

**Summary Minutes of the
U.S. Environmental Protection Agency
Science Advisory Board Hydraulic Fracturing Research Advisory Panel
Public Teleconference, September 30, 2015**

Date and Time: Wednesday, September 30, 2015, 12:00 p.m. – 4:30 p.m. ET.

Location: Teleconference Only.

Purpose: The purpose of the September 30, 2015 public teleconference was for the SAB Hydraulic Fracturing Research Advisory Panel to receive a briefing on the EPA's *Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources (External Review Draft, EPA/600/R-15/047, June 2015)* and to discuss the EPA's charge questions.

Participants:

SAB Hydraulic Fracturing Research Advisory Panel (See Roster with affiliations, Attachment A):

Dr. David A. Dzombak, Chair
Dr. Stephen W. Almond
Dr. E. Scott Bair
Dr. Peter Bloomfield
Dr. Steven R. Bohlen
Dr. Elizabeth W. Boyer
Dr. Susan L. Brantley
Dr. James V. Bruckner
Dr. Thomas L. Davis
Dr. Joseph J. DeGeorge
Dr. Joel Ducoste
Dr. Shari Dunn-Norman
Dr. Katherine Bennett Ensor
Dr. Elaine M. Faustman
Mr. John V. Fontana
Dr. Daniel J. Goode
Dr. Bruce D. Honeyman
Mr. Walter R. Hufford
Mr. Richard F. Jack
Dr. Dawn S. Kaback
Dr. Abby A. Li
Mr. Dean Malouta
Dr. Cass T. Miller
Dr. Laura J. Pyrak-Nolte
Dr. Stephen J. Randtke
Dr. Joseph N. Ryan
Dr. James E. Saiers
Dr. Eric P. Smith
Dr. Azra N. Tutuncu
Dr. Paul K. Westerhoff

Dr. Thomas M. Young

Drs. Steven R. Bohlen and Shari Dunn-Norman could not participate during the September 30, 2015 public teleconference.

EPA SAB Staff:

Mr. Edward Hanlon, Designated Federal Officer

EPA Staff:

Dr. Jeffrey Frithsen, EPA Office of Research and Development

Other Attendees:

A list of persons present at the meeting, who requested information on accessing the teleconference line, or who noted via email that they participated on the teleconference, is provided in Attachment B.

Materials Available: The agenda and other meeting materials are available on the SAB website (www.epa.gov/sab) at the following SAB Hydraulic Fracturing Research Advisory Panel September 30, 2015 public teleconference webpage:

<http://yosemite.epa.gov/sab/sabproduct.nsf/a84bfee16cc358ad85256ccd006b0b4b/4c118116b09087f185257e4a004a04da!OpenDocument&Date=2015-09-30>

Teleconference Summary

The public teleconference was announced in the Federal Register¹ and was conducted according to the teleconference agenda.² A summary of the public teleconference follows.

September 30, 2015

Opening Statements

Mr. Edward Hanlon, the Designated Federal Officer (DFO), opened the public teleconference, and made a brief opening statement noting that the SAB Hydraulic Fracturing Research Advisory Panel operates in accordance with the Federal Advisory Committee Act (FACA). He noted the teleconference was open to the public and that Agency-provided briefing materials were posted on the SAB website. He noted the Panel previously met on May 7-8, 2013 where individual members of the Panel provided expert science and engineering comments on charge questions associated with the research described in the EPA's December 2012 Progress Report on its hydraulic fracturing research. He also noted that the Panel held a teleconference on November 20, 2013 where the public provided new and emerging information related to hydraulic fracturing for consideration by the Panel. Mr. Hanlon noted that Panel members were appointed as Special Government Employees to provide individual expertise and advice, not to represent any organization. He stated that 257 sets of unique written public comments were received as of September 30, 2015 for the Panel's consideration, and that no members of the public had requested to present oral comments during the teleconference. He stated that the SAB Staff Office had identified no financial conflicts of interest or appearance of a loss of impartiality for any Panel members for this review. He also noted that minutes of the meeting were being taken to summarize discussions and action items in accordance with the requirements of FACA.

Dr. David Dzombak, Chair of the Panel, then welcomed everyone. Dr. Dzombak noted that the

goals and objectives for this teleconference are for the SAB Hydraulic Fracturing Research Advisory Panel to receive a briefing on the EPA's June 2015 draft Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources, and to discuss the EPA's charge questions and entertain any clarifying questions on the charge. Dr. Dzombak summarized the teleconference agenda, and noted that since this was a briefing of our SAB Panel there were no charge questions to respond to during the teleconference. He noted that if members of the Panel wanted to make observations during the teleconference that are relevant to the Panel's advisory effort, those observations were welcome. Dr. Dzombak stated that during this briefing the Panel was not seeking to identify points of agreement nor develop individual or consensus oral or written advice that would be provided to the EPA at this time. He noted that the Panel and the full SAB would develop such advice as it reviews the EPA's draft Assessment Report, including when the Panel meets on October 28-30, 2015 in Washington D.C.

Dr. Dzombak noted that no members of the public requested to present oral comments during the teleconference, and that while the SAB Panel was not obligated to respond to written public comments submitted to the EPA's Docket regarding the draft Assessment report or charge questions, the Panel members could ask relevant clarifying questions or supplemental information regarding any of the written public comments that the Panel received for its consideration.

Dr. Dzombak then introduced Dr. Jeffrey Frithsen of the EPA ORD, and noted that Dr. Frithsen's slides were distributed to members of the Panel and posted on the teleconference website.

Overview of the EPA's June 2015 Draft Assessment Report

Dr. Jeffrey Frithsen of the EPA ORD thanked SAB for conducting peer review on ORD's draft Assessment Report, then presented his slides entitled "Assessment of Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources."³ Dr. Frithsen noted that he represented a large team of Agency scientists who have been working on this study since 2010.

On slide 2, Dr. Frithsen noted that the scope of the EPA's hydraulic fracturing study had been modified somewhat, and that this was reflected in statements within the draft Assessment Report. On slide 6, Dr. Frithsen noted that the robust literature review that the EPA conducted included reviewing over 3500 sources of information, and that the draft Assessment Report cited approximately 950 sources of this information. He noted that various efforts supported the EPA's effort in developing the draft Assessment Report, including earlier SAB comments, ORD's stakeholder outreach efforts to industry, states, and the public, and the Docket that the EPA opened to allow members of the public to submit materials for the EPA to consider. Dr. Frithsen noted that the draft Assessment Report identified mechanisms for hydraulic fracturing to impact drinking water resources. He noted that the draft Assessment Report did not consider mechanisms for hydraulic fracturing to potentially impact ecological resources, air quality, or landscapes, assess potential socioeconomic or environmental justice impacts, identify best management practices for hydraulic fracturing activities, or identify policy options.

