From: Stephanie Meadows
Sent: Tuesday, April 30, 2013 3:46 PM
To: Hanlon, Edward
Subject: API, ANGA, AXPC, IPAA joint comments on EPA's Request for Information to Inform Hydraulic Fracturing Research Related to Drinking Water Resources (77 Federal Register 67361) – Docket ID No. EPA-HQ-ORD-2010-0674.

Dear Mr. Hanlon:

Please find attached the comments of the American Petroleum Institute, America's Natural Gas Alliance, American Exploration and Production Council, and the Independent Petroleum Association of America on EPA's Request for Information to Inform Hydraulic Fracturing Research Related to Drinking Water Resources (77 Federal Register 67361) – Docket ID No. EPA-HQ-ORD-2010-0674. This submission contains one large PDF file and we would like it to be considered by the Hydraulic Fracturing Research Advisory Panel in advance of its May 7-8, 2013 public meeting.

Should you have any questions or problems receiving the document, please contact me directly.

Regards,

Stephanie Meadows

Stephanie R. Meadows
Senior Policy Advisor
Upstream
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Washington, DC 20005
[redacted]

April 30, 2013

U.S. Environmental Protection Agency
EPA Docket Center
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Washington, DC. 20460

Re: Comments of the American Petroleum Institute, America's Natural Gas Alliance, American Exploration and Production Council, and the Independent Petroleum Association of America on EPA's Request for Information to Inform Hydraulic Fracturing Research Related to Drinking Water Resources (77 Federal Register 67361) – Docket ID No. EPA-HQ-ORD-2010-0674

Dear Docket Clerk:

From the outset, the oil and gas industry, represented by its Washington, DC trade associations -- the American Petroleum Institute (API), America's Natural Gas Alliance (ANGA), American Exploration and Production Council (AXPC), and the Independent Petroleum Association of America (IPAA) -- has sought to actively engage in the Environmental Protection Agency's (EPA) research investigating the potential relationship between hydraulic fracturing and drinking water resources. The industry has provided constructive comments and input at every possible opportunity and has on numerous occasions offered the direct counsel of our scientific and technical experts. Our member organizations support the Congressional request and the corresponding mandate to use "a transparent, peer reviewed process" in order to "ensure the validity and accuracy of the data" and produce credible findings based on sound scientific analysis.

The technical comments provided in this letter further demonstrate industry's unfaltering commitment to provide a technical perspective vital to ensuring the scientific merit of EPA's research. We hope the agency considers the attached responses to the charge questions EPA submitted to its *ad hoc* SAB Panel[1] and our comments on the EPA 2012 Progress Report.

In general, the technical comments provide are related to the following aspect of EPA's study:

[1] Identified on the SAB's website: http://yosemite.epa.gov/sab/sabproduct.nsf/02ad90b136fc21ef85256eba00436459/B436304BA804E3F885257A5B00521B3B/$File/Charge+Questions-HF+Panel-May+2013+meeting-Final.pdf

- ***Purpose:*** EPA has not appropriately acknowledged the limitations of its research to achieve the agency's stated goal of informing the public and providing decision-makers at all levels with high-quality scientific knowledge that can be used in decision-making processes.
- ***Scope:*** EPA appears to have deviated from Congress' request and the agency's stated scope of examining the relationship between hydraulic fracturing and drinking water resources.
- ***Systematic Planning:*** There is evidence that EPA's research would have benefited from a more robust and inclusive systematic planning process.
- ***Quality:*** There is a lack of alignment, in terms of content and timing of approvals, associated with EPA's quality documents (e.g., QAPP, QMP) and research implementation.
- ***Context:*** Critical context has been excluded from the study design, which significantly influences the value of any associated research results for the purpose of informing the public and decision makers. EPA's study approach should acknowledge state, local, and oil and gas industry requirements, plans, procedures and/or actions to prevent and respond to unfavorable conditions.

ANGA, API, AXPC, and IPAA appreciate the opportunity to provide these important comments and materials to EPA as part of the request for information. We will continue to work with EPA as constructive partners in this process and provide input on this critically important highly influential scientific assessment. We appreciate your recognition that openness, transparency, and stakeholder involvement are all integral parts to a successful hydraulic fracturing study.

Sincerely,

Amy Farrell
Vice President, Regulatory Affairs
America's Natural Gas Alliance

Erik Milito
Group Director
Upstream and Industry Affairs
American Petroleum Institute

V. Bruce Thompson
President
American Exploration & Production Council

Lee O. Fuller
Vice President of Government Relations
Independent Petroleum Association of America

cc: Jeanne Briskin, Office of Research and Development, U.S. Environmental Protection Agency
Edward Hanlon, Designated Federal Officer, Science Advisory Board
Dr. Glenn Paulson, Science Advisor, Office of the Administrator, U.S. Environmental Protection Agency
Robert M. Sussman, Senior Policy Counsel, U.S. Environmental Protection Agency
E. Ramona Travato, Associate Assistant Administrator, Office of Research and Development, U.S. Environmental Protection Agency

Responses to SAB Panel Charge Questions

Water Acquisition

1. *Water Quality.* What spatial and temporal scales should be considered for this analysis to best characterize the impacts, if any, on the quality of water used as a source of drinking water?

   Water use should be investigated holistically considering all water users; similar to state water planning processes. The oil and gas sector is a relatively small water user when compared to total water use. It is unclear how water quantity and quality impacts will be attributed to oil and gas operations, specifically hydraulic fracturing, within EPA's research given the connectivity between all water users and water resources. Water quality impacts associated with water acquisition that are not unique to hydraulic fracturing should not be attributed to the process, regardless of the spatial or temporal scales selected by EPA.

   - *Texas 2008: 0.003% (57 k acre-feet) and 0.002% (35.8 k acre-feet) of the total water use was O&G and hydraulic fracturing, respectively.*[2]
   - *Texas 2010: Mining, which includes but is not limited to the oil and gas sector, made up 1.8% of the total state water use.*[3]
   - *Colorado 2010: 0.08% (13.9 k acre-feet) of the total state water use was hydraulic fracturing.*[4]
   - *Oklahoma 2012: Oil and gas drilling and hydraulic fracturing accounts for a very small fraction (less than 1%) of freshwater use in Oklahoma.*[5]

   It is concerning that EPA has not referenced or considered incorporating state water planning processes or reports within the agency's research. When considering water use as an energy investment, unconventional oil and gas has one of the highest rates of return[6] *relative to other energy sources.*

   Regional, state, and local water regulators and water ownership legal doctrines appropriately allocate all water rights. Regulators' water management efforts include responding to short-term and long-term local environmental conditions. This context should be incorporated into the study design to avoid unrealistic and biased results; specifically, the scenario models must consider the existing regulatory structure (e.g., private property right issues associated with water rights), as well as operational boundaries.

   In direct response to EPA's charge questions, the agency should include a diverse range of spatial and temporal scales within the agency's research to ensure an appropriate level of context is provided to the public. Without the appropriate context

[2] http://www.senate.state.tx.us/75r/Senate/commit/c510/handouts12/0110-RRC.pdf
[3] http://www.twdb.state.tx.us/waterplanning/waterusesurvey/estimates/
[4] http://cogcc.state.co.us/Library/Oil_and_Gas_Water_Sources_Fact_Sheet.pdf
[5] http://oklahomawatersurvey.org/d1/wp-content/uploads/2012/10/04-OGS.pdf
[6] http://www.epa.gov/hfstudy/09_Mantell_-_Reuse_508.pdf

surrounding water quality impacts associated with water acquisition in general, and those specific to hydraulic fracturing, research results will not contribute to EPA's goal to inform the public and provide decision-makers at all levels with high-quality scientific knowledge that can be used in decision-making processes.

2. *Water Quality.* Please identify the most important water quality characteristics that should be considered.

   It is unclear how water quantity and quality impacts will be attributed to oil and gas operations, or specifically hydraulic fracturing, within EPA's research given the connectivity between all water users and water resources. Since water acquisition is not unique to hydraulic fracturing, water quality impacts associated with water acquisition would not be unique to hydraulic fracturing. Therefore, no water quality characteristic can be considered specifically or arbitrarily attributed to water acquisition associated with hydraulic fracturing.

3. *Water Availability.* What spatial and temporal scales should be considered for this analysis to best characterize the impacts, if any, on the availability of water used as a source of drinking water?

   Water use should be investigated holistically considering all water users; similar to state water planning processes. The oil and gas sector is a relatively small water user when compared to total water use. It is unclear how water quantity and quality impacts will be attributed to oil and gas operations, specifically hydraulic fracturing, within EPA's research given the connectivity between all water users and water resources. Water quality impacts associated with water acquisition that are not unique to hydraulic fracturing should not be attributed to the process, regardless of the spatial or temporal scales selected by EPA.

   It is concerning that EPA has not referenced or considered incorporating state water planning processes or reports within agency's research. Regional, state, and local water regulators and water ownership legal doctrines appropriately allocate all water rights and, as part of their water management efforts, respond to short-term and long-term local environmental conditions. This context should be incorporated into the study design to avoid unrealistic results; specifically, the scenario models must consider the existing regulatory structure (e.g., private property right issues associated with water rights), as well as operational boundaries.

   Given the insignificant use of fresh water in the Upper Colorado River Basin (UCRB) for the hydraulic fracturing process (i.e., 100% reused water), it appears EPA has stepped outside the scope ("hydraulic fracturing water life-cycle") of the study to investigate land use (i.e., pad constructions). It is recommended that EPA not expand the scope of the UCRB research beyond the hydraulic fracturing process.

   There appear to be significant flaws in EPA's identified future modeling scenarios and associated assumptions. For example, the model does not appear to take into consideration local regulatory authority to prioritize water use during drought conditions and operational practices to acquire/store water during wet seasons. The modeling also does not appear to account for opportunities for use of water under other existing water use permits. The inclusion of two additional scenarios in the analysis would be of value;

"no hydraulic fracturing activity" and "low hydraulic fracturing activity" scenarios. These scenarios would provide the appropriate context necessary to understand the relative influence of hydraulic fracturing on water availability for a given area.

