



Santos

CCC Presentation – Narrabri

12 March 2013

Santos standards in well design



- Santos has been a leader in the Australian oil and gas industry for more than 50 years.
- Offshore oil operations are considered more complex with
 - higher pressures,
 - higher temperatures and
 - greater depths drilled.
- The same well design principles applied to offshore operations are used across the company, specific to the well type and conditions.

Santos standards in CSG wells



- CSG operations are considered less complex with:
 - lower pressures,
 - lower temperatures and
 - shallower depths.
- The CSG conditions may be less complex, however Santos design and operating standards remain high.

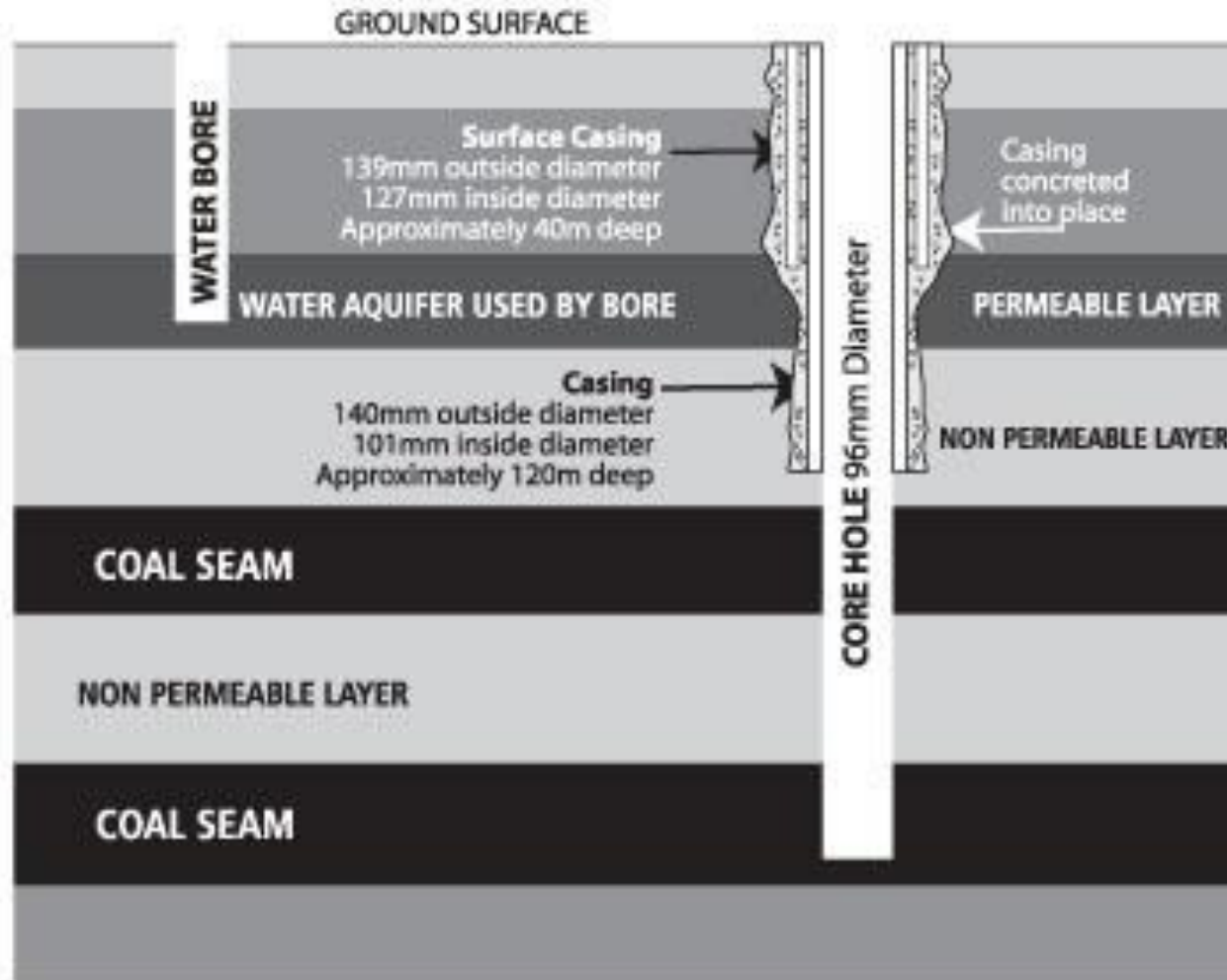
Santos has a history of high standards

- Our standards meet or exceed the Australian regulatory requirements, governed by each state
- Drilling designs are submitted to the state government regulators in the form of a drilling programme prior to commencing a well
- We comply with industry standards and best practices including the American Petroleum Institute (API) standards
 - Those standards include clear specifications for well design and construction

Well definition – types of wells

- **Core hole:** is drilled to evaluate the coal, usually by taking a sample of coal, known as a core sample, from a coal seam.
- **Pilot well:** is used to test the commercial viability of producing gas from a coal seam. It is a well that normally produces water then gas from the coal seam. If the tests are positive it may later be used as a production well.
- **Production well:** are usually of similar design as a pilot well, but are used to commercially produce gas, not to test viability. They are subject to a “production” licence.

