

Gunnedah Basin Gas

EXPLORATION DRILLING AND COREHOLE DESIGN

Santos

An Australian energy pioneer since 1954, Santos is one of the country's largest gas producers, supplying Australian and Asian customers.

Santos is one of Australia's largest domestic gas producers, providing gas to customers in all mainland States and Territories and is currently exploring in the Gunnedah Basin to determine the potential of the coal seam gas resource in the region.

Santos drills exploration coreholes to increase understanding of the quantity and depth of coal in the region, as well as its gas content and permeability. Santos uses an exploration corehole design that protects aquifers during and after drilling.

Before an exploration corehole can be drilled, a Review of Environmental Factors (REF) document is submitted to the NSW Department of Primary Industries for approval. The REF outlines how Santos will ensure that the environmental impact of drilling activities is minimised. It also commits to using water-based drilling muds. Environmental legislation and compliance is explained in more detail in the Environmental Regulation of Petroleum Activities Factsheet.

Drill site selection

Drill sites are selected for geological suitability, ease of access and lowest environmental impact. Sites are generally flat, already cleared, at least a kilometre away from houses and at least 200m from watercourses.

Once a site is selected and access conditions are agreed with the landholder, the site build begins. Over a period of about three days, an area of approximately 60m x 40m site is fenced and graded level. Topsoil is kept separate for rehabilitation. Three sumps for drilling fluids (with a total capacity of 30 000L) are excavated and lined with heavy-grade plastic. The freeboard on the sumps is calculated to withstand a one in 20 years flood storm.

Santos drilling rigs

Santos drilling rigs differ from mining exploration rigs in two ways. Firstly, they operate under the Petroleum Act (onshore) NSW 1991, which requires higher standards of well design and abandonment than the Mining Act NSW 1992. Secondly, like mining exploration rigs, Santos rigs are hired and staffed by external companies. Unlike most mining rigs, they operate under the direction of a Santos supervisor who oversees all site operations. The Santos supervisor is employed by Santos and is responsible for all operational decisions and works under the instruction of a

drilling engineer. They also look after safety, compliance and record keeping on site.

Corehole design

Each corehole has a specific design that complies with the legislation. Santos designs exploration coreholes to ensure that aquifers are isolated behind one or two layers of steel casing and pressure cement. The expected core point and total depth are also considered when designing the corehole.

A corehole between 100 and 300 millimetres in diameter is rotary drilled through alluvial and weathered material until it reaches solid rock, called bedrock. Depending on the well design, one or two layers of steel casing are run from surface to bedrock and pressure cemented in place. The cement is pressure tested to ensure integrity. At this point a Blow Out Preventer (BOP) is installed. The BOP ensures that drillers can control the corehole if unexpected water pressure is encountered.

While drilling down to bedrock, the fragments of drilled material are brought back to the surface suspended in drilling mud (a mixture of potassium chloride (KCL) and water). Drilling mud helps control swelling clays and stabilise rock layers as they are drilled through, and acts as a weighting agent to help control rock layer pressures. The drilling mud is continuously returned to the sumps, where the solids settle out and the drilling mud is reused.

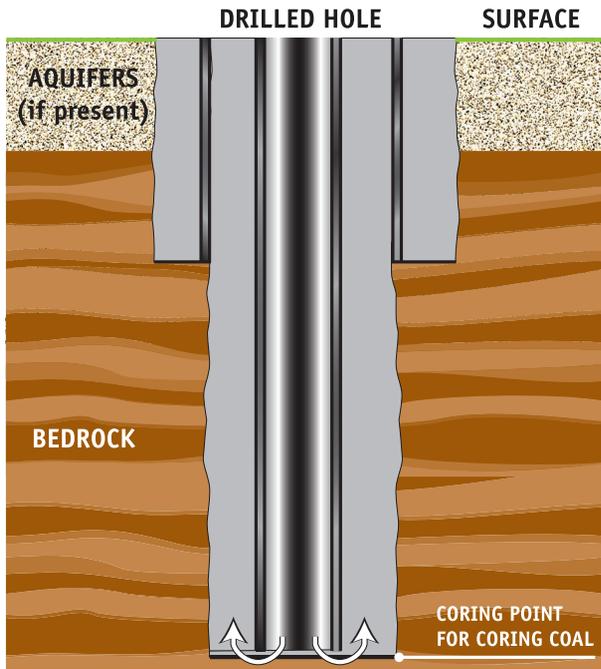
After bedrock is reached and the BOP has been installed, the drilling method switches to coring. Six-metre long cylinders of rock and coal are extracted, tested on site before being sent off site for further testing. This continues until the hole reaches basement, the point at which all known formations have been found. During coring, the drilling mud (water mixed with an organic polymer brand named CR-650 or JK-261) stabilises reactive clays and shales, and provides lubrication.