We also encourage the agency to avoid the use of the term "green technologies" as there is no pre-defined set of technologies or practices that can be considered "green" in all operating situations. For example, in some cases simple fresh water acquisition and Class II UIC disposal of produced water could be the "greenest" alternative from a holistic environmental/multi-media perspective.

In direct response to EPA's charge questions, the agency should include a diverse range of spatial and temporal scales within the agency's research to ensure an appropriate level context is provided to the public. Without the appropriate context surrounding water availability impacts associated with water acquisition in general and those specific to hydraulic fracturing research results will not contribute to EPA's goal to inform the public and provide decision-makers at all levels with high-quality scientific knowledge that can be used in decision-making processes.

Chemical Mixing

1. Given the data sets available, what information on fluid composition, factors affecting composition, and/or trends in composition of hydraulic fracturing fluids may be most useful for identifying potential impacts to drinking water resources across the United States?

   Fluid composition, factors affecting composition, and/or trends in composition should not be EPA's primary focus as it investigates the potential relationship between drinking water resources and hydraulic fracturing. EPA's study approach should acknowledge state, local, and oil and gas industry requirements, plans, procedures and/or actions to prevent, respond and control leaks and/or releases. In the rare occurrence of an unintentional environmental release, industry members act appropriately in conjunction with local authorities and in accordance with regulatory requirements to limit the impact on the environment and ensure the health and safety of the public. Not considering these facts will undoubtedly result in conclusions that are misrepresentative.

   The ultimate goal of hydraulic fracturing is to stimulate the unconventional reservoir in order to recover hydrocarbons in the safest and most efficient manner possible. The composition of fracturing fluids and associated chemical additives used are fit for purpose, optimized to deliver the desired production performance and, therefore, designed to obtain the greatest return on the natural resources (e.g., water used, surface disturbance, etc.) and financial investment made throughout the well development process. This includes the use of chemicals for well integrity assurance. Significant technological advancements have recently been made in increasing the efficiency of fracturing-execution, including methods to decrease the total volume of injected fluid, chemical additives, and propping agents. There is no simple formula or process that constitutes the most effective and environmentally friendly approach to well stimulation. For example, more benign chemicals, in some cases, can reduce the

efficiency of stimulation and result in additional wells, re-stimulation, additional cost, and/or lower ultimate recovery from the well. Thus, what might through a simplistic lens appear to be environmentally beneficial could actually increase the overall environmental footprint associated with development.

Hydraulic fracturing fluid composition varies among plays. Water is by far the most common base fluid, however, other media (e.g., nitrogen, propane, CO_2, etc.) have been utilized and continue to be evaluated for application on a case-by-case basis. After the base fluid, proppant is typically the second largest component of which sand is the common material used. Additives make up a small fraction (typically <1%) of the total frac fluid volume, and they are added only as required to achieve stimulation and well integrity performance objectives. Changes in additive make-up generally occur throughout the discovery and development of a play due to continuous refinement and improvement for treatment performance and, ultimately, hydrocarbon recovery.

The development and application of hydraulic fracturing additives that can perform effectively when produced water or alternative water sources are used in stimulation fluids can reduce alternate dependency on fresh water use. Operators and service companies continue to develop and apply more benign chemical additives and fracturing fluid mixtures on a case-by-case basis. Intellectual property right protection can have a significant impact on corporate incentives to develop technologies in these areas.

The general composition of hydraulic fracturing additives is known and many hydraulic fracturing chemical additives are found in common household products.[7] MSDS' contain information that is necessary to understand the potential health and safety hazards. The study focus should be placed on the known major constituents, not investigation of trace elements and impurities. There are also opportunities to improve the analytical methods used for laboratory testing of additives.

2. What key historical changes or current trends, if any, in hydraulic fracturing fluid composition should be considered as the EPA assesses the chemicals listed in Appendix A?

   The agency should not inappropriately generalize results; it is strongly recommended that EPA evaluate all data within an appropriate temporal and spatial context. All historical data collected - including that obtained during EPA's RFI processes - should be analyzed in the appropriate context, accounting for continuous industry practice[8] and more protective state regulatory programs that evolve as both parties use their operational experience to innovate and strive for the common goal of maximizing production while ensuring protection of the environment and health and safety of personnel and the public.

3. What criteria should be considered when identifying indicator chemicals, and why?

[7] http://www.same-satx.org/briefs/120410-holditch.pdf
[8] http://www.askchesapeake.com/Pages/Green-Frac.aspx

The use of key indicator compounds (TDS, Cl, and divalent cations) is the most reliable, efficient, and cost effective method for the initial investigation of suspected or known produced water releases. The concept of utilizing indicator compounds in the environmental field is well established[9] (e.g., Ohio[10], Louisiana[11], Oklahoma[12], Arkansas[13], California[14], Texas[15], etc.).

Sampling and analyzing for key indicator compounds using current proven analytical methods in multiple matrices offers a superior alternative to the development of new methods for constituents that will change as hydraulic fracturing fluids evolve. In the unlikely event of a produced water release, TDS, TPH, chloride, sodium, bromide, sulfate, etc. are well suited indicators. These compounds have been historically evaluated in many, if not most, groundwater aquifers used for domestic purposes, providing good background data for comparative purposes. The identification and use of key indicator compounds representative of a known hydraulic fracture fluid composition that can be detected using existing approved methods can eliminate the need for the development and use of new analytical methods. Analytical methods, which evaluate groups of compounds, e.g. TOC, TPH, TKN, etc., may be useful in getting sufficient information to assess the impact of fluid releases in an emergency situation.

Toxicity should not be a selection criterion for indicator compounds when the primary goal is to determine the relationship, if any, between hydraulic fracturing and drinking water. Caution should be taken when attempting to use glycols as an indicator because they are ubiquitous in the environment and are found in laboratory preservatives, water well construction material, and automotive anti-freeze. Iron and manganese are also poor indicators to use since they are highly influenced by sediment in the water samples. The following criteria should be considered when identifying key indicator compounds:

- *Frequency of occurrence in hydraulic fracturing fluids and produced water*
- *Uniqueness to hydraulic fracturing and produced water*
- *Stability and mobility in the environmental (fate and transport)*
- *Availability of instrumentation/detection systems, limits, and approved analytical methods for the parameter.*

Well Injection

[9] National Environmental Monitoring Conference, Topics in Shale Gas Exploration Session, August 7, 2012 http://nemc.us/meeting/2012/nemc-program.php#apm7_6 (Coleman, McElreath, Mantell)
[10] http://www.epa.state.oh.us/portals/30/rules/DI-033.pdf
[11] http://www.deq.louisiana.gov/portal/Portals/0/RemediationServices/APPENDIXD.pdf
[12] http://www.occeweb.com/rules/Chapter%2029%20Effective%207-1-09%20SOS.pdf
[13] http://www.adeq.state.ar.us/hazwaste/branch_tech/pdfs/tph_sls_web_version.pdf
[14] http://www.dtsc.ca.gov/AssessingRisk/upload/HHRA-Note-4.pdf
[15] http://www.tceq.texas.gov/publications/rg/rg-366_trrp_27.html

1. Given that hydraulic fracturing occurs at different depths and in different types of rock formations, please comment on how to best use results from these simulations to answer the research questions listed in Table 26 (page 62).

   Modeling the subsurface is inherently an extremely complex problem. Using a simplified modeling approach can lead to incorrect conclusions, particularly if limitations of the modeling approach are not fully acknowledged and understood and the results are not presented in the appropriate context.

   The scenarios, assumptions, and verification do not appear to be presented in enough detail within the study plan, progress report or LBNL Modeling QAPP to guide this highly influential research or inform peer reviewers. All presented scenarios are based on multiple barriers failing. The most valuable scenarios – no hydraulic fracturing and no failures - are missing from this research. Based on publically available information regarding this research effort, the usefulness of the current modeling effort is limited.

   It is concerning that this charge question appears to be indicative of a lack of systematic planning by EPA. The modeling research should have been designed specifically to answer appropriate research charge questions.

2. Please comment on other ways the information listed above may be used to characterize the effectiveness of well construction and operation practices at protecting drinking water resources.

   Wells are designed with multiple barriers (steel, cement, seals, etc.) intended to isolate ground water resources from the target hydrocarbon reservoirs and fluids flowing in the well. EPA should consider all layers of protection that are currently required or widely practiced, as well as monitoring and response capabilities. Each layer of protection should be assessed independently, rather than EPA's current methodology that assumes multiple layers fail without consideration of monitoring and response. A well barrier can fail internally but will not result in a release to the environment when outer barriers confine the failure. This context should be included when presenting well failure information to the public and other stakeholders.

   EPA's study approach does not appear to acknowledge state, local, and oil and gas industry plans, procedures and/or actions to respond to abnormal conditions (e.g., indication of potential or actual barrier failure). In the rare occurrence of an abnormal condition, industry members act appropriately in conjunction with local authorities and in accordance with regulatory requirements to limit the impact on the environment and ensure the health and safety of the public. Not considering this fact will undoubtedly result in conclusions that are misrepresentative.

   EPA should assess all information about barriers and risk management practices holistically. A well-established risk assessment and risk characterization framework is appropriate for this (and other) research topics.

Flowback and Produced Water

1. Please identify specific data or literature on the composition of flowback and produced water in other areas of the country.

   Produced water characteristics vary significantly temporally within, and spatially between, basins, formation, and wells. EPA does not appear to have captured the breadth of these variations within the agency's current plan. The characteristics of produced water have been studied significantly by USGS[16]. Analytical techniques used to characterize produced water must be robust to the matrix interferences resulting from high TDS concentrations.[17] Industry has and continues to participate in a number of collaborative groups regarding the characterization of produced water - Brine Chemistry Consortium[18] (20 + years) and Shale Water Research Center[19] (1 year).

   EPA has made a distinction between produced water and flowback. Produced water consists of all water that is returned to the surface through a well borehole. "Flowback" process water should be considered a subset of produced water returned during the flowback process. The only factor that is used in defining this subset of produced water is the time period in which the water is returned to the surface through the well borehole. It is not necessary or appropriate to use the term "flowback" to differentiate produced water quality.