Protecting aquifers



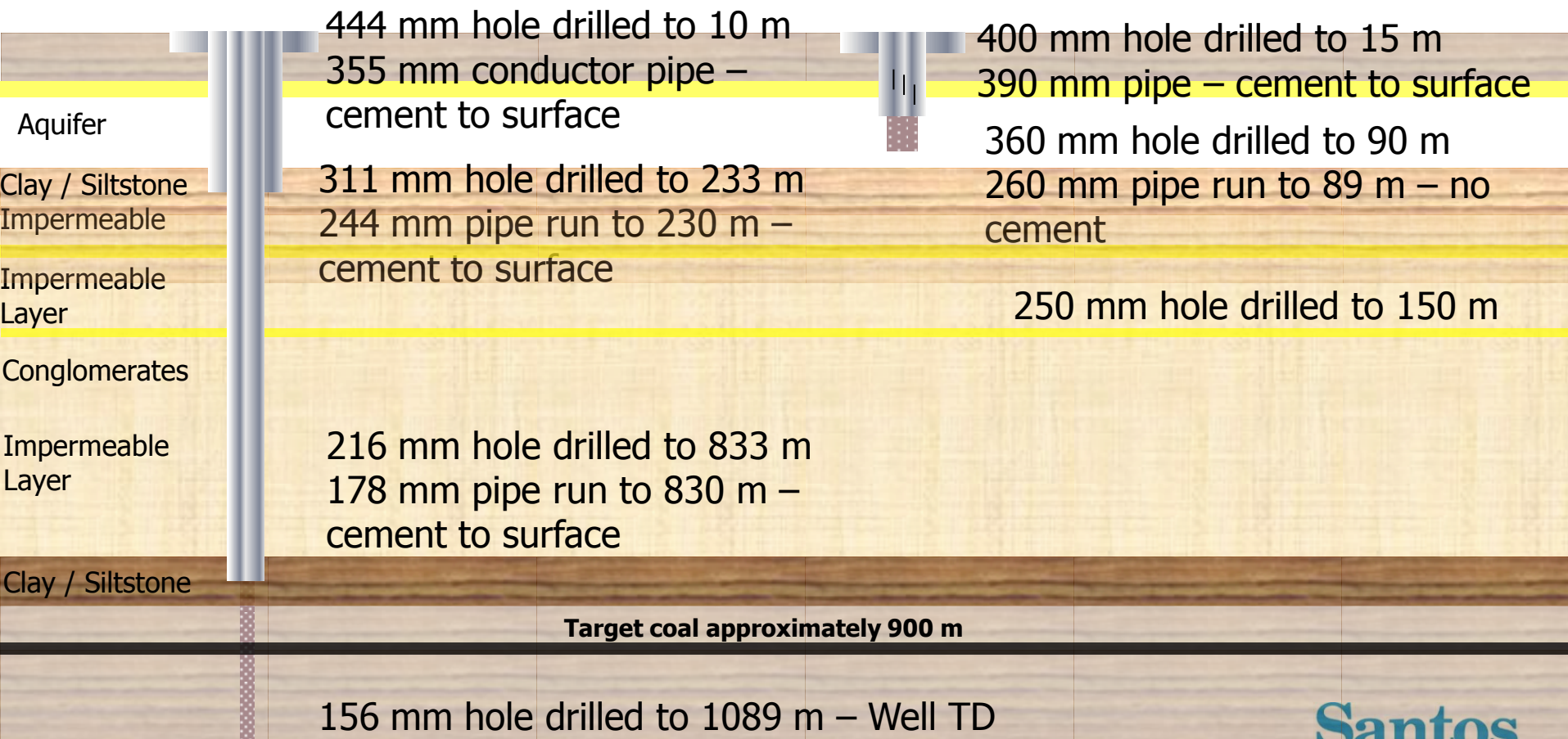
Not to scale.

