CMAG Best Management Practices
Drilling for Shallow Gas and Natural Gas from Coal (NGC)

Purpose

These recommended practices have been established by CMAG to help landowners understand the steps involved when drilling an oil or gas well including how safety is ensured and groundwater is protected.
Drilling activity may be include shallow or deep wells, oil or gas wells, and sweet or sour wells. It may also include horizontal or vertical drilling.

Glossary

Wellbore: A hole drilled or bored into the earth, usually cased with metal pipe, for the production of gas or oil.
Sweet oil and gas: Petroleum containing little or no hydrogen sulphide.
Sour gas: Natural gas at the wellhead may contain hydrogen sulphide (H_2S), a toxic compound. Natural gas that contains more than one per cent of H_2S is called sour gas. About 30 per cent of Canada's total natural gas production is sour, most of it found in Alberta and northeast British Columbia.
Infill drilling: Wells drilled between established producing wells on a lease in order to increase production from the reservoir.
Horizontal drilling: Drilling a well that deviates from the vertical and travels horizontally through a producing layer.
Exploratory well: A well into an area where petroleum has not been previously found or one targeted for formations above or below known reservoirs.
Development well: A well drilled in or adjacent to a proven part of a pool to optimize petroleum production.
Directional (deviated) well: A well drilled at an angle from the vertical by using a slanted drilling rig or by deflecting the drill bit; directional wells are used to drill multiple wells from a common drilling pad or to reach a subsurface location beneath land where drilling cannot be done.
Coalbed methane (CBM): Natural gas generated and trapped in coal seams.
Multi-well or Pad drilling: new technology allowing drilling from one surface location to multiple downhole or underground locations. Typically involves directional or horizontal drilling.

Background

Some reservoirs that are being targeted in this general area are sand and coal reservoirs within the Edmonton and Belly River formations, including the Horseshoe Canyon coals. These reservoirs produce sweet natural gas and are low pressure and typically low productivity. In this area these reservoirs typically occur at depths ranging from 170 – 1200 m (or 560 – 3940 ft).

Wells targeting these reservoirs are typically drilled as vertical wells although directional drilling may be used in this area as well. The same practices apply whether a well is

drilled vertically or directionally. These types of shallow gas/NGC wells are typically drilled with water / drilling fluid however air drilling may also be used. With the shallow depths of the reservoirs, drilling will typically take between 1 and 3 days to complete.

Deeper wells can take significantly longer to drill.

The Energy Resources Conservation Board (ERCB) regulates the drilling of wells within Alberta and in all cases companies are required to meet or exceed the ERCB requirements. Where applicable these regulations are referred to in this BMP, however not all requirements are fully defined in these practices.

Other typical drilling in the CMAG area includes deeper oil wells, some of which are sour. For more information on sour gas and ERCB regulations please see the ERCB's EnerFAQ4 on sour gas.

Sour Wells

H_2S is the chemical formula for hydrogen sulphide, a toxic gas formed by the breakdown of organic.

A critical sour well is a sour gas well that could potentially release large quantities of hydrogen sulphide (H_2S), causing significant harm to nearby people. When deciding if a sour gas well should be considered critical, the Energy Resources Conservation Board (ERCB) examines factors such as how complex the drilling will be and how many people live in the community.

All applications to the ERCB to drill oil or gas wells must take into account the possibility of encountering sour gas. If the ERCB's first evaluation shows that there may be H_2S, then the application is examined further.

The ERCB uses two major criteria to determine if a sour well is to be classified as critical:

- how close the well is to an urban centre or public facility, such as a major recreational facility, and
- the potential H_2S release rate during the drilling stage.

The potential H_2S release rate is determined by both the percentage of H_2S in the gas and the rate at which H_2S that can be delivered to the surface. This is measured in cubic meters per second at standard pressure and temperature conditions.

A critical well requires a detailed drilling plan that addresses all aspects of the proposed operation. The plan must be reviewed and approved by the ERCB before a critical well is licensed. Once a well is classified as critical, drilling preparations must meet all the

operational and safety-related requirements set out by the ERCB. The drilling plan for a critical well includes:

- well design
- equipment
- drilling procedures
- training and supervision
- inspections, and
- emergency response planning

The equipment used when drilling a critical well must be resistant to the harmful effects of sour gas and must contribute to blowout prevention. For example, the quality of the drill pipe used for critical wells must be premium and the pipe must be inspected to ensure that it meets the latest standards.

If, for any reason, blowout prevention procedures fail, a series of complementary emergency response plans are triggered to protect people's health and safety. This may include igniting the well (setting it on fire). Ignition converts the H_2S to sulphur dioxide, which disperses more effectively because the heat carries it up, resulting in lower ground-level concentrations.

Emergency Response Plan (ERP)

Every company drilling or operating critical sour wells is required to have a site-specific emergency response plan (ERP). If you live in an area where sour gas drilling is likely, be assured that no company will receive permission from the ERCB to drill a critical well until it has prepared an ERP tailored to the specific circumstances of that well, with detailed attention to such things as weather patterns, terrain, nearness of people, and anticipated release of H_2S.