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

   "Reported" or "potential" spills that have not been confirmed/validated should not be considered reliable data for a risk (likelihood and severity) analysis. For example, tip or complaint lines should not be considered appropriate data resources. In addition, many spills that are still reported may have been isolated through containment devices lined with impermeable materials (i.e., synthetic liner, coated concrete, steel, or compacted clay). Spills kept within impermeable containments have little or no potential to impact underlying soils or groundwater. Caution needs to be taken when evaluating spill databases to ensure accuracy, consistency, and comparability of reported spills, including the appropriate segregation of spill types (e.g., solids or liquids) and ensuring spills that were reported by more than one entity are captured only once in the analysis. Spills related to auxiliary activities and/or processes (e.g., pipelines) should not be included in this evaluation because it is out of the scope of the study.

   EPA's study approach does not appear to acknowledge state, local, and oil and gas industry plans, procedures and/or actions to respond and control leaks and/or releases. In the rare occurrence of an unintentional environmental release, industry members act appropriately in conjunction with local authorities and in accordance with regulatory requirement to limit the impact on the environment and ensure the health and safety of

[16] http://energy.cr.usgs.gov/prov/prodwat/
[17] http://www.epa.gov/hfstudy/producedformationwatersampleresultsfromshaleplays.pdf
[18] http://www.brinechem.rice.edu/partners.cfm
[19] http://www.shalewatercenter.com/

the public. Not considering this fact will undoubtedly result in conclusions that are misrepresentative.

Like other industries, the oil and gas sector continues to develop and deploy practices that reduce associated environmental risks. These practices are typically evaluated on a case-by-case basis with careful consideration of unintentional consequences. For example, regarding spills, pad containment and various construction materials can be used to mitigate the risk of release to the environment.

It is concerning that this charge question appears to be indicative of a lack systematic planning by EPA. The research should have been designed specifically to answer appropriate research charge questions.

Wastewater Treatment and Waste Disposal

1. Please provide recommendations for other specific chemicals that are of interest from a wastewater treatment and/or drinking water treatment perspective.

   Sampling and analyzing key indicator compounds utilizing current proven analytical methods in multiple matrices offer a superior alternative to the development of new methods for constituents that will change based on local conditions and over time as hydraulic fracturing fluids evolve. Within EPA's 2012 Progress Report, the agency clearly states that chemicals found in hydraulic fracturing additives are ubiquitous and many of the parameters of interest are naturally occurring. Understanding background conditions and natural variation (including seasonality and intra-well variability) in parameters of interest is critical to determining if an impact has occurred and assessing the possible cause of the alleged impact.

2. What key trends in wastewater management, if any, may affect the volume and/or composition of hydraulic fracturing wastewater being treated and discharged to surface water?

   Industry strives for continuous improvement in the application of produced water management alternatives. These efforts are driven by stewardship, environmental/corporate risk reduction, and economics. A number of complex operational, logistical, environmental, health, safety, regulatory, and economic factors and associated risks are evaluated prior to the development, selection, and implementation of produced water management practices or strategies. The interrelationships and trade-offs among the various aspects of decision factors industry uses in determining water management practices should be carefully considered and addressed for this study. For example, reuse of produced water for hydraulic fracturing could require more chemical volume, less benign chemicals, and/or more storage and treatment facilities. The complexities and tradeoffs involved in determining the most efficient or environmentally benign approach to development require case-by-case analysis based on local conditions and should not be generalized in the study.

   Class II disposal wells, regulated under EPA's Underground Injection Control (UIC) program, are the primary method for produced water disposal and require zero surface

discharge. And, the composition of all wastewater discharge, including discharge of any wastewater from oil and gas operation to surface water, is regulated under the National Pollution Discharge Elimination System (NPDES) permit program. EPA or states issue permits that establish water quality treatment standards and volumetric limits for effluent, which are frequently monitored, analyzed, and reported to demonstrate compliance with the standards and limits established.

Page	Section	Report Citation	Comment	References
1	ES	The purpose of the study is to assess the potential impacts of hydraulic fracturing on drinking water resources, if any, and to identify the driving factors that may affect the severity and frequency of such impacts.	Throughout the report the discussion of potential risk (likelihood and uncertainty) needs to be included. A review of hazards and factors without this context will lead to misunderstanding. Hazards, factors, and likelihood should be presented in a relative manner to the public; specifically, the EPA should provide examples and comparisons of relative risks that are familiar to the public. Sequence - more specifically the lack of sequence - of research is concerning. There appears to be activity that should be taking place in series, rather than taking place in parallel. This will reduce the value of some of the research.	
1	ES	Information presented as part of this report cannot be used to draw conclusions about potential impacts to drinking water resources from hydraulic fracturing.	This is an important disclaimer. Based on a critical review of associated study materials, this disclaimer may be necessary for all reports associated with EPA's HF research.	
2	ES	Data within these records are being scrutinized to assess the effectiveness of current well construction practices at containing gases and liquids before, during, and after hydraulic fracturing.	Overwhelming data shows that the hydraulic fracturing technique poses little risk to groundwater due to multiple geological and well design features. Industry recognizes that sound operational practices concerning well construction and integrity, water management, air emissions, and surface impacts exist and must be followed to prevent accidental releases and mitigate other concerns (Fisher 2010, 2012; King 2010, 2012; Kell, 2011; Arthur, 2009, 2012).	
2	ES	Identified hypothetical, but realistic, scenarios pertaining to the water acquisition, well injection, and wastewater treatment and waste disposal stages of the water cycle.	States have established regulations to manage sourcing/acquisition, produced water disposal, and treatment (e.g., permitting, construction, operation, etc.) and are continually updating these requirements as appropriate for local conditions. This context should be incorporated into the study design. Consultation with regional, state, and local regulators, as well as industry, in the areas of this research is critical to ensure scenarios are realistic and consistent with their historical laws and policies.	
3	ES	As a first step, the subsurface migration simulations will examine realistic scenarios to assess the conditions necessary for hydraulic communication rather than the probability of migration occurring.	Realistic scenario would consider regulation and practices in place to identify and respond to abnormal conditions. For example, casing pressure and annular pressure monitoring are done on every well by mechanical and human monitoring (Augustine, 2010). Automatic pressure relief valves (reliability of approximately 99.99%) are present on most jobs. Ruptured casing during a frac is extremely rare. Without consideration of requirements and practices associated with monitoring and response, scenarios would not be considered realistic.	

Page	Section	Report Citation	Comment	References
3	ES	Laboratory studies are largely focused on identifying potential impacts of inadequately treating hydraulic fracturing wastewater and discharging it to rivers.	The disposal of produced water in POTWs is very rare, if used at all, for unconventional oil and gas operations. The utilization of this option should be managed on a case-by-case basis with a firm understanding of the plants efficiency in removing appropriate compounds. Efficiency of all treatment processes are influenced by technological and operational factors. This context should be incorporated into the study design; specifically, the interpretation of laboratory experiments.	
3	ES	The EPA has identified chemicals reportedly used in hydraulic fracturing fluids from 2005 to 2011 and chemicals found in flowback and produced water.	Timeliness of the data is concerning and presentation of data is misleading to the public and policy makers.	
3	ES	This research will help to identify the source of any contamination that may have occurred.	EPA has not shared how they are going to determine the source of contamination. Paucity of background data and an insufficient study design will hamper EPA's ability to differentiate among all potential sources of contamination. Research methods for determining the source of contamination have not been documented prior to sampling, including the collection of baseline or background data including historical land use and environmental conditions.	
3	ES	Prospective study...involve sites where the research will begin before **well construction**….Water quality will be monitored for **any changes** throughout **drilling**, injection of fracturing fluids, flowback, and production.	A true baseline for hydraulic fracturing would be sampling after drilling and well construction. Data from state investigations and studies in Ohio and Texas (Kell, 2011) show very small percentages of construction well failures leading to pollution and none related directly to fracturing.	
3	ES	Samples of flowback and produced water will be used for other parts of the study, such as assessing the efficacy of wastewater treatment processes at removing contaminants in hydraulic fracturing wastewater.	There appears to be a misconception that all parameters should be removed from produced water during a treatment process. Treatment of produced waters must reflect reuse or disposal criteria.	
4	ES	Increased stakeholder engagement will also allow the EPA to educate and inform the public of the study's goals, design, and progress.	We support increased stakeholder involvement, but are concerned that sufficient engagement and collaboration did not occur at the outset of the planning phase of the study. We also note that the purpose of engagement should not be simply to "allow EPA to educate and inform the public," but that EPA should recognize and incorporate guidance from significant external technical expertise, particularly those experts in industry.	
4	ES	Research products, such as papers or reports, will be subjected to both internal and external peer review before publication, which make certain that the data are used appropriately.	All research products should be considered highly influential and subject to the Data Quality Act and OMB's Guidance. The "individual reports" and papers is a new concept for the EPA HF Study. EPA should publish a list of all individual reports and papers, the peer review plan for each, and the projected timeline for review completion.	

