COGA | Hydraulic Fracturing Whitepaper

WHAT IS HYDRAULIC FRACTURING?
Hydraulic fracturing is one of the final components of the overall drilling procedure and is used far below ground surface (often more than a mile) to allow the recovery of oil and gas. It is often confused with the entire drilling practice, but it is just one part. This fact sheet explains what hydraulic fracturing is, describes what concerns stakeholders have with the process, provides some technical explanations, and discusses the regulatory framework. Hydraulic fracturing is often referred to as "fracing," pronounced fracking.

WHY DO WE NEED HYDRAULIC FRACTURING?
Hydraulic fracturing is a critical part of the oil and gas production process; it allows wells to produce that would otherwise be uneconomical. It therefore allows us to maximize our domestic resource and get the most of the oil and gas infrastructure that is in place. It is estimated that up to 90 percent of the wells currently operating today have been hydraulically fractured. Without this technique, thousands of wells across the country would be closed, thereby reducing our domestic production, failing to make the most of our oil and gas infrastructure, and negatively impacting the local economies.

WHAT ARE CONCERNS WITH HYDRAULIC FRACTURING?
Many stakeholders are concerned that hydraulic fracturing may create pathways to underground sources of drinking water (called aquifers) and release hydraulic fracturing fluids into those aquifers. The oil and gas industry and the agencies that regulate us are committed to preventing these pathways and any kind of release to groundwater. Individual, community, and environmental health and safety are our priority! There is a robust regulatory framework in place to prevent any environmental effects. In addition, our industry takes every precaution in its pre-drilling well design and actual operations to prevent any release to the environment. Both the regulatory framework and the precautions that we take are described further in this fact sheet.

LET'S GET TECHNICAL
Individuals often confuse the entire drilling process with hydraulic fracturing. Because the drilling process is already extensively regulated, it is important to clarify exactly what we are talking about when we discuss hydraulic fracturing.

First, let's describe drilling. For the vast majority of wells drilled onshore in the United States, drilling a well involves two key components: the first or top part of the hole (or surface hole) is drilled at least 50 feet below all known drinking water supplies and has a hole size of approximately 12 ¼ inches in diameter.

This boring is lined with a layer of heavy steel casing and encased in cement. For all wells drilled, the cement sheath is created by pumping a cement slurry down and around the steel casing and back to the surface. When this cement solidifies, it provides a solid barrier of cement and steel casing isolating all potable water zones from the drilling and fracturing fluids used in the remainder of the drilling process. The second component involves drilling a smaller concentric hole (usually 8 ½ inches or smaller) an additional 5,000 to 10,000 feet to the proposed hydrocarbon bearing zones. This part of the hole is also lined with a string of heavy steel casing (also known as the production casing or long string) and is run inside the surface casing to the total depth of the well drilled and then totally encased with cement through and across all the oil and gas (hydrocarbon) formations. These two concentric strings of steel casing (surface casing and production casing) are totally encased with concrete that prevents all fracturing fluids and hydrocarbons from migrating up to the shallow aquifers near the surface.

