



# The Drilling Timeline



## The Chronology of a Well

### So how did that well get there?

The main goal of any well is to ensure safe production of oil and gas, which protects groundwater by keeping hydrocarbons inside the well and isolating the productive formulations from aquifers and other formations. Sound well design and drilling ensure a sealed well bore so fluids introduced at the surface or produced from the production zone will only travel inside the production casing and tubing.

Before a well can produce natural gas or oil, independent operators are hard at work on these many issues. The following is a brief overview of the processes and people involved to bring America's natural gas and oil to the surface.

### Geology

In areas that have very little production, companies have 3D seismic operations performed on the surface to give them an idea of the subsurface structure. Where there has been drilling over time, like in New Mexico, geologists, using data from previously drilled wells, are able to put together structure maps giving them indications where to drill in the future. In discovered fields there are usually "pool rules" that dictate where operators need to place their wells to maximize the drainage, protect correlative rights, eliminate waste and recover the most resources.

### Reservoir Engineering

Once areas have been identified as having the potential to produce oil and gas, reservoir engineers along with geologists, study the potential amount of recoverable oil and gas. They look at permitting, drilling and completion costs and stack those against the amount of oil and/or gas they think a well will produce. These factors help determine if the economics of the well will pay out. Trying to forecast the price of oil and natural gas versus the costs to get these products to market is challenging and may involve the cost of new rules or even legal challenges.

### Permitting Process

Assuming that an operator has purchased or leased minerals in areas they want to drill, the next step is to acquire the appropriate surface agreements and permits. The surface owner dictates this process. In New Mexico, land not privately owned is usually controlled by State, Federal or Tribal agencies. Operators must make arrangements with the surface owner(s) and make sure they have legal access onto their property. In New Mexico the Surface Owners Protection Act (SOPA) outlines how operators must make arrangements with surface owners.

Companies must obtain a drilling permit also known as an Application Permit to Drill (APD) from the agency that oversees the minerals and/or surface. Archeologists survey the potential well location to make sure there are no cultural issues. Wildlife biologists perform field inspections to insure that any threatened or endangered

species will not be impacted. If the drilling sites are on Tribal lands, even more requirements must be met. In addition, the State of New Mexico has requirements for producers to apply for pit permits that comply with Rule 17 (aka the "Pit Rule"). Add in county requirements and city special use permits and the entire process can be expensive and time consuming, often requiring over two years to obtain the APD.

## Drilling

There are several ways to drill a modern oil and gas well, but in New Mexico most wells are drilled in the same way. A drilling rig will drill holes of various sizes, reducing the hole diameter with depth, and then run casing to protect the hole. Typically, a surface hole will be drilled through the surface alluvium and deep enough to cover any fresh water aquifers. Casing, known as surface casing, will be run and then cemented in place. Once this is done, a blow-out preventer is installed to protect against any type of unexpected inflow of pressure as the well is deepened. A smaller diameter drill is run through the surface casing and utilized to drill to a deeper depth. Depending upon the formations that are penetrated, this phase can be either the intermediate hole or the production hole. Again, casing is run to protect the newly drilled open hole and cemented into place. If the well is planned to produce deeper zones, this phase is known as intermediate casing. A smaller diameter drill is run through the intermediate casing, and the well is deepened to the zone of interest. There are many sophisticated geophysical tools that can be run in conjunction with the drilling string, or on a separate wire line logging unit. This information helps the producers analyze the formation for reservoir and other geophysical properties. A final string of casing, called production casing, is run through the productive zone and cemented in place. Finally, the pipe used to drill the well is removed, a wellhead is put in place and the drilling rig is moved off the location.

## Completion

Most completions utilize a smaller rig known as a completion unit, daylight rig or pulling unit. These rigs are used to complete the well bore and prepare the well for production. During this phase, the production casing is perforated with high explosive shape charges in the productive zone and typically stimulated by a hydraulic fracturing job. Once the well is cleaned out, the rig runs smaller diameter pipe known as tubing, inside the casing. This allows the oil and gas to safely reach the surface. Many engineering and safety factors dictate the specifics of well construction. Sometimes down hole pumps and sucker rods will be run inside the production tubing to assist in "lifting" the oil, natural gas and water to the surface.

## Plug and Abandon, Reclamation

After a well has reached its economic life, it will be scheduled for plug and abandon (P&A). The type of well and its original construction determines how the well is plugged. Typically, cement is pumped into the existing perforations and a series of cement plugs are placed throughout the well bore to insure surface formations are protected from the producing zones. The production tubing and any related downhole equipment are removed along with any remaining surface equipment. The wellhead is cut off and replaced with a marker, typically a short piece of pipe, cemented on top of the old well bore. The surface area is re-contoured to its original state and re-seeded with a mixture of native and natural vegetation. After several years, the location has time to rehabilitate and the only thing visible is the P&A marker denoting the location of the well bore.