Losing drilling fluids is undesirable as they are the primary means of controlling coreholes, as well as being expensive. As soon as a loss is detected, a cellulose loss prevention



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Intermediate casing

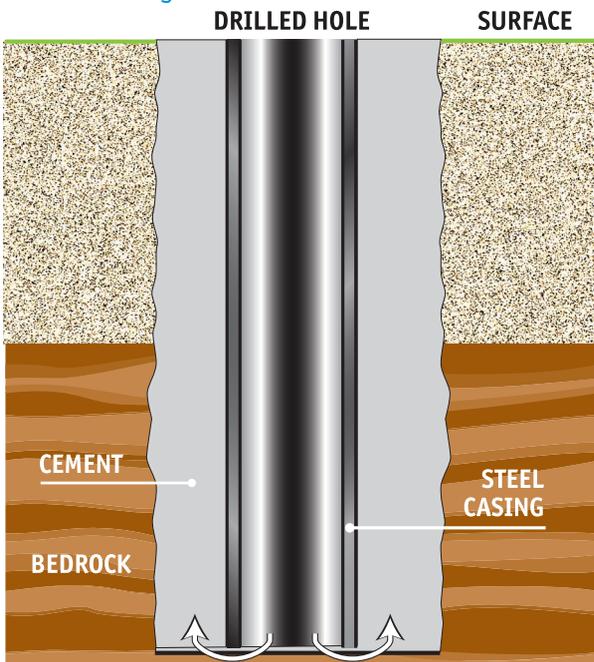


Cement pumped up the hole between the rock (gravel etc) and casing – indicative diagram only

material (called Fracseal Fine, which is similar to sawdust) is fed into the hole with the drilling fluid. Losses can also be prevented by completely sealing the hole off with a cement plug before re-drilling through it.

Once drilling is completed to the required depth, the hole is tested and logged using open hole and geophysical logging techniques.

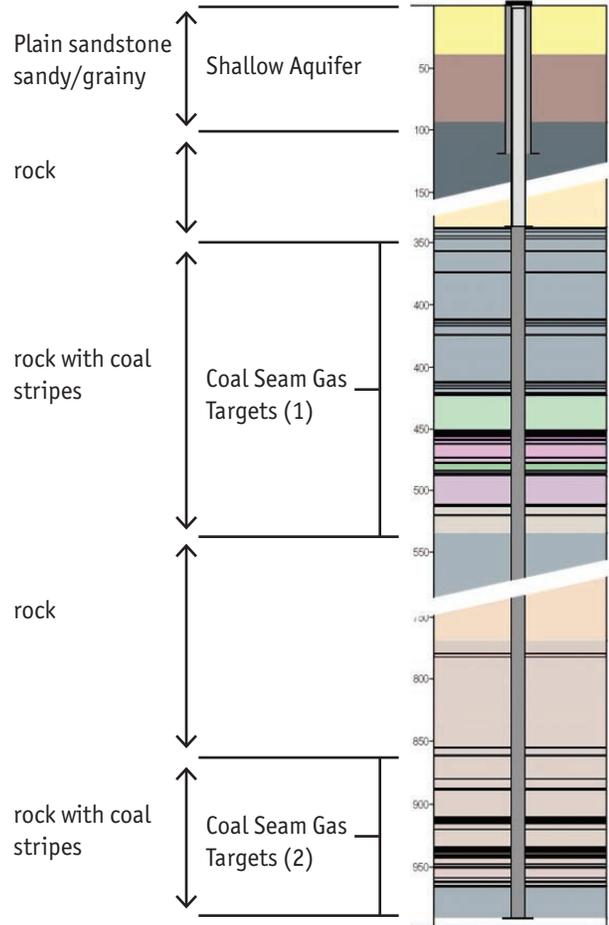
Surface casing



Cement pumped up the hole between the rock (gravels etc) and the casing – indicative diagram only

During the final abandonment process, the hole is sealed completely from bottom to surface using a series of cement plugs. The cement seal prevents any cross-flow of water and gases between underground layers, as well as isolating all down hole zones from the surface.

Stratigraphic section showing abandoned corehole



The steel casing (filled with cement) is cut off 1.5m below surface level, sealed with a metal identification plate and buried. All other surface equipment is removed. Drill fluids and cuttings are taken to an approved facility for disposal if required, or they may be buried on site. Sump liners are re-used when possible or disposed of at an approved facility.

As required by the REF, sites are rehabilitated within two months of well abandonment. Coreholes are not re-used for commercial production.

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