Couch, John

Subject: FW: Bluebonnet April 17 meeting

From: Chapman, Bryant L
Sent: Tuesday, April 09, 2013 3:26 PM
To: John Couch
Subject: Bluebonnet April 17 meeting

John,

Attached below is a statement for you to read on my behalf: It's a first pass, so input welcome....

Good evening, my name is Bryant Chapman and I am a resident in Brazos Country subdivision. I am currently out of country on business and have asked my neighbor and good friend John Couch to read the following statement for the record. My degree is in Chemical engineering and I am a professional registered Petroleum engineer. I have conducted numerous reservoir studies, including log analysis and structural geology as a petroleum engineer and supervised multi-discipline teams of petroleum engineers, geologists, geophysicists and petro physicists. Reservoir studies consider the flow of all fluids, water, oil and gas and I have done them all. I am currently the Vice President of engineering for worldwide operations for a major oil company and have been in the industry for 32 years.

I state these credentials only for the statement that I am about to make: The phase 1 hydrogeologic report conducted on behalf of and paid for by Electro Purification is grossly inadequate to ascertain whether this operation will cause irreparable damage to the Evangeline and overlying aquifers. If is filled with assertions, and assumptions that cannot be assumed or substantiated. A number of the assertions are in conflict with each other.

Water is an incompressible fluid. In a confined reservoir, meaning that there is no additional water influx, it is a fixed volume of water. This is an artesian reservoir as defined on page 5. This means that the only water that you can pump out of the ground is the minute amount of water expansion from the current reservoir pressure to the abandonment pressure. I ran the formation volume factors for water at these conditions, and as I intuitively knew, 99.99% of the available water in the pore space will be abandoned in place, unable to ever be pumped out. They refer to this as storage coefficient. Read this as for every gallon of water in the ground, you will get .00001 to .001 gallons out of the ground.... They assumed the top end and more conservative number of .001, a hundred fold difference from the lower end. I will reference this later

The amount of water in place is simply calculated by knowing the net sand thickness x porosity x areal extent. To do this, you would need to have a net sand isopach. They do not have this. In fact they only show 10 individual points from area wells that show quite a variation in sand thickness. The one well log that they supplied shows a number of discontinuous sand bodies and I would expect this heterogeneity to exist across the whole geologic area. This is also part of the reason for opening up the entire 800' sand section, so they can maximize well deliverability or well rate.

They spend quite a bit of time talking about permeability and the productivity of each well, and I have no doubt that these are highly permeable sands and can drain a lot of water in a short period of time.

The recovery factor of the water can only be improved by the degree to which it is recharged. They generically reference outcrops and recharge areas but point to none. They state regionally, the Evangeline dips deeper towards the Gulf of Mexico. No fresh water there. On page 16 they state, and I quote "By screening only the sand zones below 700', the effects of production should be minimized in wells completed in shallower zones. The lower permeability silt and clay units between the sand zones restrict the vertical follow of water between the sand zones thereby preventing deleterious effect on production from nearby wells".

If this is so, how will rain water and outcrops get from the surface through these impermeable layers to recharge the Evangeline reservoir? All of the discussion of recharge is hypothetical, it can and does happen, but there is not a shred of evidence to say that it will happen. In fact, the limited data suggests that it will not. This is part of the assumption in their 100 fold recovery assumption stated above. Why have the reservoirs serving Galveston and Fort Bend not recharged?

They state that the current water level is 100' below surface. I would contend that this represents a part of the existing depletion that has already occurred. In their discussion on water quality they mention a mound of lower water quality affected by nearby salt domes. They don't mention if this is the same acquifer, but they do mention that the water level is 600' below ground level. What does this say about reservoir interconnectivity?

Finally, they use a crude reservoir model, GAM, which they state is not applicable to single well or localized applications, but claim that the size of the project does not warrant a more thorough analysis. Instead, they use a crude analytical solution to estimate the differential equations needed to model radial flow, the Thesis model, developed in 1935. There are a number of assumptions:

- The aquifer is homogenous and isotropic.... It is not
- The aquifer is horizontal and contstant thickness: .... It is not
- Before pumping the piezometric head in the aquifer is the same at every point... it is not

I could go on, but they state that it is an appropriate model for a phase 1 study. They also state that this model will show drawdown that is greater than actually observed. Disagree... the assumptions above play a huge role in this, sand thickness and homogeneity being one of the greatest. I would content that this could be a very optimistic best case scenario. However, with that said , look at their figure 10 and 11. Within **one month** they will drop the water level by **60'** in the immediate area and by one foot all the way out to **north of Pattison and south to Wallis**. One month... Within one year the water level will drop by **150'** in the immediate area and will drop by one foot all the way **north of Monaville and almost to Richmond and Rosenberg**. By the way, if this aquifer is this contiguous and can reach out radially to Richmond and Rosenberg, why don't they drill the wells there. **Remember the assumptions: constant homogenous and contiguous sand, recharge from surface and outcrops, a recovery factor that is at the very high end of the spectrum**. I can only wonder what these numbers would look like with a proper reservoir model, using technology more current than 1935 analytical shortcuts to solve the differential equations need to properly model this.

The pressure of fluids in a pore space helps to support the weight of the earth above it, referred to as overburden. The pressure in this pore space helps provide support to the overburden. When this pressure is depleted, it allows the sand to collapse on itself, reducing porosity. It can and often does result in subsidence. This is not discussed anywhere in their work. There is also a salt dome with fairly shallow oil

production just to the east of the Brazos River. I know nothing more than that it is there, but shallow salt dome uplifts can cause all kinds of changes to the overlying and adjacent formations in terms of stresses, impermeable barriers due to faulting, unconformities, etc. Nothing is mentioned in the report on this.

This work may be acceptable for a first pass look with limited data and a limited budget, but it is not much more than an interesting exercise that does not prove much and leaves more questions unanswered than answered. It is based on assumptions with very limited data and not many facts.

However, these are some facts:

FACT: Over depletion of reservoirs can result in subsidence, as evidenced by the subsidence that started in Galveston as they pumped more groundwater than the aquifer could replenish and has since spread to the Houston area. The Fort Bend subsidence district was created in 1989.

FACT: Water law is nowhere as sophisticated as oil and gas law in that the rule of capture still applies. The only protection landowners have is a groundwater conservation district. The residents of the 4 county area approved the creation of the Bluebonnet Water conservation district, with a single purpose of preventing what is being recommended today, and that is to prevent greedy corporations and individuals from tapping into a limited and vital resource for their profit at the expense of its citizens resource and future. For this support, we pay $.04 per 1000 gals to fund their office and staff. Essentially a tax that we voted on ourselves to pay an office to protect our water supply and rights.

FACT: The entire subdivision of Brazos Country uses circa 25 million gallons per year. The proposal from these wells that are right adjacent to us will be to eventually take 20 million gallons per day.

FACT: As per the filed documents, while we pay $.04/gal, Electro Purification will sell our water to its clients for $1.28 per gallon. The land or Royalty owners will get $.40/ gallon of this. This fee will escalate every year at the CPI, but not to exceed 3%. At 20 million gals per day, this equates to $9.3 MM/yr. The landowners stand to gain almost $3MM/yr. Inflate this at 3% per annum, in 20 yrs, it goes to $16.7MM and $5.4MM respectively. No doubt, this is quite lucrative for both the company and the land owners. However, they are not simply taking water from beneath their land, they are reaching out way further than this, which could impact us all.

I look forward to future meetings and dialogue

Sincerely

Bryant L Chapman