On slide 8, Dr. Frithsen noted that he would expand on the conclusions presented in this slide during his presentation to the Panel at the October 28-30, 2015 public meeting in Washington D.C. On slide 10, he noted that the rarity of potential impacts of hydraulic fracturing to drinking water resources that the EPA reported in its draft Assessment Report may reflect uncertainties including those listed on this slide. He noted that in particular, there was a paucity of systematic

well integrity studies.

On slides 11 through 14, Dr. Frithsen summarized each of the eight charge questions. He noted that regarding charge question 1, background information in the draft Assessment Report was not intended to be exhaustive. He summarized similarities in charge questions 2 through 6. He stated that charge question 4 focused on Chapter 6 of the draft Assessment Report, and that this chapter did not assess potential impacts from prior activities. He noted that charge question 5 covered well integrity topics and topics related to flowback water definition, composition, volume and management. Dr. Frithsen noted that regarding charge question 7, Appendix A presented more information on physicochemical and toxicological properties of chemicals. He noted that the EPA released a chemical database in June 2015 on the physical/chemical and toxicological properties for more than 1100 chemicals used in hydraulic fracturing. Dr. Frithsen noted that charge question 8 sought SAB advice on whether Chapter 10 and the Executive Summary of the draft Assessment Report spoke to a broad audience and can be readily understood. He also noted that the EPA tried to define terms throughout the draft Assessment Report and included a robust glossary of terms in an Appendix to the draft Report.

Dr. Dzombak thanked Dr. Frithsen, and asked if Panel members had any clarifying questions for Dr. Frithsen or comments related to his presentation. Hearing none, Dr. Dzombak noted that the Panel would now summarize the written public comments that have been received for the Panel's consideration.

Summary of Written Public Comments

Dr. Dzombak noted that 257 sets of unique written public comments have been received to date for the Panel's consideration related to the review of the EPA's draft Assessment report and the charge questions. He noted that these written comments are posted in the EPA's Docket, and instructions on how to access the comments on the Docket are posted on the Panel's teleconference website. He noted that he asked three Panel members (Dr. Elizabeth Boyer, Dr. Susan L. Brantley, and Mr. Walt Hufford) to review these written public comments and prepare a written summary that identified which comments related to charge questions and which comments raise key science questions and issues. He then asked Dr. Boyer, Mr. Hufford and Dr. Brantley to summarize their public comment review effort.

Dr. Elizabeth Boyer noted that written public comments were available publicly on the EPA's Docket website at www.regulations.gov. She noted there was large public interest in providing public input on both the EPA's draft Assessment Report and the draft charge questions, and that the Panel appreciated the opportunity to read and reflect on them. She also noted that public comments were received from the time of the Federal Register Notice that was published on June 5th through August 28th, 2015, though comments that have come in since then are still being accepted and posted onto the Docket website. She further noted that there may be a delay in processing and posting comments that have been submitted to the Docket, and additional comments are being posted onto the Docket website.

Dr. Boyer noted that on September 14, 2015, a spreadsheet table that listed out 252 unique written public comments that were submitted and posted on the Docket as of that date was posted onto the September 30, 2015 SAB Hydraulic Fracturing Research Advisory Panel Teleconference website. She stated that the table includes embedded hotlinks to the submitted comments to facilitate review of these public comments. She noted that since September 14, five

additional public comments have been posted onto the Docket website, thus totaling 257 unique written public comments on the Docket website.

Dr. Boyer stated that the Docket website notes that 106,200 comments were received, but that 257 public comments are posted on the Docket website. She noted that within the submitted and posted public comments, there are five submitted comments that are considered 'mass mailers', and that these were identified as comments #132-135 and #207 in the Docket. She noted that these five sets of comments comprised 105,948 of the 106,200 individual commenters who submitted comments to the Docket as of September 30, 2015, and that each of these five mass mailers were considered one set of comments. She stated that, for example, comment #132 from the Union of Concern Scientists represented over 18,000 commenters.

Dr. Boyer noted that many of the 257 written public comments did not specifically refer to a section of the draft EPA Assessment Report or charge question. She noted that Dr. Dzombak asked her, Mr. Hufford and Dr. Brantley to review these public comments and prepare a written summary that identifies which comments related to charge questions or may have some key value to the scientific review process or relevance to the review document so that Panel members could readily identify those comments. She stated that on September 28, 2015, a spreadsheet table that she, Mr. Hufford and Dr. Brantley produced was posted onto the Panel's teleconference website.

Mr. Walt Hufford provided an overview of the September 28, 2015 spreadsheet. For each comment, the table identifies the docket number, link to the comment, commenter name, commenter affiliation, commenter state, notes, and check-boxes related to the report content. He noted that the table listed each of the 257 unique public comments in a separate row. He noted that he, Dr. Boyer and Dr. Brantley tried to map those public comments to charge questions. He explained that the September 28, 2015 spreadsheet table included annotations where specific comments were related or had an annotation to specific charge questions. He noted that this effort was intended to help Panel members as they developed their individual preliminary responses to charge questions. He noted that the September 28, 2015 spreadsheet table listed charge questions in order, and tried to list scientific information that was provided in the public comments.

Dr. Susan Brantley provided an overview of the scope of public comments received and considered in the analysis that she, Mr. Hufford and Dr. Boyer conducted. She summarized qualitatively what the public was most concerned about within the public comments posted on the Docket website. She stated that there were several categories of concern, and noted that she was not judging these categories either positively or negatively nor placing these concerns in any order.