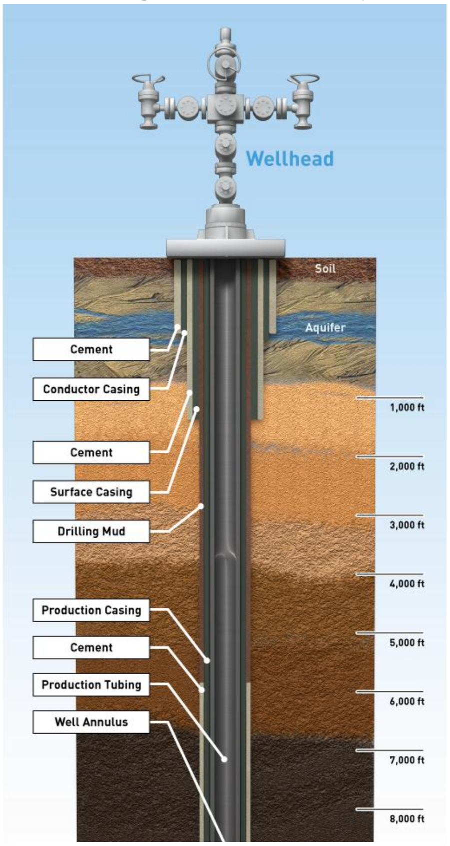

Figure 1: Layers of cement and steel casing of a typical well

For some formations, hydraulic fracturing is needed to facilitate the removal of the hydrocarbons located more than a mile or more below ground level. Now, we'll describe that process. First, the finished well bore construction as described above is tested with hydrostatic pressure greater than that calculated to occur during the fracturing treatment process itself. This measured pressure is monitored for a period of time (usually 15 to 30 minutes) to ensure that there are no leaks and well bore integrity has been obtained. Once this pressure test passes the designed engineering specifications, small holes or perforations are mechanically punched through the steel and cement directly into the hydrocarbon bearing formation. Hydraulic fluids are then pumped under pressure down the cement encased well exiting through the mechanical perforations and directly into the prospective formation. This fluid (99.5 percent water) opens or enlarges any natural fractures in the rock at the depth of the hydrocarbon formation. These fractures are initiated in the hydrocarbon formation near the bottom of the well and usually extend laterally several hundred feet within the reservoir rock. As the formation begins to fracture, a "propping agent" (usually sand carried by a high-viscosity additive) follows the first fluid and is pumped into the created fractures to keep them from closing completely when the pumping pressure is released. The oil or natural gas then uses these created "hydraulic fractures" to move through the rock pore space to the production well. The production well as described above serves as the conduit to bring the hydrocarbons to the surface.

STUDIES

The U.S. Environmental Protection Agency (EPA) has begun planning that will begin a second study "to investigate the potential adverse impact that hydraulic fracturing may have on water quality and public health." The study is expected to have preliminary results by 2012, with a final deadline of 2014.

Previous studies conducted by respected authorities have all concluded that hydraulic fracturing is safe. EPA (2004), the Ground Water Protection Council (2009), and the Interstate Oil and Gas Compact Commission (2002) have all found hydraulic fracturing non-threatening to the environment or public health.

REGULATORY OVERSIGHT

There is a lot of misunderstanding about what is and is not regulated in drilling and hydraulic fracturing –so we've provided a step-by-step overview.

1. In Colorado, operators have to apply to get a permit to drill describing all of their surface and downhole activities through the Colorado Oil and Gas Conservation Commission (COGCC). This includes well design, location, spacing, operation, water management and disposal, waste management and disposal, air emissions, wildlife impacts, surface disturbance, and worker health and safety.
2. COGCC oversees all drilling operations including prevention of surface spills, ensuring adequate cementing through cement bond logs and mechanical integrity tests, and monitoring the surface casing and production casing annulus (Bradenhead) during fracturing operations for signs of any fluids migration.
3. Information related to the constituents of hydraulic fracturing fluids are disclosed to www.Fracfocus.org, an online registry managed by the Groundwater Protection Council. If a constituent is considered a trade secret, the chemical company will be required to complete a form which is subject to review justifying its need for confidentiality. In the case of a release, COGCC could provide detailed constituent information.
4. State-level oversight and enforcement is important because drilling practices vary according to the unique geological characteristics of the region. State-level scrutiny ensures that agency officials understand the operations in each basin. By law, state regulations must be at least as protective as federal standards.

CONCERNS WITH FRACTURING FLUIDS

First, stakeholders are concerned about what is in these fluids. Fracturing fluids vary based on the specific requirements of the formation, but they generally contain 99.5 percent water and sand. The remaining chemicals are used to facilitate the flow of sand into the formation. When diluted, these chemicals pose insignificant health risks, and our operators ensure the safe handling of them at all stages of the hydraulic fracturing process. This ensures personnel health and safety are protected and surface spills are prevented.