One of the first activities initiated in a sour gas blowout is the monitoring of air quality downwind from the well. Mobile equipment is set up to track the plume and to identify concentrations of gas both inside and outside the EPZ. If the emergency response team determines that there is a danger, residents will be evacuated or the well ignited to protect the public.

The emergency provisions in place for drilling critical wells also extend to their ongoing operation and maintenance. Once a critical well is ready to be placed on production, you will be protected by an emergency response plan designed to suit this phase of development.

Practice

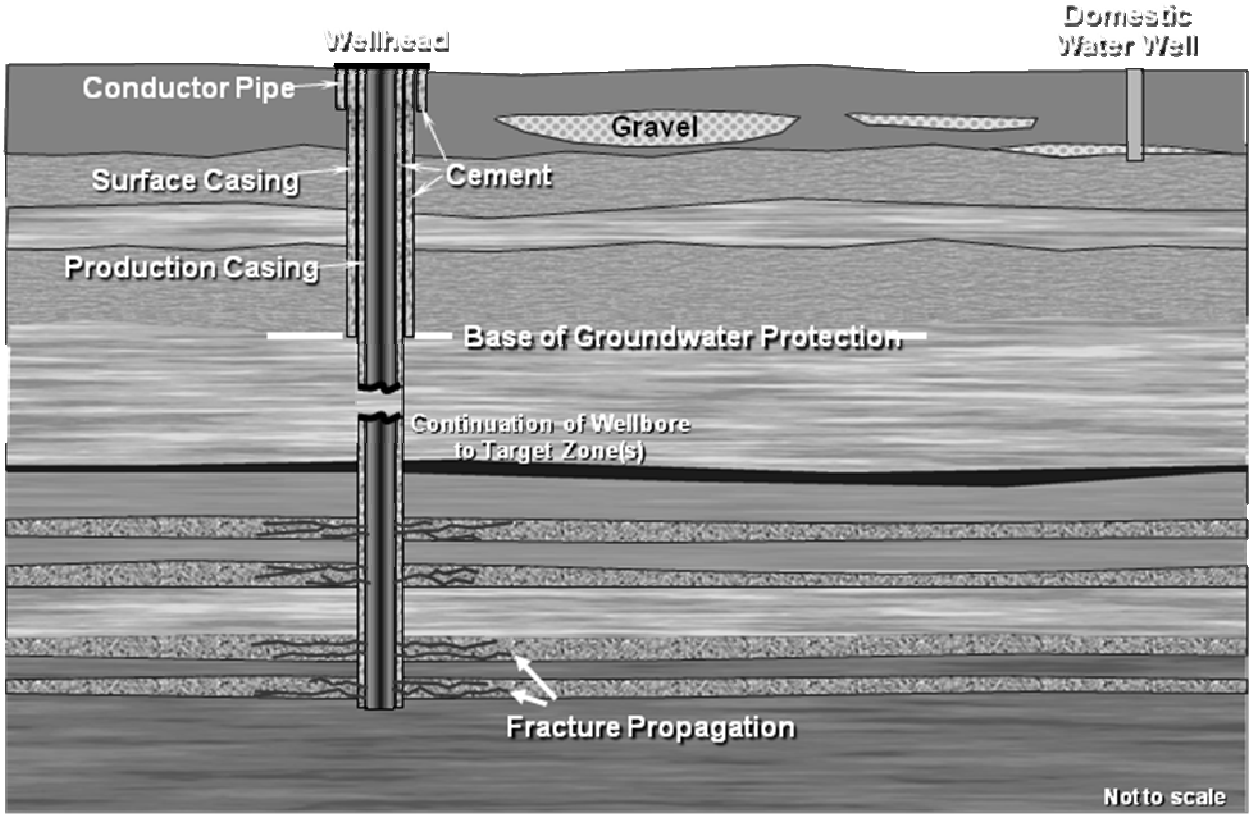
- Prior to drilling, a wellsite and access route is surveyed by a third party survey company and the land required for the well/access is acquired (leased) through a qualified land agent. The landowner and/or occupant are involved in these processes, ensuring the well location and lease terms are satisfactory to all parties involved. The Surveying BMP and Land Agent BMP already developed by CMAG cover these up-front aspects of preparing to drill a well.
- The company will undertake a review of the water wells in the general area and will conduct baseline testing of any water wells within 600m of the proposed drilling location (or as requested by a landowner for a water well in reasonably close proximity), testing both the quantity (well yield) and quality (water chemistry). This pre-drilling test will provide suitable baseline information to understand the well's capability and quality before any industry activity occurs nearby. If no water wells exist within 600m the company must extend that radius to 800m and test the nearest well within that 600-800m. If, after drilling and other well activities have occurred, cause for concern arises, a post-drilling test may be requested and will be performed by the company. In the unlikely event that damage occurs to the water well as a result of the companies activities, investigation will be performed and compensation or remedial actions may be taken as appropriate. Information from the water well testing should be given to the water well owner.
- Prior to drilling, a source of suitable water to be used for drilling fluid must be located and secured. Companies will generally attempt to locate water within close proximity to the well and often it can be purchased (water cannot be purchased only the access) from the landowner or others nearby. Depending on the water source, a water diversion permit may need to be obtained from Alberta Environment prior to removing the water. Typically, town water is not used as a source for drilling fluid.
- Once all required documentation is in place and the well is licensed, construction of the wellsite will commence. For some type of wells minimal disturbance drilling is used and construction of the lease will be minor, consisting mainly of approaches and gates. (Remote sumps may be acquired for the disposal of cement returns from cementing in of the surface casing to protect the water zones during drilling and well fracing.
- A water well rig or conventional drilling rig will be used to drill the surface hole and set the surface casing. Surface hole is drilled in a very similar manner to water wells. (Note: conductor casing is not usually used in this area for these types of wells.) The primary purpose for surface casing is to provide a method to secure the wellbore in the unlikely event that a blowout occurs. Minimum surface casing setting depths are stipulated by ERCB regulations (Directive 08) and are based on offset pressures of surrounding gas wells. Surface casing is cemented full length into place using high-strength cement that is pumped down the inside of the casing and back up the annular space between the casing and the drill hole.
- A conventional drilling rig or coiled-tubing rig will be used to drill the main hole of the well. During the drilling process, the drilling fluid is returned to surface where

