Construction: wells and gathering

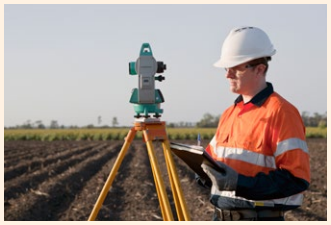
September 2019

Arrow Energy has a proven process for constructing coal seam gas (CSG) wells and their gas and water collection (or gathering) systems. Landholders and Arrow agree where well sites and gathering infrastructure should be, and agree on compensation and access conditions in a conduct and compensation agreement (CCA). Then, it is time to construct.

The major steps are:

- constructing wellpads (a levelled area of ground where the well will be installed)
- constructing or upgrading access tracks as required
- drilling and completing the wells
- installing the well pad infrastructure – i.e. well head skid and generator or power connection
- connecting the well to Arrow's water and gas networks with underground collection pipes (the gathering system).

Constructing wells and well pad infrastructure



- After the landholder and Arrow agree where the well infrastructure will be placed (see *area wide planning*):
  - a team will survey the area
  - an access track will be established (if there is not already an existing track or road).

Construction timeframe:
2 to 5 days

Construction hours:

- A wellpad area will be cleared and levelled. Depending on the site, some of the pad area may be built up and stabilised with gravel.
- Initially, the pad will be much larger than its final form:
  - a pad for a single well is 100m x 100m.
  - a multi-well pad is up to 100m x 200m, but can accommodate up to eight wells.

Construction timeframe:
4 to 8 days depending on pad size

Construction hours:

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Constructing wells and well pad infrastructure cont.

- A drilling rig and supporting equipment is set up on the wellpad.
- The well bore is drilled in stages, using the widest drill bit for the shallowest stage and then smaller bits for deeper stages.
- At the completion of each drilling stage, a steel casing (effectively, a steel straw) is inserted into the bored hole. Down to about 140m, it is cemented into place. The cement is pumped down through the steel casing and out its open bottom end, to flow back up the outside of the case to the top. In this way, the cement completely seals any gaps between the steel case and the surrounding rock.
- The next stage is then drilled.

Construction timeframe:
4-7 days per well

Construction hours:

- Once the bore has reached its target depth and all casing has been installed, the surface infrastructure is added:
  - a well head at the top of the bore
  - a metering skid (a frame with all the equipment to manage and measure the well's gas flow)
  - a power unit to drive a water pump (see next frame)
  - a control cabinet and communications aerial (to allow remote monitoring by operators in Dalby).

Construction timeframe:
30 to 90 days depending on wells per pad

Construction hours:

- A completions rig installs a water pump at the bottom of the bore.
- This pump will be used to reduce water pressure in the coal seam until gas flows (see end piece).
- The pump is powered either by an on-site gas-driven generator or by reticulated power from the local power grid.
- Some of the drilled material from the well, for example crushed rock, may be spread on the well pad site and adjoining ROW during the well pad rehabilitation.

Construction timeframe:
5 days per well

Construction hours:

- Now the well construction is complete, the well pad can be reduced in size:
  - a single-well pad will have a fenced area of about 20m x 30m
  - a multi-well pad's final size will depend on the number of wells it holds.
- The remaining area will be rehabilitated and can be used by the landholder, although Arrow may need to reuse an area of about 70m x 80m for well pump maintenance from time to time.

Construction timeframe:
30 to 90 days depending on wells per pad

Construction hours:

- Maintenance (workovers):
  - The frequency of this maintenance will vary well by well, but has averaged once every two to three years.
  - Because there are up to eight wells on a multi-well pad, the frequency will be higher than for vertical well pads, with two to eight maintenance events per year, on average.
  - Arrow requires access to the wellpad for routine maintenance, which could range from weekly to quarterly, depending on the individual well.

Timeframe:
3-6 days per well

Construction hours:

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- Decommissioning:
  - CSG wells have a finite life, typically 20 to 30 years. After this, they are decommissioned.
  - The surface infrastructure is removed.
  - The well is filled with cement.
  - The well casing is cut off below ground (deep enough to allow normal surface activity to resume).
  - The pad area is rehabilitated to its pre-well state and returned to the landholder's use.

Construction timeframe:
2 to 5 days

Construction hours:

Constructing gas and water gathering pipelines

- The area used for the pipeline and construction area is known as the 'right of way' (ROW)'
- With landholder input, we design the ROW route to minimise impacts on the property, its land use and the landholder's day-to-day activities. We will also consider future land use.
- This will include locating the above ground infrastructure in the ROW like High Point Vents (HPVs), Low Point Drains (LPDs) and some signage
- Surveyors peg the ROW.
- Once construction begins the ROW is cleared and vegetation and topsoil are stockpiled separately as required.
- The right of way is levelled for safe machinery operation.

Construction hours:

- The gathering line (polyethylene pipe) is laid out, and welded into a continuous "string".
- Underground power cabling will also be installed in areas where reticulated power can be used. Above ground power infrastructure will also be installed in the ROW where required.

Construction hours:

- The pipe string is buried in the ground.
- 'Trenching' involves excavating a clean trench, stockpiling the spoil alongside it, lowering the pipe string into the trench and then backfilling.
- Trench depth depends on land use but allows at least 750mm of cover above the pipe.

Construction hours:

- Above-ground infrastructure:
  - High-point vents and low-point drains are placed on gas gathering lines, as needed.
  - Locations depend on topography and land use.
  - Vents and drains are fenced for safety.

Construction hours:

- The buried pipeline is pressure tested to check strength and test for leaks.
- If near to a road, road closures may be necessary during the testing.

Construction hours:

- The right of way is rehabilitated, allowing normal agriculture to resume in the ROW.

Construction hours:

- After construction:
  - The pipeline route will be marked with above-ground signs.
  - Sign locations are identified on consultation with the landholder – for example, at the edge of paddocks – but must meet safety guidelines.
  - Maintenance crews will require access from time to time.

Construction hours:

Gathering systems

Coal seam gas is natural gas. It is trapped in coal seams by water and ground pressure. It is extracted by drilling to the target coal seam, reducing the seam's water pressure and allowing the gas to flow to the surface inside a steel well pipe (the casing).

Separate pipelines (the gathering system) take:

- water to a water treatment plant
- gas to a compression facility.

Area Wide Planning

This is Arrow's system of working with landholders as we plan a development, to identify property constraints and future land uses.

Where possible, we position our infrastructure where it least affects the landholder's activities.

Area wide planning allows us to incorporate local knowledge into our field designs. It is a process to support our coexistence with agriculture.

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