Water bore / gas well comparison

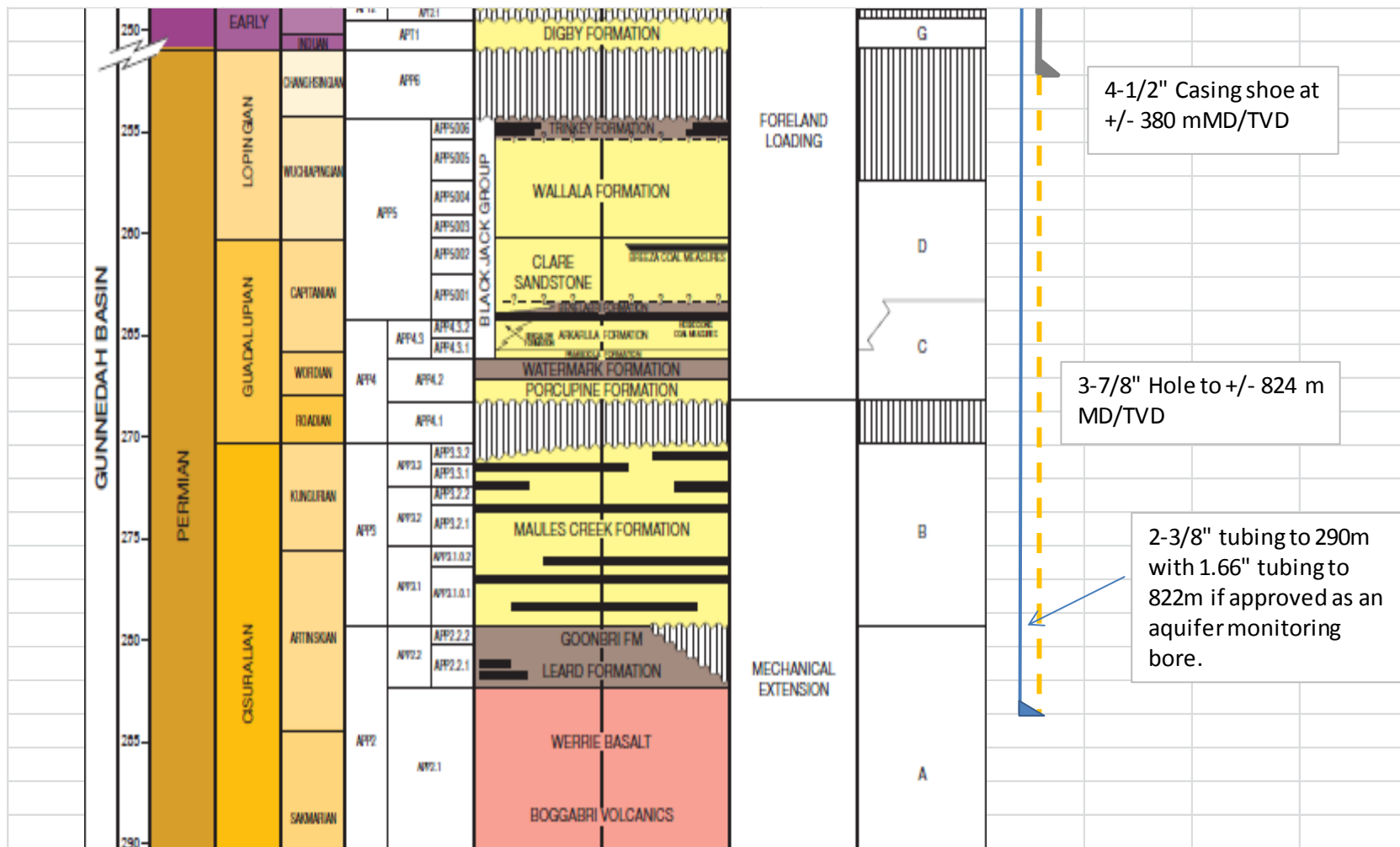
Water bores are typically drilled to about 150m. Core holes are much deeper and have extra casing to protect aquifers.