Dr. Brantley noted that, as reflected in the written public comments on the Docket website, the public was:

- 1) Concerned that hydraulic fracturing was safe but EPA regulations would be imposed and were unnecessary;
- 2) Concerned that hydraulic fracturing used a lot of water, and had concerns about the amount and quantity of water that was used;
- 3) Concerned about the toxicity of compounds that were used in hydraulic fracturing;

- 4) Concerned about the hydraulic fracturing injection process, and that chemicals used in the process would get to surface water. Also, the public had concerns about well integrity and whether injectate would stay where operators intended;
- 5) Concerned about radioactivity in flowback water and well drilling cuttings associated with hydraulic fracturing;
- 6) Concerned about how hydraulic fracturing wastewaters were being handled;
- 7) Concerned about too limited scope for the draft Assessment Report, and that the scope of the EPA's draft Assessment Report did not include their concerns (e.g., potential impacts to ecosystems and landscapes);
- 8) Concerned that the EPA did not have sufficient data, and that conclusions were being formulated without having sufficient data to come to those conclusions;
- 9) Concerned about the lack of transparency regarding company practices and compounds being used, and inability to obtain data from companies;
- 10) Concerned about the disconnect between personal experiences of members of the public with hydraulic fracturing incidents and the conclusions in EPA's draft Assessment Report;
- 11) Concerned about how the Executive Summary of the draft Assessment Report and press materials were worded and interpreted. Also, some members of the public expressed concern that statements in the Executive Summary and press materials were misleading, and that different news organizations presented differing news reports on the draft Assessment Report. Further, some members of the public thought the press was possibly misleading the public in news reports about the findings; and
- 12) Some commenters did not express a concern, but rather congratulated the EPA on the report, its comprehensiveness, and/or its conclusions.

Dr. Dzombak asked which charge questions had the most comments from the public, based on what was included in the September 28, 2015 spreadsheet table. Mr. Hufford noted that it appeared that charge questions 4, 6 and 7 had the most public comments related to charge questions.

A Panel member expressed appreciation for the work of Dr. Boyer, Mr. Hufford and Dr. Brantley on the spreadsheet table, and noted she would have added more public comments to charge question 7. The Panel member noted that slide 6 of Dr. Frithsen's presentation indicated what the EPA's draft Assessment Report was not doing, and that it would be appropriate to identify concerns of the public related to specific chemicals and make the Panel aware of these concerns.

Another Panel member noted that column B of the September 28, 2015 spreadsheet table provided information on the location/State of the address of the commenter, and assumed that if the column was blank the location/State of the commenter was unknown. The Panel member asked whether there was an area of country from which more or less written public comments were received. Mr. Hufford noted that neither he, Dr. Brantley nor Dr. Boyer assessed the table to that level of detail, and that that statistic could be developed and provided to Panel members. Mr. Hufford also confirmed that comments that were anonymous could not be tracked by state. Dr. Dzombak agreed that such a statistic would be developed and provided to the Panel for its consideration and posted on the SAB Panel's website.

One Panel member noted that some anonymous comments were very long, and that it appeared that some commenters took excerpts from other's comments and included these excerpts in their

own comments. The Panel member asked whether Dr. Boyer, Dr. Brantley and Mr. Hufford saw many repeated comments in the set of 257 comments. Dr. Brantley noted that she did see repeated comments, and that it was not uncommon for several letters to have information similar to other comments. She noted that she, Dr. Boyer and Mr. Hufford made no attempt to identify which comments were statistically similar to each other. Dr. Dzombak noted that organizations often send out comments for their members to consider. He stated that this effort by Dr. Boyer, Dr. Brantley, and Mr. Hufford attempted to identify which comments were relevant to scientific analysis of the EPA's draft Assessment Report.

Another Panel member had a comment on Dr. Brantley's overview of public comments, regarding the public comment category that expressed concern that the EPA did not have sufficient data to make conclusions in the EPA's draft Assessment Report. The Panel member pointed out that almost all commenters focused on data or lack of it, or provided information on the commenter's actual experience related to hydraulic fracturing. The Panel member further noted that these comments were in stark contrast with the groundwater modeling that the EPA conducted as part of its draft Assessment Report, and that the EPA's groundwater modeling was not mentioned in public comments regarding how to predict releases from hydraulic fracturing activities. Dr. Brantley and Mr. Hufford noted that they did not recall seeing many public comments on groundwater modeling, and Dr. Boyer noted that a few public comments may have mentioned groundwater modeling.

Dr. Boyer, Dr. Brantley, and Mr. Hufford noted that they would update their September 28, 2015 spreadsheet table and that the updated table would be posted on the Panel's website.

Review of Charge Questions and Clarifying Questions

Dr. Dzombak noted that after releasing its draft Assessment Report in early June 2015, the EPA ORD coordinated with the SAB Staff Office in the development of its charge questions. He noted that after coordinating with SAB Staff Office to clarify and sharpen the charge questions, the charge questions were released in August 2015. He noted that the base job of Panel members was to respond to the charge questions, and that at the face-to-face Panel meeting on October 28-30, 2015, the Panel would meet to discuss responses to the charge questions and try to reach consensus on SAB's advice. He stated that the Panel members could ask clarifying questions on these charge questions during the September 30, 2015 teleconference, especially if Panel members were unclear about the intended focus of the requested response.

Dr. Dzombak noted that the Panel was free to provide review comments on any other aspect of the draft Assessment report as it worked to respond to the charge questions. He noted that while the charge questions were very broad, if Panel members thought there was a charge question that had not been asked the Panel could discuss that. He stated that for any topics discussed as a Panel, the Panel would seek to form consensus of the Panel on that advice before including those topics in the SAB advisory report that the Panel would prepare after the Panel's October 28-30, 2015 public meeting. Dr. Dzombak also noted that within individual Panel member preliminary written comments or in Panel member Lead Discussant responses at the Panel's October 28-30, 2015 public meeting, Panel members should separately flag any comments that they may be making that they believed to be outside of the scope of existing charge questions.

Charge Question 1, regarding the background, scope, approach and intended use of the assessment, and the context and background of hydraulic fracturing and drinking water resources

Dr. Dzombak read the entire charge question, and noted the charge question related to Chapters 1, 2 and 3 of the EPA's draft Assessment Report. He then asked whether any Panel member had a clarifying question or comment on this charge question.

Several Panel members commented on the following sentence from the preamble to the charge question: "The goal of the assessment was to review, analyze and synthesize available data and information concerning the potential impacts of hydraulic fracturing on drinking water resources in the United States, including identifying factors affecting the frequency and severity of any potential impacts."

A few Panel members noted that Charge Question 1 asked how the EPA's draft Assessment Report addressed frequency and uncertainty, and expressed concern regarding how Panel members could identify the relevant factors related to frequency and severity of potential impacts. Several Panel members noted that this clause could be interpreted broadly, and that Charge Question 1 should be narrowly focused towards the frequency and severity of any potential impacts to the hydraulic fracturing water cycle. A Panel member noted that this concern also related to the title of the EPA's draft Assessment Report.