Page	Section	Report Citation	Comment	References
4	ES	The EPA will seek input from individual members of an ad hoc expert panel convened under the auspices of the EPA Science Advisory Board.	EPA should provide all SAB Panel members and other stakeholders with an opportunity to provide input. EPA should not cherry pick the individual members that will be consulted on specific charge questions.	
4	ES	Ultimately, the results of this study are expected to inform the public and provide decision-makers at all levels with high-quality scientific knowledge that can be used in decision-making processes.	EPA should acknowledge the limitations associated with its research and expected report of results. Specifically, the agency appears to be misrepresenting the ability of the public or decision makers to use the information currently being gathered or generated prior to conducting formal risk assessment and risk characterization. In particular EPA should be mindful of the limits the lack of sufficient background data will place on its ability to attribute water quality impairment to any particular potential source of contamination.	http://www.epa.gov/spc/pdfs/rchandbk.pdf
4	ES	Look Forward: From This Report to the Next	There is no acknowledgement of the roundtable and/or workshop technical engagements in this process. EPA should indicate whether and how that process will be used to improve its study methodology.	
6	1	Results from individual projects will undergo peer review prior to publication.	All research products should be considered highly influential and subject to the Data Quality Act and OMB's Guidance. The "individual reports" and papers is a new concept for the EPA HF Study. EPA should publish a list of all individual reports and papers, the peer review plan for each and the projected timeline for review completion.	
7	1.1.	Information presented during the [2011] workshops is being used to inform ongoing research.	There appears to be a wealth of technical information that was presented during EPA's 2011 technical workshops that has not been used to inform the study or it has been referenced incorrectly. EPA should update its website to include an explanation of whether and how presentations from the 2011 workshops were or were not incorporated.	
7	1.1.	ensure that the EPA is current on changes in industry practices and technologies so that the report of results reflects an up-to-date picture of hydraulic fracturing operations	All historic data collected - including that obtained during EPA's RFI processes - should be analyzed in the appropriate context, accounting for continuous industry practice and updated state regulatory programs that evolve as both parties use their operational experience to innovate and strive for the common goal of maximizing production while ensuring protection of the environment and health and safety of personnel and the public.	
7	1.1.	Stakeholder Engagements… These efforts will help: …. Identify **future** research needs.	EPA should focus the agency's finite resources on the scope request by Congress, as recommended by the SAB Environmental Engineering Committee.	http://yosemite.epa.gov/sab/sabproduct.nsf/368203f97a15308a852574ba005bbd01/CC09DE2B8B4755718525774D0044F929/$File/EPA-SAB-10-009-unsigned.pdf
11	2	Table 1. Bradford County, Pennsylvania	Susquehanna County appears to have been arbitrarily removed for the study scope. EPA should include an explanation of how it has revised the study plan and why, including a description of why Susquehanna County was removed.	

Page	Section	Report Citation	Comment	References
11	2	Table 1. Prospective Study...Investigation of potential impacts of hydraulic fracturing through collection of samples from a site before, during, and after well pad construction and hydraulic fracturing	Investigating surface disturbance (i.e., pad construction) appears to be outside the scope of the study and not unique to hydraulic fracturing or oil and gas development. There is a great amount of information and research that has been conducted on this topic and it is not necessary for EPA to reinvent the wheel. It is recommended that the agency not include costly field activities that are not absolutely necessary to answer Congress' request.	
14, 15	2.1.1	The EPA is working to better characterize the amounts and sources of water currently being used for hydraulic fracturing operations, including recycled water, and how these withdrawals may impact local drinking water quality and availability. To that end, secondary research questions have been developed, as well as the research projects listed in Table 2.	Characterization of the amount and sources of water, including current and future trends, appears to be of value. Therefore, the first secondary charge question in Table 2 seems relevant. However, the 2nd and 3rd do not appear to be unique to hydraulic fracturing and cannot be evaluated without a comprehensive evaluation of all water users and a prioritization, similar to what is included in the existing state and/or regional water planning processes water utilization laws.	
15	2.1.2	Chemicals are added to the fluid to change its properties (e.g., viscosity, pH) in order to optimize the performance of the fluid.	The development and application of hydraulic fracturing additives that can perform effectively when produced water or alternative water sources are used in stimulation fluids can reduce fresh water use. Operators and service companies continue to develop and apply environmentally conscious chemical additives and fracturing fluids mixtures on a case-by-case basis. Intellectual property right protection can have a significant impact on corporate incentives to advance technologies in these areas. In addition, some chemicals serve well-integrity purposes. This context should be included in EPA's research. Certain considerations should also be given to the increasing trend in chemical identity-disclosure, through services including fracfocus.org.	
16	2.1.3	Production wells are drilled and completed in order to best and most efficiently drain the geological reservoir of its hydrocarbon resources.	The ultimate goal of hydraulic fracturing is to stimulate unconventional reservoirs in order to recover hydrocarbons in the most efficient manner possible. The composition of frac fluids and associated chemical additives used are fit for purpose, and designed to obtain the greatest return on the natural resources (e.g., water used, surface disturbance, etc.) investment made throughout the well development process. Significant technological advancements have recently been made in increasing the efficiency of fracturing-execution, including methods to decrease the total volume of injected fluid, chemical additives, and propping agents. However, more benign chemicals, in some cases, can reduce the efficiency of stimulation and may require additional wells, re-stimulation, cost and/or lower ultimate recovery from the well, and, therefore, increase the environmental footprint associated with development.	

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18	2.1.4	For this study, “flowback” is the fluid returned to the surface after hydraulic fracturing has occurred, but before the well is placed into production, while “produced water” is the fluid returned to the surface after the well has been placed into production.	EPA has made an arbitrary distinction between produced water and flowback. Produced water is all water that is returned to the surface through a well borehole. Flowback process water should be considered a subset of produced water returned during the flowback process. The only factor that is used in defining this subset of produced water is the time period in which the water is returned to the surface through the well borehole. It is inappropriate and unnecessary to use the term “flowback” to differentiate produced water quality.	
19	2.1.4.	What is the composition of hydraulic fracturing wastewaters, and what factors might influence this composition?	Produced water characteristics vary significantly temporally within, and spatially among, basins, formation, and wells. EPA does not appear to have captured the breadth of these variations within the agency’s current plan. The characteristic of produced water have been studied significantly by USGS. a. Analytical techniques used to characterize produced water must be robust to the matrix interferences caused by high TDS. b. Benzene, ethyl benzene, toluene, and xylenes are the most frequently detected VOCs in shale gas produced water, and are naturally occurring. c. Industry Participation in Collaborative Groups i. Brine Chemistry Consortium – 20 + years ii. Shale Water Research Center - New group (1 year)	http://energy.cr.usgs.gov/prov/prodwat/ http://www.epa.gov/hfstudy/producedformationwatersampleresultsfromshaleplays.pdf http://www.brinechem.rice.edu/partners.cfm http://www.shalewatercenter.com/
19	2.1.4	What are the chemical, physical, and toxicological properties of hydraulic fracturing wastewater constituents?	Context regarding constituent concentration and risk of exposure, including a description of existing barriers, should be provided when discussing fracturing fluid and produced water properties.	
19	2.1.4	If spills occur, how might hydraulic fracturing wastewater contaminate drinking water resources?	Current state and federally regulations should be considered when answering this question. EPA’s study approach does not appear to acknowledge state, local, and oil and gas industry plans, procedures and/or actions to respond and control leaks and/or releases. In the rare occurrence of an unintentional environmental release, industry members act appropriately in conjunction with local authorities and in accordance with regulatory requirements to limit the impact on the environment and ensure the health and safety of the public. Not considering this fact will undoubtedly result in conclusions that are misrepresentative and misleading.	
19	2.1.5	[produced water] is generally managed through disposal into deep underground injection control (UIC) wells, treatment followed by discharge to surface water bodies, or treatment followed by reuse.	The disposal of produced water to POTWs is very rare, if used at all, for unconventional oil and gas operations. The utilization of this option should be managed on a case-by-case basis with a firm understanding of the plant’s efficiency in removing appropriate compounds. Efficiency of all treatment processes are influenced by technological and operational factors. This context should be incorporated in to the study design; specifically, the interpretation of laboratory experiments.	

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21	2.2.	Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.	EPA's definition of EJ and the inclusion of the topic within this research implies that the agency considers this research a direct component of environmental laws, regulation, and/or policy development.	
21	2.2.	Environmental Justice	The June 13, 2011 QAPP stated that the project would be completed by August 2011 (4 months prior to the finalization of the study plan). There is no reference to this study or status. This appears to be indicative that EPA was premature to include Environmental Justice in this study.	EJ QAPP: http://www.epa.gov/hfstudy/environmental-justice-analysis.pdf
22	2.2.	Nationwide data on the locations of water withdrawals and wastewater treatment associated with hydraulic fracturing activities are difficult to obtain. The EPA was not able to identify comprehensive data sources that identify the locations of water withdrawals associated with hydraulic fracturing or facilities receiving hydraulic fracturing wastewaters.	EPA has acknowledged significant limitations regarding the ability to use this information to achieve the agency's research objectives. The agency should have understood and evaluated these databases and associated limitations during a systematic planning process (e.g. DQO) prior to implementing research activities and allocating significant finite resources. The "Data Acceptance Criteria" identified in EPA's HF Surface Spill Data Analysis QAPP (9 pages, Rev 0 Approved August 6, 2012) does not appear to be adequate for a highly influential scientific assessment. In addition the "Data Acceptance Criteria" (i.e., timeliness, comparability, and completeness) is not consistent with assessment factors used within the literature review QAPP to assess data quality (i.e., soundness, applicability and utility, clarity and completeness, uncertainty and variability, and evaluation and review).	
22	2.2.	The county-level resolution provided by the service company data set is insufficient for determining whether hydraulic fracturing activities are occurring in communities that possess characteristics associated with environmental justice populations. Finer resolution is needed since counties can contain a multitude of communities, townships, and even cities, with diverse populations.	The RFI EPA sent to the service companies in September 2010 (over a year prior to the finalization of the study plan), did not specifically request this information. This is a clear example why all research, especially a highly influential scientific assessment, should undergo a systematic planning process (e.g., DQO development) prior to implementation.	
25	3	Analysis of Existing Data	FracFocus is the best existing data source for HF fluid compositions. It is strongly recommended EPA evaluate all data within appropriate temporal and spatial context. All historic data collected - including that obtained during EPA's RFI processes - should be analyzed in the appropriate context, accounting for continuous industry practice and state regulatory improvements that evolve as both parties use their operational experience to innovate and strive for the common goal of maximizing production while ensuring protection of the environment and health and safety of personnel and the public. The development and application of hydraulic fracturing additives that can perform effectively when	