Santos core hole

Landholders water bore

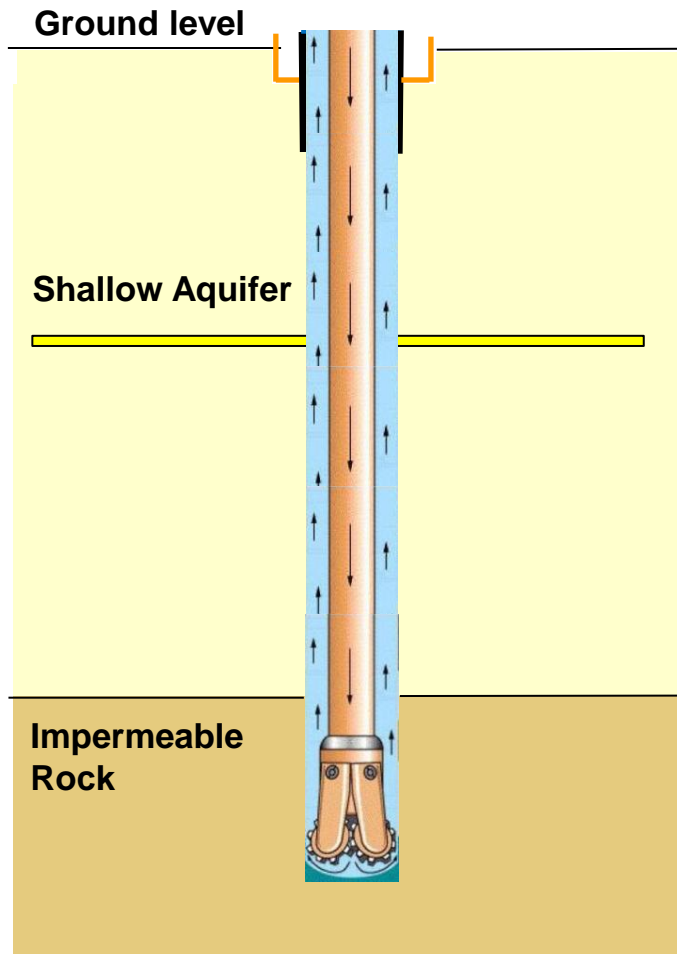


Proposed exploration hole and geology



Pilot well design and construction

Well Schematic



14" steel conductor is cemented into competent rock, 10 m below ground level

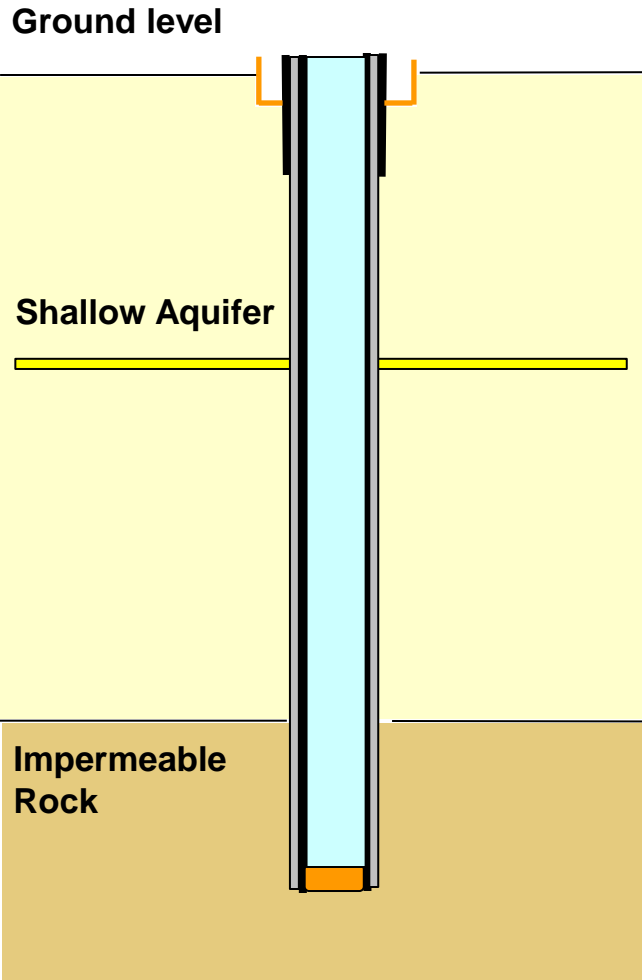
- isolates loose / unconsolidated rock near surface

12-1/4" hole drilled through sandstone aquifers to between 300 and 400m, drilling fluid circulates down through drill bit and returns to surface, carrying rock chips out of the hole

