Water Protection Issues

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Mr. Chairman, Commissioners

Introduction

My name is Bob Wessely, 270 County Road A3, Las Vegas. My background is small business owner and systems engineer. I chaired the Water Assembly as we led the development of the Regional Water Plan for Sandoval, Bernalillo and Valencia Counties. I'm Chair of the Las Vegas Community Water Board and of the City's Utility Advisory Committee. I am here to identify some of the key water issues related to oil and gas development in the County.

San Miguel County, like much of New Mexico and the southwest, does not have a surplus of water. Our water is precious, and we have darn little of it. The health, welfare and safety of the citizens of the County depend upon our short water supply. The County cannot afford to jeopardize that supply.

I think it is important for you to understand the risks that come from heavy industrialization, and to understand how those risks can be avoided or mitigated. And, of course, that mitigation should be done with industry funds, not taxpayer funds.

I am going briefly to address seven questions related to water issues in San Miguel County. Please consider these carefully as you draft your ordinance. The problem is complex. I will try to highlight the key topic areas: What should the County be trying to protect, and from what? And how might the County go about achieving that protection. There are many of points of risk and several ways to mitigate those risks. My discussion will be at a top level, the details are too voluimous to enumerate today.

Outline – Water Issues

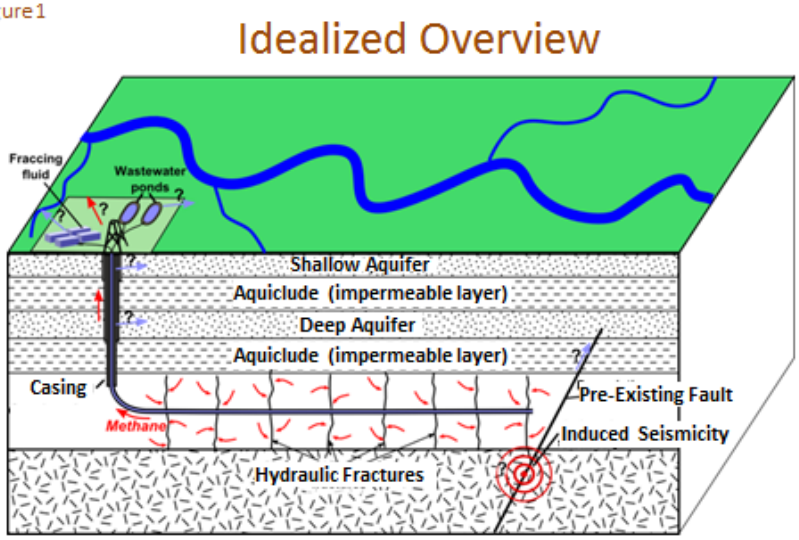
- Introduction
- What Water Supplies Are There?
- What Are the Risks to Those Supplies?
- What Could Damage Water Supplies?
- What are the Protection Strategies?
- What Needs to be Monitored?
- What Can Cause Loss of Supply?
- What Other Concerns Are There?
- Conclusions

What water supplies are there?

Figure 1 contains an idealized gas well diagram showing water locations relative to a gas well. We have surface streams, originating from snowmelt, springs, and rainwater runoff. These, of course are dependent upon the variable generosity of Mother Nature. They have been used for agricultural and domestic purposes for centuries.

In some places, we have multiple formation layers of fresh groundwater that have been deposited over the millennia, water that we pump for domestic and agricultural uses. These layers ("aquifers") are refreshed by rainwater seepage, but way more slowly than our ability to extract water from them.

Figure1



We also have, in some places, have layers of older, usually deeper, brackish aquifers – water that contains more than 1000 ppm (1 gram per liter) of dissolved salts and other substances. Technology is approaching the point where this brackish water can competitively be extracted, purified, and used for domestic and agricultural purposes. As an example, Sandoval County, to support Rio Rancho and a new development, has drilled two brackish water wells, one to 3800 feet and one to 6400 feet.

The schematic Figure 2 shows that the layers are not quite as simple as it might have appeared from Figure 1. And Figure 3 shows the complexity of some real layers near Las Vegas.