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			produced water or alternative water sources are used in stimulation fluids can reduce fresh water use. Operators and service companies continue to develop and apply environmentally conscious chemical additives and fracturing fluids mixtures on a case-by-case basis. Intellectual property right protection can have a significant impact on corporate incentives to develop technologies in these areas.	
25	3.1.	Literature Review	It is strongly recommended that EPA use the wealth of information contained in the full range of peer reviewed publications, including industry references and sources (e.g., OnePetro). In addition, evaluations of peer reviewed publications should be conducted prior to use; specifically, peer review publications that have received significant criticism within the scientific community (e.g., Osborne, 2011). In addition, the work and expertise of other federal agencies and credible stakeholders should be incorporated into the study as appropriate.	
27	3.1.3.	Principal investigators on this project are responsible for deciding whether to include these data and providing all available background information in order to place these results in the appropriate context.	The "Reference Evaluation" Excel file discussed in EPA's Data and Literature Evaluation QAPP (September 4, 2012 revision 0; 10 months after the final study plan) should be provided to peer reviewers and the public during the results peer review process. EPA should provide the SAB Panel and public with the "Reference Evaluation" Excel file that was used to develop the study plan and project plans.	Lit Review QAPP: http://www.epa.gov/hfstudy/pdfs/literature-review-qapp.pdf
27	3.1.4.	The chemical composition of flowback and produced water from hydraulically fractured formations is similar to that of conventional reservoirs	EPA has made an arbitrary distinction between produced water and flowback. Produced water is all water that is returned to the surface through a well borehole. Flowback process water should be considered a subset of produced water returned during the flowback process. The only factor that is used in defining this subset of produced water is the time period in which the water is returned to the surface through the well borehole. It is inappropriate and unnecessary to use the term “flowback” to differentiate produced water quality.	
27	3.1.4.	Water Acquisition	It is concerning that EPA has not referenced or considered incorporating state water planning processes or reports within the literature review portion of the agency's research. Water use should be investigated holistically considering all water users; similar to state water planning processes. The oil and gas sector is a relatively small water user when compared to total water use. It is unclear how water quantity and quality impacts will be attributed to oil and gas operations, specifically hydraulic fracturing, within EPA’s research given the connectivity between all water users and water resources.	Texas 2008: 0.003% (57 k acre-feet) and 0.002% (35.8 k acre-feet) of the total water use was O&G and hydraulic fracturing, respectively. (http://www.senate.state.tx.us/75r/Senate/commit/c510/handouts12/0110-RRC.pdf) Texas 2010: Mining, which includes but is not limited to the oil and gas sector, made up 1.8% of the total state water use. (http://www.twdb.state.tx.us/waterplanning/waterusesurvey/estimates/) Colorado 2010: 0.08% (13.9 k acre-feet) of the total state

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				water use was hydraulic fracturing. (http://cogcc.state.co.us/Library/Oil_and_Gas_Water_Sources_Fact_Sheet.pdf) Oklahoma 2012: Oil and gas drilling and fracing accounts for a very small fraction (less than 1%) of freshwater use in Oklahoma. (http://oklahomawatersurvey.org/d1/wp-content/uploads/2012/10/04-OGS.pdf)
27	3.1.4.	Water Acquisition	Regional, state and local water regulators appropriately allocate all water rights and respond to short-term and long-term local environmental conditions during as part of their management of water resources. This context should be incorporated in to the study design to avoid unrealistic results; specifically, the scenario models must consider the existing regulatory structure (e.g., private property right issues associated with water rights), as well as operational boundaries. a. Regulatory agencies take action to prioritize water resources, including temporarily halting oil and gas withdrawals (e.g., SRBC, TX). b. LA Cooperative Endeavor Agreement / Plan of Water Use requires a demonstration to the DNR that the water use does not unreasonably interfere with any other use of the water presently, or which may legally and reasonably be anticipated, for purposes including public consumption, agriculture, industrial uses, and recreation.	http://www.tceq.texas.gov/response/drought http://dnr.louisiana.gov/assets/docs/11DRAFT-Water-Application.pdf
27	3.1.4.	The literature review is currently underway. Water acquisition, chemical mixing, and flowback and produced water are the only stages of the hydraulic fracturing water cycle for which specific updates are available at this time.	EPA did not provide any literature review progress in the areas of injection or treatment/disposal. Literature review should be the first phase of any research initiative and field/laboratory activity should not be implemented prior to a significant portion of this research phase.	
28	3.1.4.	Information on volumes and sources of water in the Bakken Shale comes largely from news articles.	EPA should not be considering media references within this highly influential study.	
28	3.1.4.	Chemical Mixing	It appears that EPA has not considered investigating the concentration of chemical components within the scope of this study. It is highly recommended that the agency include this context within the research. The ultimate goal of hydraulic fracturing is to stimulate the unconventional reservoir in order to recover hydrocarbons in the most efficient manner possible. The composition of frac fluids and associated chemical additives used are fit for purpose given the specific well bottomhole temperature, executional factors (such as pumping rate), local factors (such as	

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			mix-water quality), and desired fracture geometry (wide, biwing fractures, versus narrow, complex fractures). More benign chemicals could be less efficient and fracturing fluids may require additional wells, stimulation, cost and/or lower ultimate recovery from the well.	
30	3.1.4	Papers describing impacts from spills of produced water from conventional oil and gas production wells are being considered as part of the literature review because the chemical composition of flowback and produced water from hydraulically fractured formations is similar to that of conventional reservoirs (Hayes, 2009).	HF occurs in both conventional and non-conventional resource plays. It appears that EPA is not acknowledging this fact.	
30	3.1.4.	Chemicals commonly used in hydraulic fracturing fluid are ubiquitous, a very large numbers of papers have been found.	The general composition of HF additives is known. MSDSs contain information that is necessary to understand potential health and safety hazards. HF chemical additive constituents are found in common household products. A research focus should be placed on known major constituents, and not investigation of trace elements and impurities. Additionally, there are opportunities for improvement regarding the development of analytical methods associated with testing additives.	http://www.same-satx.org/briefs/120410-holditch.pdf
31	3.2.	Spills Database Analysis	"Reported" or "potential" spills that have not been confirmed/validated should not be considered reliable data for a risk (likelihood and severity) analysis. For example, tip or complaint lines should not be considered appropriate data resources. Caution needs to be taken when evaluating spill databases to ensure accuracy, consistency, and comparability of reported spills, including the appropriate segregation of spill types (e.g., solids or liquids) and ensuring spills that were reported by more than one entity are captured once in the analysis. Spills related to auxiliary activities and/or processes (e.g., pipelines) should not be included in this evaluation because it is not within the scope of the study.	

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32	3.2.3.	There is currently no national repository or database that contains spill data focusing primarily on hydraulic fracturing operations.	Potential risks to drinking water from spills are not specific to those associated with hydraulic fracturing. National and state databases are fit for their intended purposes in terms of being generalized to include spills from all industrial and/or anthropogenic activities. EPA should not attempt to assess current databases on the basis of their ability to fulfill the agency's current research objectives. Rather, the agency should have understood and evaluated these databases and associated limitations during a systematic planning process (e.g. DQO) prior to implementing research activities and allocating significant finite resources.	
32	3.2.3.	The search timeframe is limited to incidents between January 1, 2006, and April 30, 2012	It is recommended that EPA expand the timeframe of FracFocus data acquisition and evaluation to ensure more current information is provided in the 2014 report of results.	
34	3.2.4.	This information is often based on the estimates made by persons responding to a spill and may be incomplete. More accurate information may be available once a response is complete, but this database is not updated with such information.	EPA has acknowledged significant limitations regarding its ability to use this information to achieve the agency's research objectives. The agency should have understood and evaluated these databases and associated limitations during a systematic planning process (e.g. DQO) prior to implementing research activities and allocating significant finite resources. The "Data Acceptance Criteria" identified in EPA's HF Surface Spill Data Analysis QAPP (9 pages, Rev 0 Approved August 6, 2012) does not appear to be adequate for a highly influential scientific assessment. In addition the "Data Acceptance Criteria" (i.e., timeliness, comparability, and completeness) is not consistent with assessment factors used within the literature review QAPP to assess data quality (i.e., soundness, applicability and utility, clarity and completeness, uncertainty and variability, and evaluation and review).	Spill QAPP: http://www.epa.gov/hfstudy/pdfs/hf-spills-analysis-qapp.pdf Lit Review QAPP: http://www.epa.gov/hfstudy/pdfs/literature-review-qapp.pdf
36	3.2.4.	The database containing information regarding contamination of ground water due to pits tracks only the current company, facility name, tracking number, county, location, and status of the contamination incidents. Details regarding the contamination incident and the relation of the event to hydraulic fracturing are not included. Additional research is needed to determine if the pit information is related to hydraulic fracturing.	EPA has been tasked with investigating potential impacts of HF, which is a specific step in the process of developing unconventional oil and natural gas. When the Agency references or reports information that it has not confirmed is related to the HF phase of development, it is both confusing and misleading to the public. The agency should refrain from publishing information that has no applicability to the Congressional scope of the study and that the potential to mislead the public. Precise use of terminology is critical as the public looks to the government as a definitive source of information.	

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38	3.2.5.	The spills database analysis has several important limitations: Potential underreporting...Variation in reporting requirements for different sources...The lack of electronic accessibility of some state-reported data on oil and gas-related spills and emergency responses.	The limitations EPA has identified regarding variation and electronic accessibility should be interpreted as deficiencies in the agency's study planning and design, not necessarily the databases.	
40	3.3.3.	Research Approach	The "Quality Objectives and Criteria" identified in EPA's Analysis of Data Received by Service Company QAPP (14 pages, Rev 0 Approved September 1, 2012) does not appear consistent with assessment factors used within the literature review QAPP to assess data quality (i.e., soundness, applicability and utility, clarity and completeness, uncertainty and variability, and evaluation and review).	Service Company Data QAPP: http://www.epa.gov/hfstudy/pdfs/qapp-service-company.pdf Lit Review QAPP: http://www.epa.gov/hfstudy/pdfs/literature-review-qapp.pdf
41	3.3.3.	information… being assembled…Concentration of each chemical in each fluid product	The agency should include date of use and chemical concentration within the fracturing fluid. EPA should integrate the context of concentration information throughout the agency's research.	
47	3.4.3.	Well File Selection. The EPA used a list of hydraulically fractured oil and gas wells provided to the agency by the nine hydraulic fracturing service companies (referred to hereafter as the "service company well list") to select 350 specific well identifiers associated with nine oil and gas operators.	A sample size of 350 wells is a relatively small dataset and does not appear to be statistically significant or representative. Roughly 1.4 percent of wells and less than one percent of operators. The lack of a comprehensive program to determine representative wells would automatically introduce unintentional biases.	
53	3.4.4.	The EPA is creating queries on the extracted data that are expected to determine whether drinking water resources were protected from hydraulic fracturing operations.	Determination of protection appears to be outside EPA's stated study scope - the identification of factors - and more aligned with an enforcement initiative.	
54		Distances between wells hydraulically fractured and geologic faults	Any research or reports that reference faults should be conducted and referenced in the appropriate contexts. For example, the existence of a fault does not mean that it is transmissive and/or extends to drinking water resources.	
54	3.4.5.	Statistical Analysis. Once the data analysis has been completed, where possible, extrapolation of the results will be performed to the sampled universe of 24,925 wells	Statistics without context and appropriate assumptions could be extremely misleading. For example, spatial and temporal relationships should not be considered the sole bases for conclusions.	