A Panel member noted that the term 'impact' was defined broadly within the EPA's draft Assessment Report, and that the term referred to surface spills and other activity. Several Panel members commented that it was necessary to have information on impacts to the ground surface if such impacts have occurred, and noted that leaving the term 'frequency and severity of potential impacts' within the charge question inferred that there was an understanding of frequency and severity of such potential impacts. A Panel member noted that while the EPA's draft Assessment Report had good intentions to identify potential mechanisms or factors that affected potential impacts, the draft Report did not include a quantitative assessment on frequency or severity of such potential impacts. The member then recommended striking the phrase "including identifying factors affecting the frequency and severity of any potential impacts" from the charge question.

Another Panel member stated that Slide 9 of Dr. Frithsen's presentation noted that the number of documented impacts to drinking water resources was small relative to number of fractured wells, and that it was uncertain what was considered 'small'. The Panel member noted this concern related to how the Panel should quantify frequency and severity. A Panel member suggested that the Panel might be able to address this issue more specifically in its discussions on the other charge questions.

Dr. Dzombak noted that the study framework, based upon the hydraulic fracturing lifecycle, includes factors that may affect drinking water resources. Dr. Dzombak noted that frequency and severity of potential impacts was open to different perspectives, and that the EPA's draft Assessment Report tried to characterize the magnitude of potential impacts. Dr. Dzombak asked Dr. Frithsen if the phrase "including identifying factors affecting the frequency and severity of any potential impacts" could be dropped from the charge question. Dr. Frithsen responded that the EPA approached frequency and severity of potential impacts throughout the EPA's draft Assessment Report, and that the EPA did not want the assessment to be a litany of potential impacts. He noted that the EPA tried to identify when data were available, when data could

provide support, and factors that served to modify the types of impact that might occur to drinking water resources. He noted that, for example, within the draft Assessment Report's identification of the types of impact associated with withdrawal of water, the EPA tried to clearly identify those potential impacts and identify the factors that affect frequency and severity of those potential impacts. Dr. Frithsen also stated that the entire first preamble sentence of Charge Question 1 could be deleted.

Dr. Dzombak noted that other charge questions had a brief preamble discussion and thus it would be consistent to include preamble text in charge question 1. Dr. Dzombak recommended the clause "including identifying factors affecting the frequency and severity of any potential impacts" remain in the first sentence of charge question 1 and suggested the clause "on drinking water resources" be added to the end of this sentence. Several Panel members agreed that leaving the first sentence in the preamble without change focused the Panel's attention on this topic. Dr. Dzombak then stated that the first sentence would remain in the preamble to Charge Question 1 without change.

Dr. Dzombak asked if Panel members had any additional comments on Charge Question 1. Hearing none, Dr. Dzombak began discussion on Charge Question 2.

Charge Question 2, regarding water acquisition - the use of ground or surface water for hydraulic fracturing

Dr. Dzombak read the entire charge question, and noted the charge question related to Chapter 4 of the EPA's draft Assessment Report. He then asked whether any Panel member had a clarifying question or comment on this charge question.

A Panel member referred to sub-question e of the charge question regarding what additional information should be added to the report, and noted that since the EPA released a draft final report, it seemed late to identify what additional information or databases could be added at this stage. The Panel member noted that research gaps could be identified. Another Panel member noted that prior SAB advice on the EPA's draft Study Plan for conducting research on hydraulic fracturing recognized that the EPA had limited resources to conduct this research, and noted that there were a small number of well files examined within the well file review that is described in the draft Assessment Report. The Panel member commented that it would take a large amount of resources to add additional well files to the draft Assessment Report, and noted that the EPA would have to have a cut-off date to finalize the Report.

Dr. Dzombak noted that the EPA's research team was seriously interested in knowing whether they have missed anything in the draft Assessment Report. He noted that the Panel member individual preliminary comments and Panel discussion at the Panel's October 28-30, 2015 public meeting would provide opportunity for the Agency to hear comments on what was missing from the draft Report, and stated that after the Panel's October meeting there would be a long period of time for the Panel to produce its consensus advice. He noted that the EPA would have opportunity during this time to work on revision of the draft Assessment Report, which he expected would begin immediately after the Panel's October 28-30, 2015 public meeting.

Dr. Frithsen noted that the EPA wanted to make sure that the Assessment Report captured the state of the science, and that the EPA sought information from the Panel on whether it thought the EPA missed anything in the draft Assessment Report. Dr. Frithsen noted that a significant amount of literature related to hydraulic fracturing and drinking water resources has been

published since the draft Assessment Report was released on June 4, 2015, and that it would be helpful if Panel members identified what literature was missing or should be included. He noted that at some point in time the EPA would have to finalize the Assessment Report.

A Panel member commented that sub-question b of the charge question asked: “Are the quantities of water used and consumed in hydraulic fracturing accurately characterized with respect to total water use and consumption at appropriate scales?” The Panel member noted that consideration of “appropriate time scales” in the charge questions did not ask how time should be considered, including temporal issues such as: how long did hydraulic fracturing pressurizations occur, how long water resources would be impacted from hydraulic fracturing, and how long would it take to recover water resources from hydraulic fracturing activities. The Panel member noted that the Panel should consider how rainfall would replace water from unconfined aquifers that was used during hydraulic fracturing activities, and consider the time and geographic scale of such potential impacts. Dr. Dzombak suggested amending the final clause of sub-question b to: “at appropriate temporal and spatial scales?” No Panel members objected to this suggestion, and Dr. Frithsen agreed that this would be an agreeable change.

A Panel member suggested that sub-question e of charge question 2 should add the clause “to drinking water resources” after the clause “any potential impacts”. No Panel members objected to this suggestion. Dr. Frithsen noted this was an agreeable change.

Another Panel member noted that Charge Question 2 focused on water acquisition and impacts, and that water acquisition and impacts has become a local or regional issue where water resources are limited, and was generally not an issue specific to particular hydraulic fracturing wells nor quite a national issue. The Panel member asked how the Panel should consider these points in responding to this charge question. Dr. Dzombak suggested that to the extent that Panel members thought Chapter 4 of the draft Assessment Report was ignoring or not sufficiently addressing the strong regional aspect of water acquisition, Panel members include these topics in their individual Panel member preliminary comments and in comments at the meeting, and the Panel would consider what advice to provide on this topic.

Dr. Dzombak asked if Panel members had any additional comments on Charge Question 2. Hearing none, Dr. Dzombak began discussion on Charge Question 3.