Figure2

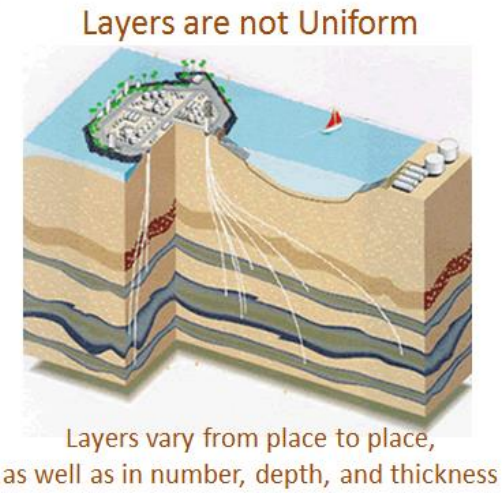
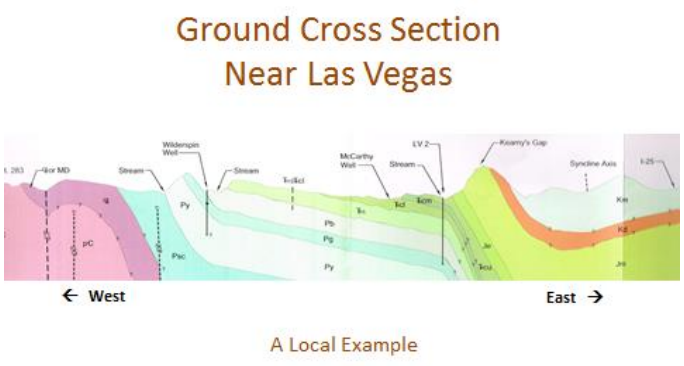


Figure3



It is probably obvious that the County needs to be highly protective of its surface waters and its fresh, ground waters. However, as the County's needs for water increase, as precipitation continues to shrink toward long term averages, as technology improves, and as the County depletes fresh water aquifers, the deep brackish waters become increasingly critical to citizens' health, welfare and safety, and therefore must also be protected.

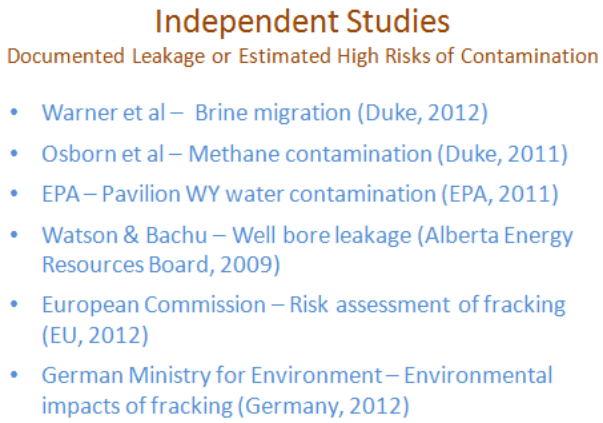
What are the risks to these supplies?

At the top level, there are two forms of risk to three sources of water – damaging existing water sources and creating new consumptive uses that draw on existing water sources. The health, welfare and safety of San Miguel depend upon control of both forms of risk. The County must take steps to keep hazardous substances out of all three forms of water sources (surface water, fresh aquifers, and brackish aquifers).

The risks are significant, both in likelihood of occurrence and in consequences of failure. Bachu & Watson's data for Alberta suggest failures at 2% for newer wells (20 'bad' wells out of 1000). And failures can irrevocably contaminate an aquifer. A State of NM report shows 857 instances of groundwater contamination – that are self-reported by the operators – from O&G operations and facilities.

A number of independent studies give rise to concern. They include::

- Warner et al - Brine migration (Duke)
- Osborn et al – Methane contamination (Duke)
- EPA - Pavilion WY water contamination (EPA)
- Watson & Bachu – Well bore leakage (Alberta Energy Resources Board)
- European Commission – Risk assessment of fracking (EU)
- German Ministry for Environment – Environmental impacts of fracking (Germany)



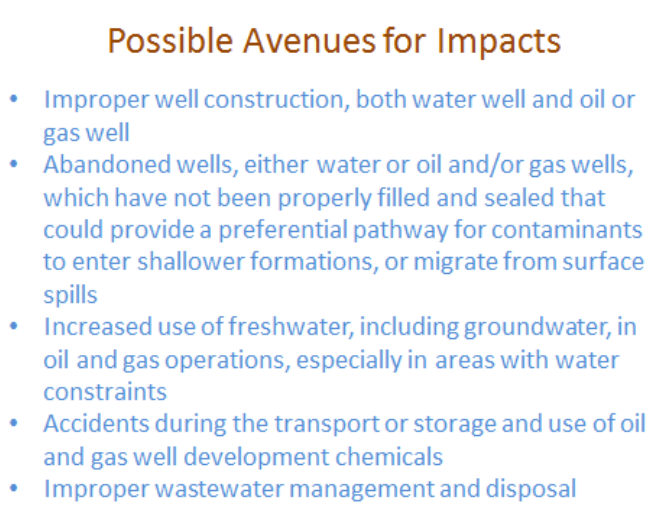
What could damage water supplies?