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55	3.5.2.	This analysis is gathering information on water and chemical use in hydraulic fracturing operations and attempts to answer the following questions:	EPA does not appear to be leveraging the full potential of this data source. For example, trends in chemical use and fracturing fluid concentrations are not included in EPA's questions.	
55	3.5.2.	What are the different sources of water reported in FracFocus, and is it possible to determine the relative proportions by volume or mass of these different sources of water?	Caution should be used when relying on FracFocus for water types. There is the potential that the term “fresh” is used not to signal that it came from a new water source compared to being recycled, but to signify that it does not have chemicals added to it yet. (this pertains to statements on page 59 as well)	
56	3.5.3	It is beyond the scope of the project to evaluate the quality or representativeness on a national scale of the data submitted to FracFocus by oil and gas operators.	EPA should fully understand the quality and representativeness of all information it utilizes to draw research conclusions.	
57	3.5.3.	Figure 13. Example of data disclosed through FracFocus	EPA's disclosure example is not representative and is misleading in terms of make-up and concentrations.	
59	3.5.4.3.	Data Analysis - Water Acquisition	The approach EPA is proposing to determine the volume of water utilized in HF operations could lead to inaccurate results. While “total water” is given on the FracFocus reports in gallons, the only case in which an accurate assessment of the type of water used in HF operations can be determined is if the operator indicates in the breakout section that the only water source used was “fresh water.” Then and only then can the assumption of 8.35 lb / gal (water density) be used to reverse calculate the volume of “fresh water” used in the completion. If any other type of “non-fresh water” albeit brackish, recycled, or produced water is used in the completion, without a mass provided for each water type, it’s not possible to determine accurate volumes based on total water mass and percentages of each water type alone. The reason for this is the density of brine is different than fresh water and will cause variation in the data. It is recommended that EPA not use this approach to calculate total volume of water or HF chemicals used.	

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62	4.1.	Subsurface Migration Modeling	All models must include all assumptions and any sensitivity analysis. It is critical to apply an appropriate physical model to evaluate the transport of tracers and the effect of injection pulses on flow in reservoirs and toward the surface. a. Models must not apply standard hydrogeologic approaches that treat the entire subsurface as a fully interconnected pore space that does not honor the physical reality of the horizontal and vertical transport properties in such strata. Most consolidated clastic rocks in sedimentary basins are highly layered systems with (1) widely varying horizontal permeabilities in the different layers and (2) more importantly, much lower vertical permeabilities – often orders of magnitude lower. It is these low vertical permeabilities, along with capillary pressure and clay/water interaction among other factors that form what is commonly known as a caprock that traps the hydrocarbons in place and creates reservoirs. Such a “sandbox” approach is highly inappropriate for modeling the effect of subsurface operations/processes on near-surface layers. b. There are available reservoir simulators that can be used to perform the modeling, and these should be populated with realistic transport parameters that are accepted by petroleum scientists. c. Assessment of “What If” scenarios will lead to an inaccurate “convection” or whatever the modeler puts in as worst case. As such, these scenarios become useless to describe what may really happen in a well and describe only the modeler’s imagination. d. EPA’s guidelines on building, applying, calibrating, and analyzing the results from models must be honored in this highly influential scientific assessment.	http://www.epa.gov/sab/panels/cremgacpanel.html
62	4.1.	Lawrence Berkeley National Laboratory (LBNL), in consultation with the EPA, will simulate the hypothetical subsurface migration of fluids (including gases) resulting from six possible mechanisms using computer models. The selected mechanisms address the research questions identified in Table 26.	It is not apparent how this research will be able to answer "how effective are current well construction practices at containing gases and fluids before, during, and after fracturing?"	
62	4.1.	The segment of the population that receives drinking water from private wells may be especially vulnerable to health impacts from impaired drinking water. Unlike water distributed by public water systems, water from private drinking water wells is not subject to National Primary Drinking Water Regulations, and water quality testing is at the discretion of the well owner.	This statement acknowledges a general risk to private well owners that is not specific to hydraulic fracturing. Undoubtedly, these risks will be highlighted during EPA's research, however, it should not be assumed that elevated parameters are attributable to oil and gas development. It is important to describe the baseline health risks regarding drinking water. Private drinking water wells are subject to poor installation, maintenance (e.g., well disinfection) and operations. Additionally many are contaminated inadvertently by poorly placed septic systems and storm water run in.	

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62	4.1.	Lawrence Berkeley National Laboratory (LBNL), in consultation with the EPA, will simulate the hypothetical subsurface migration of fluids (including gases) resulting from six possible mechanisms using computer models.	Scenarios and assumptions are not presented in enough detail within the study plan, progress report or LBNL Modeling QAPP to guide this highly influential research or inform peer reviewers. All presented scenarios are based on multiple barriers failing. The most valuable scenario and the one missing from LBNL/EPA's research is a **no failure scenario**. **Operational practice and response** do not appear to be factored into the model. For example, monitoring annular casing pressure during HF allows for the processes to be halted when abnormal conditions are observed.	LBNL Modeling QAPP: http://www.epa.gov/hfstudy/QAPP_LBNL_analysis%20of%20HF%20Final%2020111201%20unsigned_508_km.pdf
64	4.1.1.	Figure 14: Scenario A	There is not representation of the intermediate and surface strings of casing/cement, which protect the groundwater aquifer and other potential shallow hydrocarbon and natural resource zones. The figure is an unrealistic conceptual model of inadequate cement and fractured cement. Any competent cement along the wellbore would effectively seal gas from migrating vertically, similar to a plug.	
65	4.1.1.	Figure 15: Scenario B1	Propagation of fractures from target formation to surface, or 1,000 meters vertically such as shown, is not representative. Multiple peer-reviewed papers discuss the impossibility of such based on stress fields and overburden, such as described in Carter et al., 2013. Natural fractures/faults below 1,000' depth are noted as healed, not open conduits, based on calcite fill observed in cuttings and cores, and would have bled off the gas from the target formation over geologic time, which is not the case.	http://www.pcpg.org/Resources/Documents/Shale%20Gas/PAGS%20PCPG%20Rebuttal%20to%20Frac%20Induced%20GW%20Contamination%20Article%201.pdf
66	4.1.1.	Figure 16: Scenario B2	See comments on Figure 15. The fracture would not continue to propagate vertically to surface since the fracture eventually intersects a porous zone, at which point the pressure would drop and the fracture would terminate due to fluid diffusion in a porous medium.	
67	4.1.1.	Figure 17: Scenario C	See comments on Figure 15.	
68	4.1.1.	Figure 18: Scenario D1 Figure 19: Scenario D2	Illustrations do not show the lateral distance to the offset well, which is avoided during planning. Figure 14 comments apply.	

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70	4.1.2.	This research project does not assess the likelihood of a hypothetical scenario occurring during actual field operations.	This research has little value regarding informing the public and decision makers without the context of likelihood. In addition, statements found in EPA's progress report conflict with the QAPP associated with this research. LBNL Modeling QAPP (approved on 12/06/2011) includes the evaluation of likelihood of occurrence of the hypothetical failures. In addition, EPA's study approach does not appear to acknowledge state, local, and oil and gas industry plans, procedures and/or actions to respond and control leaks and/or releases. In the rare occurrence of an unintentional environmental release, industry members act appropriately in conjunction with local authorities and in accordance with regulatory requirements to limit the impact on the environment and ensure the health and safety of the public. Not considering this fact will undoubtedly result in conclusions that are misrepresentative.	LBNL Modeling QAPP: http://www.epa.gov/hfstudy/QAPP_LBNL_analysis%20of%20HF%20Final%2020111201%20unsigned_508_km.pdf
73	4.1.2.	Uncertainty in the data will be addressed by first analyzing base cases that involve reasonable estimates of the various parameters and conditions and then conducting sensitivity analyses that cover (and extend beyond) the possible range of expected values of all relevant parameters.	Modeling subsurface phenomena is extremely complex and must consider a range of broad uncertainty; it appears unlikely EPA will have adequately addressed the broad uncertainty or be able to achieve appropriate model calibration with integrated holistic data-sets, and as such conclusions based on models will not be robust representations for policy or regulatory decision making.	LBNL Modeling QAPP: http://www.epa.gov/hfstudy/QAPP_LBNL_analysis%20of%20HF%20Final%2020111201%20unsigned_508_km.pdf
74	4.1.3.	Results from this work are being analyzed and will be published when complete.	All research products should be considered highly influential and subject to the Data Quality Act and OMB's Guidance. The "individual reports" and papers is a new concept for the EPA HF Study. EPA should publish a list of all individual reports and papers, the peer review plan for each and the projected timeline for review completion.	
74	4.1.3.	As illustrated in Figure 15, the simulated system is composed of a 100-meter thick aquifer (from 100 to 200 meters below the surface), a fracture extending from the bottom of the gas reservoir at 1,200 meters below surface to the base of the aquifer, which is 1,000 meters above the gas reservoir.	The depths of wells being simulated are not representative of typical depth to shale.	