Charge Question 3, regarding chemical mixing - the mixing of water, chemicals, and proppants at the well pad

Dr. Dzombak read the entire charge question, and noted the charge question related to Chapter 5 of the EPA’s draft Assessment Report. He then asked whether any Panel member had a clarifying question or comment on this charge question. One Panel member noted that while fate and transport was approximately 20 percent of this chapter, the Panel could spend a significant amount of time reviewing this topic. The Panel member asked what should be the Panel’s scope of review on this topic. Dr. Dzombak noted that fate and transport was covered in several chapters of the draft Assessment Report, and that a fair amount of industrial process focus here was understandable since this chapter focused on chemical mixing. He noted that this comment could potentially be considered advice, and asked whether the charge question as stated would permit the Panel to develop advice on this topic. The Panel member agreed that there was sufficient latitude in the charge question to raise comments on this topic, and that thus no change to the charge question was needed.

A Panel member commented that the EPA did a good job in identifying hydraulic fracturing industrial processes in this chapter, and noted that it was appropriate to include discussion on fate and transport in this chapter since the chapter assessed potential impacts from spills.

Dr. Dzombak asked if Panel members had any additional comments on Charge Question 3. Hearing none, Dr. Dzombak began discussion on Charge Question 4.

Charge Question 4, regarding well injection - the injection of hydraulic fracturing fluids into the well to fracture the geologic formation containing oil or gas

Dr. Dzombak read the entire charge question, and noted the charge question related to Chapter 6 of the EPA's draft Assessment Report. He then asked whether any Panel member had a clarifying question or comment on this charge question.

Several Panel member commented that while the depth of discussion was impressive in all chapters of the draft Assessment Report, the draft Report lacked information on how changes in hydraulic fracturing industry practice has occurred over time such as in the use of new chemicals and new cementing techniques. These Panel members suggested that this charge question and also perhaps charge questions 7 and 8 could ask questions related to where industry is heading related to hydraulic fracturing industrial practices. One Panel member suggested that Panel members identify industrial progress within their individual Panel member comments. A Panel member noted this would be difficult for Panel members to do, and suggested that the EPA identify within the draft Assessment Report how the industry has progressed from early 2000 to now, including topics such as how hydraulic fracturing fluids, well logging and well placement have changed over time. Another Panel member suggested that Panel members include timeframes for suggested improvements in the future to prevent or mitigate impacts. Dr. Dzombak noted that these comments could potentially be considered advice, and suggested that Panel members include these topics in their individual Panel member preliminary comments. He also noted he assumed that the charge question as stated would permit the Panel to develop advice on this topic. One Panel member agreed that there was sufficient latitude in the charge question to raise comments on this topic and that no change to the charge question was needed.

One Panel member suggested that the draft Assessment Report should assess the geologic factors that affect the frequency and potential impacts associated with natural fractures in relation to hydraulic fracturing. A Panel member suggested that the following sentence from the preamble to the charge question be amended: "The third step in the hydraulic fracturing water cycle is well injection: the injection of hydraulic fracturing fluids into the well to fracture the geologic formation." The Panel member suggested replacing the clause "to fracture the geologic formation" with "to create new fractures and dilate existing fractures." Dr. Dzombak suggested amending the clause as suggested, and no Panel members objected to this change.

A Panel member noted he struggled with understanding the term "major finding" that was used in the charge question.

Several Panel members discussed whether the charge question should specifically mention modeling. A Panel member asked whether the charge question addressed how modeling addresses future risk, including how hydraulic fracturing fluids could enter existing wells. Another Panel member commented that if modeling was key to the EPA's findings, then modeling could be added to the charge question to focus the Panel's attention on this topic. Another Panel member noted that such additional language could help the Panel focus on

assumptions made in the model. A Panel member noted that public commenters did not mention modeling, and noted that while the charge question was broadly written so that modeling could be addressed by the Panel, additional words could be included within the charge question to help the Panel focus on assumptions made in the model. Several Panel members commented that it may not be necessary to include additional language to the charge question on modeling since modeling was a primary focus for the chapter, and since modeling was one technique that could show potential impacts and observation was another technique. Dr. Dzombak also noted that since sub-question a of the charge question referred to movement of hydraulic fracturing fluids in the subsurface, this language presumably allowed modeling to be addressed without changing the existing charge question language. No Panel members objected to this suggestion.

Dr. Dzombak asked if Panel members had any additional comments on Charge Question 4. Hearing none, Dr. Dzombak began discussion on Charge Question 5.

Charge Question 5, regarding flowback and produced water - the return of injected fluid and water produced from the formation to the surface and the subsequent transport for reuse, treatment, or disposal

Dr. Dzombak read the entire charge question, and noted the charge question related to Chapter 7 of the EPA's draft Assessment Report. He then asked whether any Panel member had a clarifying question or comment on this charge question.

A Panel member noted that the term "major finding" that was used in the charge question was not a defined term, and asked how that term should be defined. Dr. Dzombak asked Dr. Frithsen to inform the Panel on how "major finding" should be defined. Dr. Frithsen noted that in developing this large-scale assessment, the EPA pulled data from thousands of pieces of information. He noted that the EPA synthesized details in each chapter in order to help write Chapter 10 and the Executive Summary of the draft Assessment Report. He noted that the EPA used some degree of subjectivity in writing Chapter 10 and the Executive Summary, and also used a different level of detail in synthesizing the draft Assessment Report in presentations to outside organizations. Dr. Frithsen noted that there was no algorithm used by the EPA to identify what are the major findings, and asked SAB to provide advice on whether the EPA correctly identified the major findings. Dr. Dzombak noted that through the charge questions the EPA implicitly seeks SAB advice on whether the draft Assessment Report should list other major findings.

A Panel member asked whether the question should be restated to ask "Have the major findings been adequately emphasized?" Dr. Dzombak suggested adding the following additional sentence to sub-question b of charge questions 2, 3, 4, 5 and 6: "Are there other major findings that have not been brought forward?" Several Panel members agreed to add this sub-question to each of these charge questions, and no Panel members objected to this suggestion.

A Panel member asked why Charge Question 5 had a separate sub-question on additional information, but Charge Questions 4 and 6 merged this question with another sub-question. Dr. Dzombak suggested that Charge Questions 4 and 6 have a separate sub-question on additional information, and no Panel members objected to this suggestion.

Dr. Dzombak asked if Panel members had any additional comments on Charge Question 5. Hearing none, Dr. Dzombak noted there would be a ten minute break, after which discussion would begin on Charge Question 6.