I would like to first quote from the November 2011 report by the National Ground Water Association. "The greater use of horizontal wells and hydraulic fracturing technology has the potential to significantly expand natural gas and oil supplies and hold down prices; however, concomitant with this enhanced production is the increased possibility for groundwater contamination, and other impacts to drinking water supplies if best practices and proper

procedures are not used, and if appropriate regulations are not in place." They cite possible avenues for impacts to groundwater and drinking water to include:

- Improper well construction
- Abandoned wells,
- Increased demand for fresh water
- Accidents during transport or storage
- Improper wastewater management and disposal.

The NGWA article goes on to list ten principles as a foundation for policy making focused on groundwater and drinking water protection. Please do take them into account in formulating your ordinance.



Amid the deeper layers, there are deposits of oil and gas locked up in the formations. And along with the oil and gas there are many other chemicals, some radioactive. The process of releasing and extracting oil or gas carries with it the release and extraction of these other substances, which can be quite hazardous.

While there are several ways to release the oil and gas, a common one is injecting large quantities of high pressure water containing chemicals, some of which are toxic ("fracking"). Other techniques include the use of subsurface explosives and injection of concentrated acid. In all of these, some of the injected fluids are then recovered for storage and some of the fluids remain in the ground.

In drilling a well, large quantities of a drill bit lubricant fluid called "drillers mud" are used. Mostly, this material is recovered and stored after the drilling operation.

What are the protection strategies?

To protect water supplies from damages, the goal is to reliably keep the hazardous substances where they belong, and out of streams, out of fresh aquifers, and out of brackish aquifers.

The backup to the mechanisms for keeping hazardous substances where they belong is to closely monitor all containment facilities so that any failures are promptly detected and remediated.

And to protect existing water sources from depletion, the goal is to ensure that the large quantities of water needed for drilling mud and for fracking are not drawn from sources that are or can be used by existing water users in the County.

What needs to be monitored?

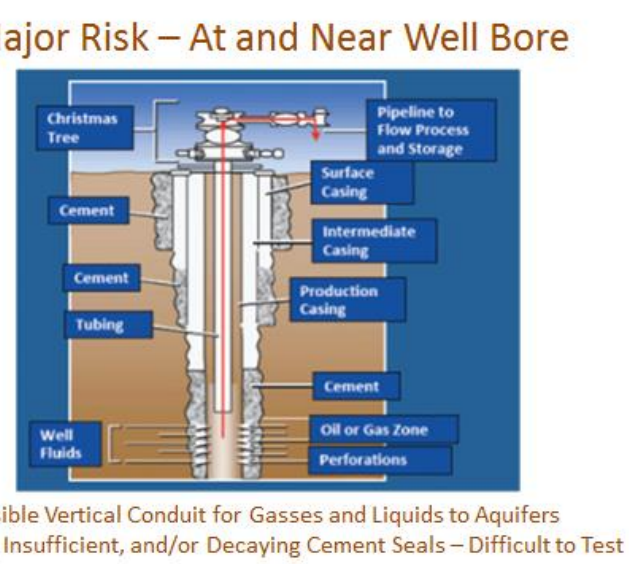
A December 2012 report by Los Alamos National Laboratory for Environmental Building Sciences contains a detailed protocol for water monitoring at oil and gas exploration and production sites. Some aspects of that report could well serve as a guide in establishing your ordinance's water monitoring requirements. Let me discuss an overview of the appropriate monitoring needs:

The industry stores hazardous fluids above ground in tanks or open pits. Leaks above and below the ground surface can migrate into aquifers. Mechanisms should be established to make leaks unlikely, and mechanisms are needed to detect any leaks promptly. Examples of targets for monitoring include alpha and beta radiation, methane/ethane presence, oil/grease presence, acidity, and selected volatile organic compounds (VOCs) .

Automated monitoring stations with alarms should be placed below all storage facilities. Monitoring wells should surround the vertical oil and gas wells, (at least four orthogonal directions), and should be capable of detections at each aquifer level above the target oil and gas layer.