volumes are carefully monitored, allowing any losses to be detected before entering groundwater aquifers.

- Loss of circulation may occur when a formation being drilled through breaks down and the drilling fluid migrates into it. Formations in which lost circulation occurs are weak and cannot support the pressure of the column of fluid in the well. To rectify this problem, lost circulation material, composed of non-toxic material such as untreated sawdust, non-toxic cellulose material, or grit (untreated calcium carbonate or limestone) is added to the drilling fluid to 'seal' up the area of concern in the wellbore.
- When the main hole has been drilled to total depth, production casing is then installed to the bottom of the well and cemented full length in place. This practice ensures hydraulic isolation of the entire wellbore from all reservoirs is obtained and ensures that all nearby groundwater aquifers are protected from any wellbore activity.
- As drilling fluids are comprised of non-toxic and environmentally approved components, the fluids are disposed of through one of two methods: landspraying or hauling off-site. Landspraying on farmland, where agreed to by the landowner, is most common, however, some fluids that are part of the drilling process (such as cement returns) cannot be landsprayed and must then be disposed of in an appropriate offsite location such as a containment site or a disposal facility. Drilling waste management and disposal is regulated by the ERCB and is covered further in ERCB Directive 50.
- Upon completion of drilling operations, a wellhead will be installed and the well will now be ready for completions operations.
- Oil and gas companies are required by the ERCB and Alberta Emergency Management Agency to have an area Emergency Response Plan (ERP) in place in the unlikely even that an emergency occurs. If concerned, ask your land agent for the company's toll-free emergency phone number in advance.

Well Diagram

With proper well construction, shallow groundwater aquifers are protected from fracture fluids or hydrocarbons.



Fracturing or "Fracing"

The oil and gas industry is highly regulated and takes strict measures to protect both surface water and groundwater quality. When an oil and gas well is drilled, cement and steel casing is placed around the production casing to prevent hydrocarbons from moving into fresh water zones. Cement also prevents the vertical flow of groundwater between zones, particularly between fresh and saline intervals. During fracturing operations (sometimes called "fracking"), groundwater is protected in accordance with regulations that permit the use of only non-toxic fracture fluids above the base of groundwater protection.

FAQ's

Why isn't town water typically used as the water source for drilling fluids?

- Towns or municipalities have limited water supplies and may not be able to supply the quantities required for the drilling operations. Supplying these quantities would also take away from the supply of suitable water for townspeople.
- Use of a town's water facilities would increase traffic within town limits.
- Alternative sources that have not already been treated for human consumption but are suitable for drilling are usually available.
- The water used in drilling must be potable.

What is the composition of drilling fluid?

- For surface hole, the fluid consists of water and bentonite (clay) which swells when it comes into contact with water.
- For main hole, a flocculating agent containing similar components to those in agricultural or lawn fertilizer may be added.
- Components are non-toxic and environmentally friendly ensuring suitability for landspraying after usage.

What is the function of drilling fluid?

- Carry drill cuttings to the surface.
- Control subsurface pressures.
- Cool and lubricate the drill bit.
- Provide a low permeable filter cake on the wellbore, i.e. a layer of thick semi-solid mud that forms on the walls of the borehole preventing the seepage of fluids into formations.
- Minimize damage to subsurface formations.

References

ERCB Directive 08
ERCB Directive 50
ERCB Directive 56
Oil and Gas Conservation Act

More Information:

Energy Resources Conservation Board www.ercb.ca
Red Deer Field Centre: 403-340-5454

Canadian Association of Petroleum Producers www.capp.ca

Canadian Society for Unconventional Gas www.csug.ca