Charge Question 6, regarding wastewater treatment and disposal - the reuse, treatment and release, or disposal of wastewater generated at the well pad

Dr. Dzombak read the entire charge question, and noted the charge question related to Chapter 8 of the EPA's draft Assessment Report. Dr. Dzombak noted that the following additional sentence would be added to subpart b of this charge question: "Are there other major findings that have not been brought forward?" Dr. Dzombak then asked if Panel members had a clarifying question or comment on Charge Question 6.

A Panel member asked whether disposal of hydraulic fracturing well drilling cuttings into landfills was covered in the EPA's draft Assessment Report. The Panel member noted that the chapter excluded cuttings from the scope of the assessment and that the preamble to Charge Question 6 may be too narrowly worded to potentially include disposal of cuttings, and suggested that the preamble language could be revised so that cuttings be covered within the scope of the assessment. Another Panel member noted that leaking pits containing drilling cuttings leakage was anecdotally reported in Ohio and western Pennsylvania, and suggested that the EPA consider developing another report on best practices associated with disposal of hydraulic fracturing well drilling cuttings since it was such an important issue. Dr. Dzombak noted that this issue was also raised in public comments. Dr. Frithsen noted that the scope of the assessment did not include drilling waste. He noted that Chapter 8 of the EPA's draft Assessment Report discussed liquid and solid residuals from the treatment of hydraulic fracturing wastewaters. Dr. Dzombak suggested that Panel members could include these types of comments in their individual Panel member preliminary comments.

Dr. Dzombak asked if Panel members had any additional comments on Charge Question 6. Hearing none, Dr. Dzombak began discussion on Charge Question 7.

Charge Question 7, regarding chemicals used in hydraulic fracturing or present in flowback and produced waters known physicochemical and toxicological properties

Dr. Dzombak read the entire charge question, and noted the charge question related to Chapter 9 of the EPA's draft Assessment Report. Dr. Dzombak asked whether any Panel member had a clarifying question or comment on this charge question.

Regarding major findings, Dr. Dzombak suggested adding the following additional sentences to sub-question b of this charge question: "Are there other major findings that have not been brought forward? Are the major findings fully supported by the information and data presented in the assessment?" No Panel members objected to this suggestion. A Panel member commented that Chapter 9 did not have a major findings section as provided in Chapters 4 through 8. Dr. Dzombak noted that Chapter 9 had final sections entitled 'Synthesis' and 'Conclusion', and Dr. Frithsen noted this was a good observation and that this comment raised an editing and formatting issue that the Agency would address in finalizing the Assessment Report.

Several Panel members commented that this charge question should ask for advice on factors affecting the frequency, severity and magnitude of potential impacts. A Panel member noted that the public was very concerned about this particular issue. Another Panel member noted that frequency and degree of exposure in toxicology were very important factors. A few Panel members discussed the degree to which prior SAB advice on the EPA's draft study plan for conducting research on hydraulic fracturing included recommendations on conducting exposure

frequency research. A Panel member noted that Chapter 9 of the EPA's draft Assessment Report has a section on frequency and severity of impact, and it would be reasonable to include a charge question referring to frequency and severity of impact. Another Panel member noted that frequency could be frequency of detection related to levels of concern, which was related to frequency and severity of potential impacts on water. Dr. Dzombak noted that page 9-17 of Chapter 9 of the draft Assessment Report discussed quantitative information on frequency. He suggested that a sub-question similar to the wording in Charge Question 6 on frequency should be included in Charge Question 7.

Dr. Frithsen noted that Charge Question 7 focused on chemicals and not on impacts. Several Panel members noted that over 1100 constituents of concern were identified in the EPA's draft Assessment Report, and that the identification of chemicals as constituents of concern implied a potential impact on water quality. Dr. Frithsen responded that hydraulic fracturing chemicals were discussed in Chapter 5 and Chapter 7 of the draft Assessment Report. He noted that Chapter 9 of the draft Assessment Report was somewhat different than the other chapters. He stated it would be challenging to include a question on factors affecting the frequency and severity of potential impacts in this charge question since Chapter 9 discussed hazard identification and did not focus on impacts per se. He noted that Chapter 9 provided some information on chemicals of interest for hydraulic fracturing, and evaluated what was known about toxicity and chemical behavior in these chemicals of interest. He also noted that sub-question b of this charge question already asks for the Panel's advice on constituents of concern.

A Panel member suggested revising sub-question a to add the clause "for example, exposure frequency, duration, level, and potency" to the end of sub-question a. Dr. Dzombak suggested revising this additional clause to read as follows: "including potential exposure frequency, duration, and level." Several Panel members agreed and no Panel members objected to this suggestion.

A Panel member noted that Chapter 9 could provide more information on what chemicals were detected. Another Panel member noted that the EPA's draft Assessment Report did not discuss particulates nor radionuclides, and asked whether particulates should be considered chemicals of concern. Dr. Frithsen commented that the EPA could potentially improve its statements on what industrial activities and which radioactive materials are involved in hydraulic fracturing activities. Dr. Dzombak suggested that sub-question b of Charge Question 7 was sufficiently broad to allow Panel members to provide comments on constituents of concern, and noted that Panel members could include these types of comments in their individual preliminary comments.

Dr. Dzombak asked if Panel members had any additional comments on Charge Question 7. Hearing none, Dr. Dzombak began discussion Charge Question 8.

Charge Question 8, regarding integration and summary of major findings

Dr. Dzombak read the entire charge question, and noted the charge question related to the Executive Summary and Chapter 10 of the EPA's draft Assessment Report. He then asked whether any Panel member had a clarifying question or comment on this charge question.

A Panel member asked for clarification on the term "integrated between stages" within sub-question c, and expressed concern regarding the word "integrated" since it inferred that the EPA tried to bridge across stages of its hydraulic fracturing research. Dr. Dzombak noted he thought the term meant that there was an overlap of some issues for some of the five chapters associated

with the hydraulic fracturing water cycle stages (i.e., Chapters 4 through 8), and that different perspectives from these chapters were brought out in the major findings discussions within these chapters. He also suggested the word ‘between’ should be changed to ‘among’. Dr. Frithsen noted that the EPA sought the Panel’s advice on whether it clearly identified interdependencies within the draft Assessment Report, and stated that the EPA had concerns that they were ‘stove-piped’ at the end of the EPA’s draft Assessment Report. He noted that, for example, the EPA sought to know whether the draft Assessment Report clearly linked wastewater management with water acquisition since water use was a particular focus area for industry for a variety of reasons, and that if water use could be reduced in hydraulic fracturing operations, the demand for water could be reduced. He stated that the EPA tried to identify similar interrelationships within the draft Assessment Report.