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76	4.2.2.	In Pennsylvania, however, wastewater has been treated in wastewater treatment facilities (WWTFs), which subsequently discharge treated wastewater to surface water bodies.	The disposal of produced water in POTWs is very rare, if used at all in a given area, for unconventional oil and gas operations. The utilization of this option should be managed on a case-by-case basis with a firm understanding of the plant's efficiency in removing appropriate compounds. Efficiency of all treatment processes are influenced by technological and operational factors. This context should be incorporated in to the study design; specifically, the interpretation of laboratory experiments. a. PA DEP reported for the first 6 months of 2012 0 bbls of produced water (formation or flowback fluids) from unconventional wells were disposed in POTWs. b. PA DEP reported for the first 6 months of 2012 1,174 bbls (0.01% of total) of produced water (formation or flowback fluids) from unconventional wells were disposed in Commercial Treatment Systems.	PA DEP Reference: https://www.paoilandgasreporting.state.pa.us/publicreports/Modules/DataExports/ExportWasteData.aspx?PERIOD_ID=2012-1
77	4.2.3.	The results of the mass balance model simulate possible impacts during a large volume, high concentration discharge without natural attenuation of contaminants. The empirical model and a hybrid empirical-numerical model estimate impacts in a more realistic setting with variable chemical concentrations, discharge volumes, and flow rates of the receiving surface water.... the steady-state mass balance model may be too conservative (by providing larger concentration estimates) to accurately represent downstream concentrations of chemicals.	EPA has acknowledged that the simplicity of the mass balance model and assumptions are unrealistic. Providing this analysis to the public and decision makers would only mislead them. For this reason, it is recommended that the mass balance model not be included in reports of results.	
78	4.2.3.	Hybrid Empirical-Numerical Model Estimates Impacts for River Networks...Using these approaches provides improved accuracy in the simulation results. The EPA will prepare a user's guide to the model and make both the computer model and user's guide widely available for duplicating the results prepared for this project and for more general use.	EPA should make this model and user guide available to the public and peer reviews in advance of releasing model results.	
79	4.2.5.	A description of the EPA-developed empirical-numerical model and application of the empirical-numerical and mass balance models to tracer experiments is being developed by EPA scientists and are expected to be submitted for publication in a peer-reviewed journal. The results from testing of the models and the analysis of the WWTF effluent data will be included in another peer-reviewed journal article.	All research products should be considered highly influential and subject to the Data Quality Act and OMB's Guidance. The "individual reports" and papers is a new concept for the EPA HF Study. EPA should publish a list of all individual reports and papers, the peer review plan for each and the projected timeline for review completion.	

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80	4.3.	Table 29. Research questions addressed by modeling water withdrawals and availability in selected river basins	Consultation with regional, state, and local water regulators, as well as industry within diverse areas, is critical during this research due to the variability in local environmental conditions and present considerable difficulty in the current national research approach.	
80	4.3.1.	The volume of water needed for well drilling is understood to be much less, from 60,000 gallons in the Fayetteville Shale to 1 million gallons in the Haynesville Shale (GWPC and ALL Consulting, 2009). Water-based mud systems used for drilling vertical or horizontal wells generally require that freshwater (non-potable, potable, or treated) be used as makeup fluid, although wells can also be drilled using compressed air and oil-based fluids.	Drilling is outside the scope of the study. EPA should refrain from including information, within deliverables, that is not associated with the scope of the study because it has the potential to mislead the public.	
89	4.3.2.	SWAT is an appropriate choice in the less data-rich UCRB, where hydrological response units can be parameterized based on publicly available GIS maps of land use, topography, and soils.	Given the insignificant use of fresh water in UCRB for the HF process, it appears EPA has stepped outside the scope ("HF water life-cycle") of the study to investigate land use (i.e., pad constructions). The model does not appear to account for discharge benefits. The focus of the study seems to be very negative and the benefits are not included. It is recommended that EPA not expand the scope of the UCRB research beyond the HF process and incorporate benefits into the research on this topic.	
90	4.3.2.	Modeling Future Scenarios…three separate scenarios will be simulated: business-as-usual, energy plus, and green technology...water use will be assessed across a range of weather conditions (i.e., drought, dry, wet, and very wet years based on the historical record).	There appear to be significant flaws in EPA's identified scenarios and associated assumptions. For example, the model does not appear to take into consideration local regulatory authority to prioritize water use during drought conditions and operational practices to acquire/store water during the wet season. The modeling also does not appear to account for opportunities for use of water under existing water use permits. Two additional scenarios that would be of value and should be included in the analysis are a no HF activity and low HF activity scenario. These scenarios would provide the appropriate context necessary to understand the relative influence of HF on water availability. In addition, the use of the term "green technologies" is concerning, in some cases conventional water management could be the “greenest” alternative from a holistic perspective.	

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92	4.3.2.	In the UCRB, 100% recycled water use is typical for hydraulic fracturing of tight sandstones (personal communication, Jonathan Shireman, Shaw Environmental & Infrastructure, May 7, 2012). Surface water is acquired for well drilling and cementing (0.18 million gallons), dust abatement (0.03 million gallons), and hydrostatic testing (0.04 million gallons) only (US FWS, 2008). Per well surface water use in the UCRB business as usual and energy plus scenarios will therefore be 0.25 million gallons. For the UCRB green technology scenario, surface water will be assumed to be acquired for well drilling and cementing only (0.18 million gallons per well).	Given the insignificant use of fresh water in UCRB for the HF process, it appears EPA has stepped outside the scope ("HF water life-cycle") of the study to investigate drilling and cementing, dust abatement, and hydrostatic testing. It is recommended that EPA not expand the scope of the UCRB research beyond the HF process.	
92	4.3.3.	The models are being calibrated and validated. The future scenarios are being designed, with model simulations to follow. Work is underway and will be published in peer-reviewed journals when completed.	All research products should be considered highly influential and subject to the Data Quality Act and OMB's Guidance. The "individual reports" and papers is a new concept for the EPA HF Study. EPA should publish a list of all individual reports and papers, the peer review plan for each and the projected timeline for review completion.	
95	5.1.2.	High TDS levels—including bromide and chloride—have been detected in the Monongahela River in 2008 and the Youghiogheny River in 2010 (Lee, 2011; Ziemkiewicz, 2011). The source and effects of these elevated concentrations remains unclear.	EPA should review references and databases with historic/pre-HF water quality information to determine if the water quality has significantly changed in these areas.	
98	5.1.3.2.	These models have previously been used to evaluate a wide range of environmental data for air, soil, and sediments (Cao et al., 2011; Pancras et al., 2011; Soonthornnonda and Christensen, 2008), and are now being used for emerging issues, such as potential impacts to drinking water from hydraulic fracturing.	All research products should be considered highly influential and subject to the Data Quality Act and OMB's Guidance. The "individual reports" and papers is a new concept for the EPA HF Study. EPA should publish a list of all individual reports and papers, the peer review plan for each and the projected timeline for review completion.	
99	5.1.4.	Median concentration of selected chemicals and conductivity of effluent treated and discharged from two wastewater treatment facilities that accept oil and gas wastewater.	It appears EPA did not confirm that when the samples were taken that the facilities were discharging oil and gas treated wastewater. Additionally at this time operators were no longer sending HF flowback/produced water to wastewater treatment facilities.	

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103	5.2.2.2.	The exact number of POTWs currently accepting hydraulic fracturing wastewater is not known.	It is concerning that EPA is expending significant resources in an area that the agency has not properly assessed. This statement brings into question EPA's original risk-based prioritization for the study plan development. One would expect the number of POTWs to be a key input into that process. Study Plan citation: "Following guidance from the SAB, EPA used a risk-based prioritization approach to identify research that addresses the most significant potential risks at each stage of the hydraulic fracturing water lifecycle. The risk assessment paradigm (i.e., exposure assessment, hazard identification, dose-response relationship assessment, and risk characterization) provides a useful framework for asking scientific questions and focusing research to accomplish the stated goals of this study, as well as to inform full risk assessments in the future."	EPA HF Study Plan: http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/upload/hf_study_plan_110211_final_508.pdf
104	5.2.2.3.	Gas producers are accelerating efforts to reuse and recycle hydraulic fracturing wastewater in some regions in order to decrease costs associated with procuring fresh water supplies, wastewater transportation, and offsite treatment and disposal.	This statement misleads the public to conclude that cost is the only driver in a producer's decision to reuse water. This is particularly disconcerting given the industry efforts to educate the agency on our operations. Cost is definitely a factor, but not the only one. Industry strives for continuous improvement in terms of understanding local water availability, publically disclosing water use and prudent fresh water use/reduction practices. These efforts are driven by stewardship, environmental/corporate risk reduction and economics. A number of complex operational, logistical, environmental, health, safety and economic factors/risks require evaluation prior to the implementation of fresh water use/reduction practices. These factors require case-by-case analyses and should not be generalized in the study. The application of recycling and reuse technologies has reduced fresh water use in specific areas. However, it requires acknowledgement that there is not a "one size fits all" technology that can be applied across all developments, and evaluation of this practice and alternative technologies should be conducted on a case-by-case basis using a holistic approach (e.g., logistics, water-energy nexus).	http://www.shalegas.energy.gov/resources/HF2_e1.pdf Luedecke, R. "Devon's Water Sustainability Initiatives – Technologies and Policies to Reduce Shale-Related Impacts" 2012 The Nature Conservancy Reducing Energy's Impacts to Water and Biodiversity Conference, July 12, 2012.
104	5.2.3.	The EPA is examining the fate and transport of chemicals through conventional POTWs treatment processes and commercial chemical coagulation/settling processes.	The context regarding fate, transport and exposure should be provided within all EPA research deliverables, however, currently appears to be lacking throughout the study.	
105	5.2.3.	Microbial community health will be monitored in the reactors to identify the point where biological processes begin to fail.	Microbial community health can be impacted by numerous factors. Microbes have the ability to adapt to the extreme conditions. EPA's research has not been designed appropriately to capture these complexities.	