As shown in Figure 4, the drilling process leaves a jagged-edged surface in the hole. Pipes are dropped into the hole. Unless proper steps are taken, gasses and liquids will migrate upward between the pipe and the jagged surface, and then flow into any aquifers that have been penetrated. Usually cement is forced into that space outside of the pipe. Especially risky is the seal between the concrete and the jagged aquifers surfaces at all depths. Mechanisms, inspection and monitoring, should be established to ensure the concrete seals really do keep fluids out of the intervening aquifers, both fresh and brackish.

Figure4



Possible Vertical Conduit for Gasses and Liquids to Aquifers
Imperfect, Insufficient, and/or Decaying Cement Seals – Difficult to Test

With horizontal drilling, there is a risk that the drill bore will intersect already-existing fractures, or water wells or other O&G wells in the ground layers that could serve as a conduit to aquifers or to the surface (see the lower right corner of Figure 1). Generally locations of such fractures are unknown and difficult to detect, making safety of any particular location questionable. Mechanisms to detect leakage should be placed around the well bore and along the path of any horizontal drilling. Monitoring should be accomplished at each existing well along any horizontal oil and gas drilling path (perhaps within 1000 feet either side)

Since protective well sealing materials, materials and casings can decay over time and because some leak testing is less than certain, it is important to monitor so as to know promptly when a leak occurs. Baseline measurements are necessary so as to make follow-up measurements meaningful.

Surface water and groundwater at each aquifer layer should be tested regularly during operations and for a many decades after well abandonment for traces of hazardous substances. Emphasis on such testing should be around vertical oil and gas wells, and above the path of horizontally drilled wells. Similarly, automated monitoring devices and alarms should be placed around and below all storage facilities to detect leaks before they have a chance to migrate and do substantial aquifer damage.

What can cause loss of supply?

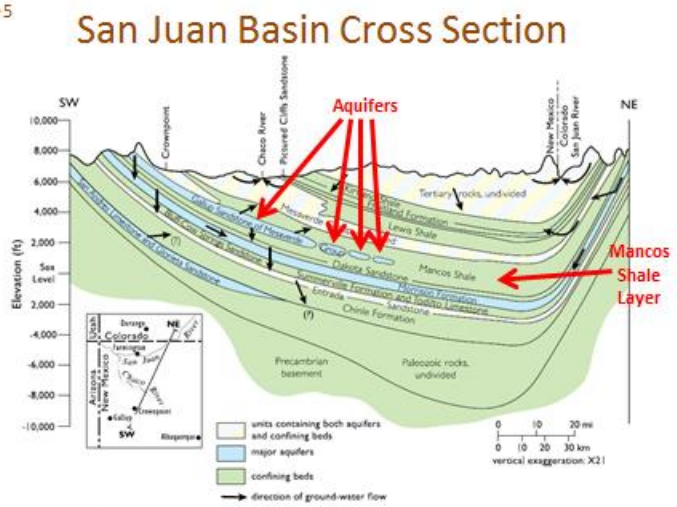
Huge quantities of water are required for oil and gas industry operations. Amounts vary depending upon the geologic formations. At 4 million gallons per well, it would take fewer than 200 wells to far exceed Las Vegas' annual use. And most of that water is lost from the hydrologic cycle forever. That new substantial demand for water would certainly be a significant stress on the County's limited water resources, imposing a degradation of the citizens' health, welfare and safety.

The County should consider prohibiting use of County water resources, both fresh and brackish, for drilling and for fracking certainly within the County, and probably also outside of the County.

Miscellaneous cautions

Consider Figure 5 which is a cross section from studies in the San Juan Basin. Note the aquifers were found in the midst of the petroleum bearing Mancos Shale. Such interleaving may occur in San Miguel County where the eastern part of the County is rich in brackish water supplies. Those valuable aquifers should not be sacrificed. The permitting process should require scientific knowledge of where such interleaving conditions arise, and should limit nearby oil and gas operations accordingly.

Figure5



Aquifer Layers Interleaved with Oil and Gas Layers

In the event of a detection of impurities, it is important to know whether the impurity is a natural occurrence or caused by recent industrial activities. Baseline measurements should be made before any industrial activity takes place. Those measurements should be done for each substance and at each site where monitoring will, after permitting, take place.

Further, data gathering and reporting is frequently an inexact science. It is important that those tasked with the inspection and monitoring do not have a pecuniary interest in the results of the monitoring.

Conclusions

Water is crucial to the health, welfare and safety of the County citizenry. And heavy industrialization, particularly oil and gas operations, creates a real and significant, multifaceted risk to the County's water resources. Before authorizing industrial operations, the County should require that adequate protections and monitoring are in place, and that there is a strong incentive for the industry to employ strong protective practices.

Thank you.