A Panel member commented that a separate question should be included on identifying relationships between the stages of hydraulic fracturing. Dr. Dzombak suggested revising sub-question c to be two separate questions: “In Chapter 10, have interrelationships and major findings for the major sections of the water cycle been adequately explored and identified? Are there other major findings that have not been brought forward.”

A Panel member expressed concerns regarding Panel member preliminary individual comments on the Executive Summary of the EPA’s draft Assessment Report, and noted it was difficult to identify key issues that should be included within the Executive Summary. The Panel member noted that it would be more appropriate to identify what the Executive Summary was missing. Another Panel member noted that the existing charge question asked whether Chapter 10 and the Executive Summary were consistent and had similar emphasis with the body of the draft Assessment Report. Dr. Dzombak noted that ideas on how to comment on the Executive Summary would change as the Panel reviews different parts of the EPA’s draft Assessment Report. He noted that preliminary individual comments on the Executive Summary may be more preliminary than comments on other sections of the EPA’s draft Assessment Report. He stated that preliminary individual Panel member comments before the meeting were important, and that Panel advice on consistency with major findings would evolve as Panel’s October 28-30, 2015 public meeting progressed.

A Panel member noted there were some typographical errors in the charge questions, and Dr. Dzombak noted Panel members should send DFO Edward Hanlon an email identifying those errors.

Dr. Dzombak asked if Panel members had any additional comments on Charge Question 8. Hearing none, Dr. Dzombak asked DFO Edward Hanlon to summarize next steps and action items.

Wrap Up and Remaining Issues, Action Items and Next Steps

A Panel member asked about the process that Panel members should follow in submitting their preliminary individual Panel member comments, and whether it was acceptable to submit preliminary individual member comments after the requested date of October 12, 2015. Dr. Dzombak noted that Panel members should develop their individual preliminary comments on their assigned Lead Discussant charge questions before the meeting, and that it was common that Panel members evolved in their thinking as the Panel developed advice and points of consensus. He noted there would be writing groups at the meeting, and that the preliminary individual Panel member comments would help Panel members in those writing sessions. He noted that the

preliminary individual Panel member comments would not be appended to the final SAB consensus report, but rather would be posted on SAB's website for the Panel's and public consideration.

DFO Edward Hanlon summarized next steps for the Panel:

October 5, 2015: Panel members should send DFO Edward Hanlon an email identifying any typographical errors in the charge questions.

By October 9, 2015: SAB Staff Office would post final revised charge questions on SAB's website and email those revised charge questions to the Panel.

October 12, 2015: Panel members would send in their individual Panel member preliminary written comments, and by October 13, 2015, a compilation of these individual Panel member preliminary written comments would be emailed to Panel members and also posted onto SAB's October 28-30, 2015 meeting website.

October 15, 2015: An updated version of the table of public comments that was posted on September 14 and 28 would be posted onto SAB's October 28-30, 2015 meeting website. This table would include all written public comments posted in the EPA's Docket as of October 14th on both the EPA's draft Assessment Report and draft charge questions, and include notes from Dr. Elizabeth Boyer, Dr. Susan L. Brantley, and Mr. Walt Hufford on which comments relate to charge questions, appendices or references.

October 19, 2015 Teleconference: This teleconference would occur if the SAB Staff Office determines that there would be insufficient time during the October 28-30, 2015 Panel meeting to accommodate the members of the public who registered in advance to provide oral public comments. DFO Edward Hanlon would email the Panel by October 18, 2015 if the teleconference was cancelled due to insufficient need for the call. A cancellation notice would be posted onto the October 19 SAB Panel teleconference website.

October 28-30, 2015 Panel Public Meeting

Dr. Dzombak asked if Panel members had any additional comments to make. Hearing none, he noted that since all agenda items for the September 30, 2015 teleconference were completed, the Panel's teleconference scheduled for October 1, 2015 from noon to 5pm Eastern was cancelled. DFO Edward Hanlon noted that he would place a cancellation notice on SAB's October 1st teleconference website.

Dr. Dzombak asked if the Panel members had any additional questions or comments. Hearing none, Dr. Dzombak thanked the Panel members, the EPA staff, and SAB Staff Office. With the meeting business concluded, the Designated Federal Officer adjourned the meeting at 4:30 pm ET.

Respectfully Submitted:

/signed/

Mr. Edward Hanlon
Designated Federal Officer

Certified as Accurate:

/signed/

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

NOTE AND DISCLAIMER: The minutes of this public meeting reflect diverse ideas and suggestions offered by Panel members during the course of deliberations within the meeting. Such ideas, suggestions and deliberations do not necessarily reflect consensus advice from the Panel members. The reader is cautioned to not rely on the minutes to represent final, approved, consensus advice and recommendations offered to the Agency. Such advice and recommendations may be found in the final advisories, commentaries, letters or reports prepared and transmitted to the EPA Administrator following the public meetings or teleconferences.

Materials Cited

The following meeting materials are available on the SAB website (www.epa.gov/sab) or through the following SAB Hydraulic Fracturing Research Advisory Panel May 7-8, 2013 meeting webpage:

<http://yosemite.epa.gov/sab/sabproduct.nsf/a84bfee16cc358ad85256ccd006b0b4b/4c118116b09087f185257e4a004a04da!OpenDocument&Date=2015-09-30>

¹ June 5, 2015 Federal Register Notice announcing the public meeting (80 FR 32111 – 32113)

² Agenda for September 30, 2015 public teleconference

³ EPA Presentation - Assessment of Potential Impacts of HF for Oil and Gas on DW Resources

ATTACHMENT A – ROSTER

U.S. Environmental Protection Agency Science Advisory Board Hydraulic Fracturing Research Advisory Panel

CHAIR

Dr. David A. Dzombak, Hamerschlag University Professor and Department Head, Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh, PA

MEMBERS

Dr. Stephen W. Almond, Director of Research & Development, Fritz Industries, Inc, Houston, TX

Dr. E. Scott Bair, Emeritus Professor, School of Earth Sciences, Ohio State University, Columbus, OH

Dr. Peter Bloomfield, Professor, Statistics Department, North Carolina State University, Raleigh, NC

Dr. Steven R. Bohlen, State Oil and Gas Supervisor, and Head of the Division of Oil, Gas and Geothermal Resources (DOGGR), State of California Department of Conservation, Sacramento, CA

Dr. Elizabeth W. Boyer, Associate Professor, Department of Ecosystem Science & Management, Pennsylvania State University, University Park, PA

Dr. Susan L. Brantley, Distinguished Professor of Geosciences and Director, Earth and Environmental Systems Institute, Pennsylvania State University, University Park, PA

