

**Bryce F. Payne Jr., PhD comments to the**

**Hydraulic Fracturing Research Advisory Panel review of EPA draft Assessment Report on Hydraulic Fracturing during the meeting of 10/28/2015.**

Given the purpose of this Research Advisory Panel it seems appropriate and perhaps helpful to present my comments in the context of the “Charge Questions for the SAB Review of the USEPA Report: Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources”. To that end, let me begin by stating that I was engaged by Mr. Steven Lipsky to undertake a review and investigation of the contamination that has affected the residential water wells on his property and neighboring properties apparently since as early as late 2009, though he was unaware of the contamination until July 2010. I will refer to this case as the Southern Parker County (SPC) case. I would like to offer what lessons I can in short comments related to certain specific points in the Charge Questions to this Panel.

Charge Question 1-- The goal of the assessment was to review, **analyze**, and synthesize available data and information concerning the potential impacts of hydraulic fracturing on drinking water resources in the United States, including identifying factors affecting the frequency or severity of any potential impacts. ... **Are there topics that should be added...to provide needed background for the assessment? YES**

Charge Question 4 -- The third stage in the hydraulic fracturing water cycle is well injection: the injection of hydraulic fracturing fluids into the well to enhance oil and gas production from the geologic formation by creating new fractures and dilating existing fractures.

b. ...Are there other major findings that have not been brought forward? **YES Are the factors affecting the frequency or severity of any impacts described to the extent possible and fully supported? NO**

c. Are the uncertainties, assumptions, and limitations concerning well injection fully and clearly described? **NO**

d. What additional information, background, or context should be added, or research gaps should be assessed, to better characterize any potential impacts to drinking water resources from this stage of the hydraulic fracturing water cycle? **TO BE CONCISE, HENRY’S LAW.**

The extent to which Henry’s Law (basically the law describing the solubility of gases in water) and its implications for dissolved hydrocarbon gases, especially methane, were ignored during sampling and data synthesis and interpretation by numerous parties in the Southern Parker County case was quite astonishing to me. What was even more astonishing was realizing how widely Henry’s Law is ignored in efforts to develop data on methane migration generally, but seemingly especially in relation to HF gas wells. At a basic and fundamentally important level, the dimensionless Henry’s Law constant for methane, around 30, tells us that given a choice between being dissolved in water and being a free gas, nearly all the methane will move into the gas phase. Further, given that methane is the epitome of a non-polar and small molecule, and water the classical polar solvent, it also follows that methane dissolved in water will rapidly exsolve from the water whenever environmental conditions change. This all boils down to the simple realization that collecting a representative sample of water that contains any appreciable

amount of methane presents a serious challenge, and the challenge becomes ever more difficult as the methane concentration increases.

The open VOA vial sample collection method (often incorrectly referred to as the EPA RSK-175 method with which it has been associated) is widely used to collect water samples for methane analysis, including by environmental contractors for Range Resources and the TX RRC, and is recommended by numerous other similar authorities in other states. Henry's Law tells us we should consider the use of any open vessel to sample for methane in water as probably not a great idea. Still, for many samples with commonly low methane levels, <1 or perhaps 2 ppm, it is very convenient and provides reasonable results. The problem arises when one does not know if the methane levels are less than 2 ppm at the time of sampling. In cases where methane migration and related ground water contamination is possible, it should be assumed that methane concentrations may be well above 2 ppm, and, therefore, the open VOA vial method is not appropriate. Conversations with EPA personnel confirm that EPA is aware there is a serious sampling methods problem.

In the SPC case samples collected by Range Resources contractors using open VOA vials indicated methane concentrations in ground water samples in the area were no higher than 3 ppm. One might conclude from such data, as Range and the TX RRC did, that there was no contamination. However, this presented a bit of a dilemma when that same well water would sustain continuous flame, and the water well head vent would continuously flare a flame over a meter in length (as it still does to this day). If only the relevant authorities had realized that they were looking at a full blown incarnation of Henry's Law. Given the choice between a palpable real world observation of combustible concentrations of gas coming from both the water and the water well head space, and a sampling method that should be regarded by theoretical default as unreliable for contaminated wells, the authorities in the SPC case chose to go with the unreliable sampling method. As the SPC case progressed, other entities and agents (not the EPA) would sample in SPC using other more reliable methods which preclude contact of the water sample with open air, and always find methane in the 40-70 ppm range, fully in accord with Henry's Law and the simple observation of high concentrations of combustible gas at the faucet and the water well head (head space combustible gas concentrations over 85% are readily measurable at the Lipsky water well head, with somewhat lower concentrations in numerous neighbors wells).

Now, one might ask what do such details of the SPC case have to do with the EPA HF Assessment Report? Simply this: many state authorities and industry contract laboratories, and, indeed, some standard methods publications explicitly stipulate the open VOA vial sampling procedure is to be used when sampling to determine methane in water. The SPC case clearly has shown that this "standard" sampling method provides no reliable indication of elevated levels of dissolved methane even when those levels are very high by any reasonable comparison. That is to say, then, dissolved methane data that has been available from much of the previous literature, including scientific, industry or government (especially state) sources probably was collected using the VOA sampling method, and, hence, is at best unreliably informative on when or not methane contamination was or was not present in a given ground water source (well). It follows then, that the Assessment is attempting to discern contamination by looking at methane-in-water data from a method (or related other methods) effectively blind to the contamination of concern. For the sake of brevity I will now refer back only to Charge Question 1. In my opinion one

cannot properly analyze data if one does not know the methods used to acquire that data. One cannot meaningfully synthesize data that does not reliably speak even to the presence or absence of contamination, let alone the level.

There is much more to be gained from a thorough examination of the science in the SPC case, and, among other things, Henry's Law implications in it. It is my understanding that the SPC case was not explicitly considered in the Assessment. It should be for there is much to learn from it, most of which will be extendible to other cases. Without the explicit consideration of the SPC case and other thoroughly documented cases, the Assessment will be running blind, lacking answers to the most straightforward question, when and where have methane migration events actually occurred? Where are they still occurring? Are new ones appearing? How many go unreported because the victims fear the costs and implications of legitimately speaking up in their own interest? How many more aquifers as in SPC have to be degraded before such cases will be considered in this or other such Assessments? When will EPA look at simple, robust, rapid field evaluation methods for methane migration and ground water contamination? Henry's Law tells us that a more convenient and reliable means of sampling for the presence of methane in aquifers would be to (appropriately) test the head space gas in water wells because even small amounts of methane in the ground water will give rise to easily measured levels of methane in the head space air. When will EPA require the oil/gas industry to routinely apply such methods to assure residents in the vicinity of HF wells are protected from harm? When will EPA fully consider the sub-lethal health threats posed by continuous methane contamination of ground water resources of the United States?

I invite the Panel or any of its members to contact me in regard to these and further relevant matters should any wish to do so.

Thank you for your attention.