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106	5.2.4.	Water Treatability Studies - This research is currently in the planning stage.	Given the technical concerns and the limited progress regarding this research activity, EPA should consider removing it from the scope of the study.	
108	5.3.1.	As a first step, this project is examining the formation of brominated THMs, including bromoform (CHBr3), dibromochloromethane (CHClBr2), and bromodichloromethane (CHCl2Br), during drinking water treatment processes. The formation of haloacetic acids (HAAs) and nitrosamines during drinking water treatment processes is also being investigated. 64 Nitrosamines are byproducts of drinking water disinfection, typically chloramination, and currently unregulated by the EPA. Data collected from the second Unregulated Contaminant Monitoring Rule indicate that nitrosamines are frequently being found in PWSs. Nitrosamines are potentially carcinogenic.	The formation of these compounds is not unique to HF, therefore, EPA should consider removing this research the HF Study.	
112	5.4.	Sample analysis is an integral part of the EPA's Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources (US EPA, 2011e) and is clearly specified in research plans being carried out for the study's retrospective case studies, prospective case studies, and laboratory studies. The EPA requires robust analytical methods to accurately and precisely determine the composition of hydraulic fracturing-related chemicals in ground and surface water, flowback and produced water, and treated wastewater.	All analytical methods should have been developed in advance of implementing them in HF study laboratory/field activities.	

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112	5.4.2.	The analytical methods chosen must undergo rigorous testing, verification, and potential validation to ensure that the data generated they generate are of known and high quality.	The use of key indicator compounds (TDS, Cl, and divalent cations) is the most reliable, efficient, and cost effective method for initial scientific investigations for potential or know produced water releases. The concentration of VOCs and SVOCs in shale gas produced water are generally too low for use as indicator compounds. The concept of indicator compounds in the environmental field is well established (e.g., Ohio, Louisiana, Oklahoma, Arkansas, California, Texas, etc.).	http://www.epa.state.oh.us/portals/30/rules/DI-033.pdf http://www.deq.louisiana.gov/portal/Portals/0/RemediationServices/APPENDIXD.pdf http://www.occeweb.com/rules/Chapter%2029%20Effective%207-1-09%20SOS.pdf http://www.adeq.state.ar.us/hazwaste/branch_tech/pdfs/tph_sls_web_version.pdf http://www.dtsc.ca.gov/AssessingRisk/upload/HHRA-Note-4.pdf http://www.tceq.texas.gov/publications/rg/rg-366_trrp_27.html
113	5.4.3.1.	The following criteria were developed to identify a subset of the chemicals listed in Appendix A for initial analytical method testing activities: • Frequency of occurrence in hydraulic fracturing fluids and wastewater • Toxicity • Mobility in the environment (expected fate and transport) • Availability of instrumentation/detection systems for the chemical	Uniqueness to HF should have been a criterion. An appropriate screen would include a complete analysis to determine if HF is involved, then potential exposure should be considered, and then and only then should toxicity be reviewed.	
118	5.4.4.1.	Glycols (diethylene glycol, triethylene glycol, and tetraethylene glycol) and the chemically relatedcompounds 2-butoxyethanol and 2-methoxyethanol are frequently used in hydraulic fracturing fluids and not naturally found in ground water. Thus, they may serve as reliable indicators of contamination of ground water from hydraulic fracturing activities.	Glycols may be found in HF fluids, however, these chemical are ubiquitous. For example, they are used in food products, laboratory preservatives and water well construction materials.	
122	6	Toxicity Assessments	The development and application of hydraulic fracturing additives that can perform effectively when produced water or alternative water sources are used in stimulation fluids can reduce fresh water use. In addition, some additives serve an important role in protecting well integrity. A focus on toxicity without an understanding of why the chemical is used and the potential environmental benefits should be avoided. Intellectual property right protection can have a significant impact on corporate incentives to develop technologies in these areas.	

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129	7.1.1.	Table 50. General approach for conducting retrospective case studies. The tiered approach uses the results of earlier tiers to refine sampling activities in later tiers.	EPA has not provided the specific tier that each retrospective studies is currently under. Nor has the agency identified a consistent methodology for determining if a retrospective study or site requires further investigation. This methodology should be spelled out and the agency should describe how each of the retrospective cases has gone through review and the conclusions reached (i.e. Tiering).	
129	7.1.1.	Tier I - Verify potential issues • Evaluate existing data and information from operators, private citizens, state and local agencies, and tribes (if any) • Conduct site visits • Interview stakeholders and interested parties	EPA has not published a QAPP for evaluating existing data and information related to the retrospective study locations. Specifically, there is no evidence that EPA has comprehensively collected and evaluated background/baseline water quality information that could be used to evaluate potential evidence of drinking water contamination is caused by HF. The EPA failed to interview operators during tier 1 activities; operators within the area of interest should have been considered stakeholders.	
129	7.1.1.	Tier 2 - Determine approach for detailed investigations • Conduct initial sampling of water wells, taps, surface water, and soils • Identify potential evidence of drinking water contamination • Develop conceptual site model describing possible sources and pathways of the reported or potential contamination • Develop, calibrate, and test fate and transport model(s)	EPA should work closely with states and operators in the retrospective study areas to develop the conceptual site model. States and operators have critical experience that would contribute to the quality of research results.	
130	7.1.1.	Table 51. Analyte groupings and examples of chemicals measured in water samples collected at the retrospective case study locations.	A number of the analytes listed in the table have methods that are being developed by the EPA. It is recommended that methods that have not been completely developed, verified, validated and approved not be used for field sampling activities.	
132	7.2.1.	Potential sources of ground water contamination under consideration include activities completion and enhancement techniques, improperly plugged and abandoned wells, gas migration, and residential impact.	The agency should not assume a potential impact has been caused by HF, therefore, investigating other potential sources of contamination and understanding background conditions and water quality variability may be necessary. However, if it is highly likely that a potential impact is not caused by HF, the agency should not expend significant project resources to perform further investigation under the jurisdiction of the study.	
138	7.3.1.	Since the blowout, the State of North Dakota has overseen site cleanup and has required the well's operator to conduct ground water monitoring on a quarterly basis.	These types of responses and associated regulations and operational plans/practices have not been taken into consideration by the EPA within the study. This context is critical to understanding the risk to drinking water and the public.	

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143	7.4.1	If anomalies in ground water quality are found during sampling, all potential sources of contamination in the study area will be considered, including those not related to hydraulic fracturing.	The agency should not assume a potential impact has been caused by HF, therefore, investigating other potential sources of contamination and understanding background conditions and water quality variability may be necessary. However, if it is highly likely that a potential impact is not caused by HF, the agency should not expend significant project resources to perform further investigation under the jurisdiction of the study.	
143	7.4.1.	The EPA chose Bradford County, and parts of neighboring Susquehanna County, as a retrospective case study location because of the extensive hydraulic fracturing activities occurring there, coincident with the large number of homeowner complaints regarding the appearance, odor, and possible health impacts associated with water from domestic wells.	It is paramount that background, baseline and natural variation are understood, and other potential sources of contamination are considered. Starting from a known cause (i.e., operational failure or incidence), and investigating the severity of impacts on drinking water is more likely to produce reliable research conclusions and reduce uncertainty. Initiating the process at locations that have perceived drinking water impacts and attempting to trace those perceived impacts back to a hydraulic fracturing location will most likely produce unreliable conclusions and increased uncertainty.	
145	7.4.2.	Naturally high levels of TDS, barium, and chloride found in ground water make it difficult to assess the potential impacts of hydraulic fracturing activities in this part of the country since these analytes would normally serve as indicators of potential impacts. In addition, methane occurs naturally in ground water in the study area, making an assessment of potential impacts of methane due to hydraulic fracturing on drinking water resources more challenging than at other study locations.	EPA should acknowledge that the naturally occurring water characteristics could have led to false groundwater contamination allegations, which was their sole selection criterion for retrospective site selection.	
146	7.4.3.	Since methane is known to be naturally present in the ground water of northeastern Pennsylvania	Building on EPA's statement, studies using larger groundwater sample populations have proven that gas is in highly localized seep areas and is not related to natural gas development (Molofsky, 2012; Baldassare, 2012; Weston Solutions, 2012). Methane is the most common contaminant found in well water, regardless of whether there is gas drilling in the area.	
159	8.1.	All agency research projects that generate or use environmental data to make conclusions or recommendations must comply with the EPA QA program requirements...the Quality Management Plan was created to make certain that all research be conducted with integrity and strict quality controls.	EPA appears to have begun the agency's research activities in 2010, however, the revision 0 project QMP was approved Oct. 2011. Typically QMPs are developed and approved prior to beginning research activities to make certain that all research is conducted with integrity and strict quality controls. This is even more important during the conduct of a highly influential scientific assessment.	http://www2.epa.gov/sites/production/files/documents/HF-QMP-1-19-2012.pdf

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161	8.2.	Peer review, an important part of every scientific study, is a documented critical review of a specific scientific and/or technical work product (e.g., paper, report, presentation). It is an in-depth assessment of the assumptions, calculations, extrapolations, alternate interpretations, methodology, acceptance criteria, and conclusions in the work product and the documents that support them.	EPA has provided the recently established ad hoc SAB Panel with charge questions that are not geared toward evaluating EPA's methodologies and acceptance criteria. EPA is encouraged to involve industry to provide current information and confirmation. Industry is committed to ensuring the study is based on sound science and believes that this report will verify what has been repeatedly shown – that HF performed responsibly is environmentally safe.	
170	9.3.	While the EPA expects hydraulic fracturing technology to develop between now and the publication of the report of results, the agency believes that the research described here will provide timely information that will contribute to the state of knowledge on the relationship between hydraulic fracturing and drinking water resources.	The industry and state regulatory agencies continue to improve practices and regulations associated with unconventional oil and gas development based on experience. There is concern that the study has not been designed to capture this progress. It is recommended the agency carefully review conclusions and finding within the appropriate context of current practices and regulations at the state level. a. RFI: The original data collected by EPA from Service Companies and Operators during the RFI process could be out of date (e.g., well construction and other industry practices)	
170	9.3.	The agency does not believe that the report of results will provide definitive answers on all research questions for all time and fully expects that additional research needs will be identified.	All conclusions and limitations associated with EPA's research should be disclosed within report of results and all other research deliverables.	