Dr. James V. Bruckner, Professor of Pharmacology and Toxicology, Department of Pharmaceutical and Biomedical Sciences, College of Pharmacy, University of Georgia, Athens, GA

Dr. Thomas L. Davis, Professor, Department of Geophysics, Colorado School of Mines, Golden, CO

Dr. Joseph J. DeGeorge, Global Head of Safety Assessment and Laboratory Animal Resources, Merck Research Laboratories, Lansdale, PA

Dr. Joel Ducoste, Professor, Civil, Construction, and Environmental Engineering Department, North Carolina State University, Raleigh, NC

Dr. Shari Dunn-Norman, Professor, Geosciences and Geological and Petroleum Engineering Department, Missouri University of Science and Technology, Rolla, MO

Dr. Katherine Bennett Ensor, Professor and Chair, Department of Statistics, Rice University, Houston, TX

Dr. Elaine M. Faustman, Professor, Department of Environmental Health, and Director, Institute for Risk Analysis and Risk Communication, School of Public Health, University of Washington, Seattle, WA

Mr. John V. Fontana, Professional Geologist and President, Vista GeoScience LLC, Golden, CO

Dr. Daniel J. Goode, Research Hydrologist, U.S. Geological Survey, Pennsylvania Water Science Center, Exton, PA

Dr. Bruce D. Honeyman, Associate Vice President for Research and Emeritus Professor of Environmental Science and Engineering, Colorado School of Mines, Golden, CO

Mr. Walter R. Hufford, Director of Government and Regulatory Affairs, Talisman Energy USA Inc. - REPSOL, Warrendale, PA

Dr. Richard F. Jack, Director, Vertical Marketing for Environmental and Industrial Markets, Thermo Fisher Scientific Inc., San Jose, CA

Dr. Dawn S. Kaback, Principal Geochemist, Amec Foster Wheeler, Denver, CO

Dr. Abby A. Li, Senior Managing Scientist, Exponent Health Sciences, Exponent, Inc., San Francisco, CA

Mr. Dean N. Malouta, White Mountain Energy Consulting, LLC, Houston, TX

Dr. Cass T. Miller, Daniel A. Okun Distinguished Professor of Environmental Engineering, Department of Environmental Sciences and Engineering, University of North Carolina, Chapel Hill, NC

Dr. Laura J. Pyrak-Nolte, Professor, Department of Physics, College of Science, Purdue University, West Lafayette, IN

Dr. Stephen Randtke, Professor, Department of Civil, Environmental, and Architectural Engineering, University of Kansas, Lawrence, KS

Dr. Joseph N. Ryan, Professor of Environmental Engineering and Bennett-Lindstedt Faculty Fellow, Department of Civil, Environmental, and Architectural Engineering, University of Colorado-Boulder, Boulder CO

Dr. James E. Saiers, Clifton R. Musser Professor of Hydrology and Associate Dean of Academic Affairs, School of Forestry and Environmental Studies, Yale University, New Haven, CT

Dr. Azra N. Tutuncu, Professor and Harry D. Campbell Chair, Petroleum Engineering Department, and Director, Unconventional Natural Gas and Oil Institute, Colorado School of Mines, Golden, CO

Dr. Paul K. Westerhoff, Professor, School of Sustainable Engineering and The Built Environment, Ira A. Fulton Schools of Engineering, Arizona State University, Tempe, AZ

Dr. Thomas M. Young, Professor of Civil and Environmental Engineering, University of California – Davis, Davis, CA

SCIENCE ADVISORY BOARD STAFF

Mr. Edward Hanlon, Designated Federal Officer, U.S. Environmental Protection Agency, Science Advisory Board Staff, Washington, DC

ATTACHMENT B – Other Attendees

List of Members of the Public Who Requested Information on Accessing the Teleconference Line or Live Audio Webcast, or Who Participated On the Live Audio Webcast: September 30, 2015

Name	Affiliation
Akhavan, Maryam	No Affiliation Given
Alford, Dulce	Missouri S&T
Anderle, Anneliese	CFROG
Aschenbach, Ernie	Virginia Department of Game and Inland Fisheries
Aubie, Karissa	Environment Canada
Backus, Ann	Harvard School of Public Health
Beale, John C.	No Affiliation Given
Borawski, Teddy	State of Pennsylvania
Cluff, Maryam	EPA
Crane, Jessica	No Affiliation Given
De Marcellis-Warin, Nathalie	Harvard School of Public Health
Demirkanli, Inci	The Cadmus Group, Inc.
DiCosmo, Bridget	Inside EPA
Dobson, Natenna	U.S. Department of Energy
Dutton, Steve	EPA
Fleming, Megan	EPA
Gibbons, Dayna	EPA
Gillespie, Andrew	EPA
Harmon, Shani	Baker Botts LLP
Hecker, Jennifer	No Affiliation Given
Hoffman, Jeffrey L.	New Jersey Geological & Water Survey
Hoverman, Taylor	No Affiliation Given
Jackson, Tom	Baker Botts LLP
Johnston, Gretel	BEST/MATRR
Kassim, Rashid	No Affiliation Given
Klewicki, Ken	The Cadmus Group, Inc.

Name	Affiliation
Knights, Chris	EPA
Koplos, Jonathan	The Cadmus Group, Inc.
Kraemer, Stephen	EPA
LeDuc, Stephen	EPA
Lees, Michael	South Dakota DENR
Maloney, Kelsey	EPA
Meeker, Jessica	University of Pennsylvania
Murray, Chad	ABC News
Oxenford, Jeff	Oxenford Consulting, LLC
Pearen, Holly	Environmental Defense Fund
Penning, Trevor	University of Pennsylvania
Pepino, Richard V.	University of Pennsylvania
Perry, Dale	EPA
Quigley, James	Stony Brook University
Ring, Shari	The Cadmus Group, Inc.
Ross, Mary	No Affiliation Given
Schagrin, Zachary	NJDEP
Scott, James	San Joaquin Chemicals, Inc.
Simmons, William	LWVNJ
Solomon, Sarah	No Affiliation Given
Stanek, John	EPA
Teichman, Kevin	EPA
Tuccillo, Mary Ellen	The Cadmus Group, Inc.
Ware, Pat	Bloomberg BNA
Weaver, Jim	EPA
Weber, Anna	The Cadmus Group, Inc.
Weber, Caitlin	No Affiliation Given
White, Kim	Baker Botts LLP
Wiser, Nathan	EPA