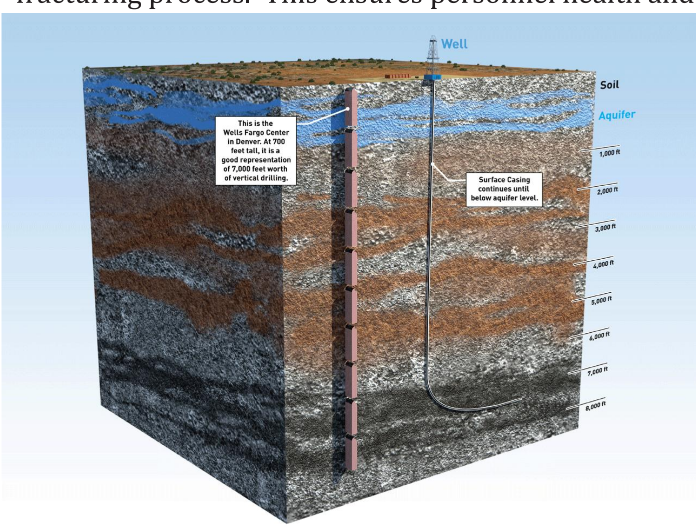

Figure 2: Horizontal wells extending 7000+ feet to reach shale formations

The types of chemicals used in fracturing are described below. Remember – in fracturing, all chemicals combined are diluted to less than one half of one percent of the fluid!

Second, stakeholders are concerned about the potential of fracturing fluids to be released into underground sources of drinking water from the fractures created in the hydrocarbon formation. In fact, fracturing has too small of an area of influence to release fluids through thousands of feet of rock to reach underground aquifers. The volume of fluid for each fracture treatment is individually designed to impact a few hundred feet of lateral growth in the reservoir, not thousands of vertical feet.

In reality, our industry has to focus on two areas to prevent impacting underground sources of drinking water: (1) preventing surface spills, and (2) ensuring casing protection. Both of these areas are currently regulated in Colorado. We work closely with regulatory agencies and communities to continue to prevent releases in these areas.

FRACTURING INGREDIENTS			
Product Category	**Main Ingredient**	**Purpose**	**Other Common Uses**
Water	99.5%	Expand fracture and deliver sand	Landscaping and manufacturing
Sand		Allows the fractures to remain open so the gas can escape	Drinking water filtration, play sand, concrete and brick mortar
OTHER	**Approximately 0.5%**		
Diluted Acid	Hydrochloric acid or muriatic acid	Helps dissolve minerals and initiate cracks in the rock	Swimming pool chemical and cleaner
Antibacterial agent	Glutaraldehyde	Eliminates bacteria in the water that produces corrosive by-products	Disinfectant; Sterilizer for medical and dental equipment
Breaker	Ammonium persulfate	Allows a delayed break down of the gel	Used in hair coloring, as a disinfectant, and in the manufacture of common household plastics
Corrosion inhibitor	n,n-dimethyl formamide	Prevents the corrosion of the pipe	Used in pharmaceuticals, acrylic fibers and plastics
Crosslinker	Borate salts	Maintains fluid viscosity as temperature increases	Used in laundry detergents, hand soaps and cosmetics
Friction reducer	Polyacrylamide	"Slicks" the water to minimize friction	Water treatment, soil conditioner
	Mineral Oils		Used in cosmetics including hair, make-up remover, nail and skin products
Gel	Guar gum or hydroxyethyl cellulose	Thickens the water in order to suspend the sand	Thickener used in cosmetics, baked goods, ice cream, toothpaste, sauces and salad dressings
Iron control	Citric acid	Prevents precipitation of metal oxides	Food additive; food and beverages; lemon juice ~7% citric acid
Clay stabilizer	Potassium chloride	Creates a brine carrier fluid	Used in low-sodium table salt substitute, medicines and IV fluids
pH adjusting agent	Sodium or potassium carbonate	Maintains the effectiveness of other components, such as crosslinkers	Used in laundry detergents, soap, water softener and dishwasher detergents
Scale inhibitor	Ethylene glycol	Prevents scale deposits in the pipe	Used in household cleansers, de-icer, paints and caulk
Surfactant	Isopropanol	Used to increase the viscosity of the fracture fluid	Used in glass cleaner, multi-surface cleansers, antiperspirant, deodorants and hair color

Figure 3: "Modern Shale Gas Development in the United States: A Primer" U.S. Department of Energy Office of Fossil Energy and National Energy Technology Laboratory. April 2009 and Chesapeake Energy