this to the public, and EPA did a reasonably good job of this on the first page of Chapter 7. The glossary definitions could be embellished a bit. Also, we recommend elsewhere that the time frames pertaining to the various stages of the HFWC need to be more clearly described, and this is a good opportunity to do so. People need to realize that “flowback” (as the term is commonly understood) occurs for a relatively short period of time, and that produced water is produced throughout the lifetime of an oil and gas well – whether or not it is hydraulically fractured! This merits more discussion, not less!

Regarding flowback and produced water, here are the definitions listed in the glossary (Appendix J):

Flowback: The term is defined multiple ways in the literature. In general, it is either fluids predominantly containing hydraulic fracturing fluid that return from a well to the surface or a process used to prepare the well for production.

Produced water: Water that flows from oil and gas wells.

The latter definition could perhaps be fleshed out a bit more. Perhaps "... wells, i.e., water that is produced along with oil and gas as they are produced. Depending on when production is deemed to begin, relative to well development, produced water may initially contain chemicals used in hydraulic fracturing, but the concentrations of these chemicals are expected to rapidly diminish over time as the produced water gradually becomes indistinguishable from the formation water." EPA states this reasonably well on p. 7-1 of the draft Assessment Report, which seems to have been ignored in the related paragraph on p. 61 of our SAB report."

29. Source of salt in waters

Page 71, lines 12 through 27, note the following:

"7) The source of salt in waters: The draft Assessment Report emphasizes (from Blauch et al., 2009) that brine salts in produced waters derive from dissolution of halite and other evaporite salts in the target shale. The SAB suggests that the EPA rewrite this discussion, since this emphasis does not generally describe/explain the general presence of salts in produced waters (since salt is not found in all or most shales). The SAB notes that while some places may have subsurface halite that interacts with fluids, salts are largely derived from brines in the target formation itself or surrounding formations (and evaporites may be present in the basin but not necessarily in the target formation itself). In addition, on lines 25 and 26 of Page 7-16 the EPA does not comprehensively list causes of increasing solutes because the increase in salt content of production waters with time could be attributed to transport of brine from small pores in the shale into the fractures. Alternately, the increase could be related to the increasing percentage of formation waters returning through the production of the well after the hydraulic fracturing process is completed. A paper describing a mass balance calculation on the brine salt for wells in the Marcellus shale showed a proof of concept for how the salt enters the return water and why it changes with time (Balashov et al., 2015). The EPA could cite the Balashov, et al. (2015) paper in the discussion provided on page 7-7, Section 7.3, and on Page 7-26, Section 7.4.1, lines 3-16 of draft Assessment Report.

A Panel member noted the following concerns regarding this paragraph:

"The title of this section needs to be changed to 'The source of salts in subsurface waters.' In addition, this paragraph needs to be more precise in terms of the word "salt" when referring to the mineral halite and the words "salt" or "salts" when referring to metal cations. As it stands, the general reader will be confused and misled."

30. Long distance travel incidents

Page 73, lines 5 through 8, note the following: “*While such long-distance travel incidents have only been rarely reported (Vidic et al., 2013; Llewellyn et al., 2015), the draft Assessment Report should describe the frequency and severity of such events, or outline a plan for such an assessment as a future activity, and recognize that such events occur.*”

A Panel member noted the following concerns regarding this sentence:

“EPA should be assessing the literature. I don’t believe we have offered a thorough literature review to substantiate our claim. It would be more even handed to suggest that EPA investigate not for us to offer an unsubstantiated conclusion on the frequency without saying what we have examined in detail to arrive at this conclusion.”

31. Comparison between number of identified cases where drinking water resources were impacted and the number of drinking water resources that have been impacted:

A Panel member noted the following concerns regarding this topic:

“In its Executive Summary (pages ES-6 and 23) and in Chapter 10 (pages 10-1 and 10-20), the Draft Assessment asserts that “The number of identified cases where drinking water resources were impacted are[sic] small compared to the number of hydraulically fractured wells”. Our draft report suggests on page 127 that the EPA should clarify the statement. We should also point out that the number of HF wells is not the relevant denominator: it should be the number of drinking water resources.

For instance, in a basin with 40-acre well spacing, there are around 50 wells within a one-mile radius of a given drinking water resource. Contamination from just one well would be 2% of wells, but 100% of drinking water resources.

I suggest that we add to the bullet point at the foot of page 127 (top of page 135 in the red-line version) the following: “The agency should also discuss how the number of identified cases compares with the number of drinking water resources at risk.”