- water based drilling fluid used

Pilot well design & construction

Well Schematic



9-5/8" steel casing is run into the hole

- This forms a barrier over shallow aquifers

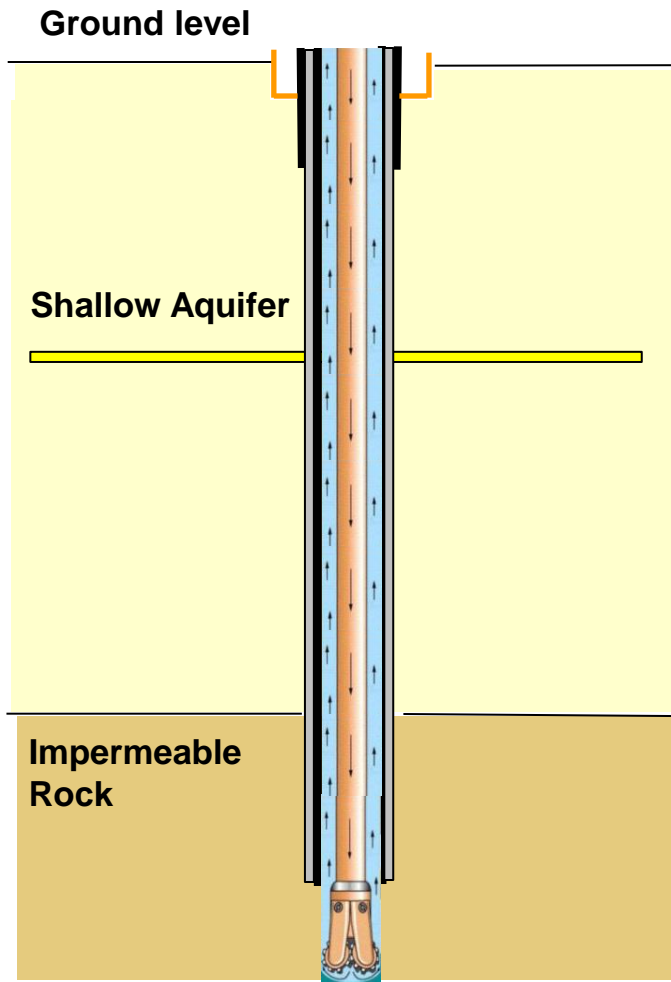
Cement is pumped down the inside and then up around the outside of the casing

- Cement used is designed for the well conditions and once set, has a high compressive strength

Impermeable rock layers exist at various depths and provide natural seals that stop water seeping down to deeper strata

Pilot well design & construction

Well Schematic

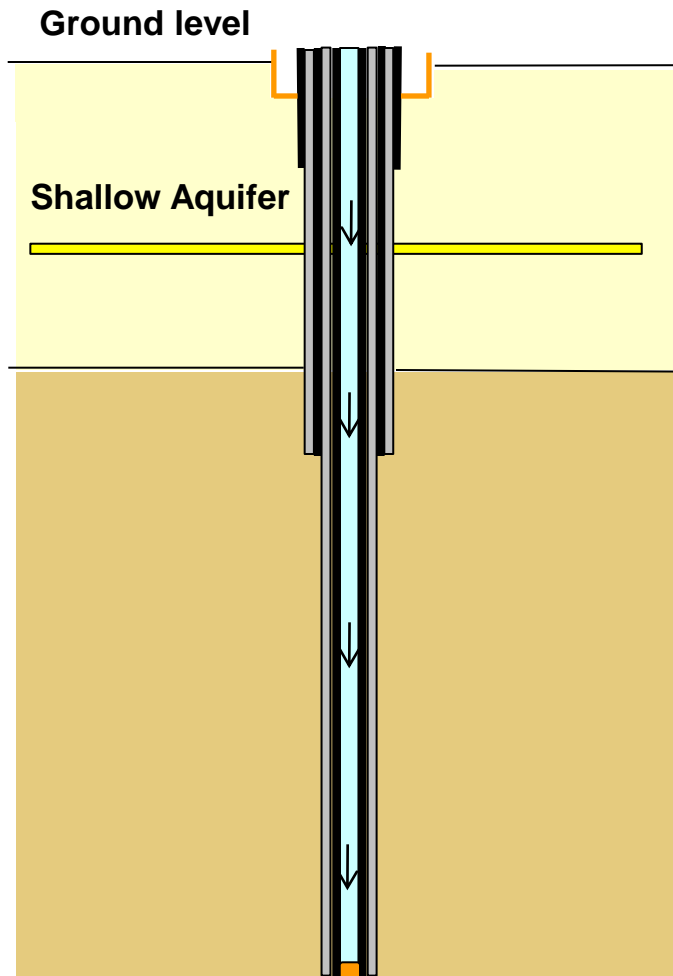


8-1/2" diameter hole is drilled through a series of impermeable rock layers finishing below the targeted coal seams at approximately 850 to 950m

Impermeable rock layers exist at various depths and provide natural seals that stop water seeping down to deeper strata

Pilot well design & construction

Well Schematic



7" diameter production casing is run into the hole to near the bottom in vertical wells

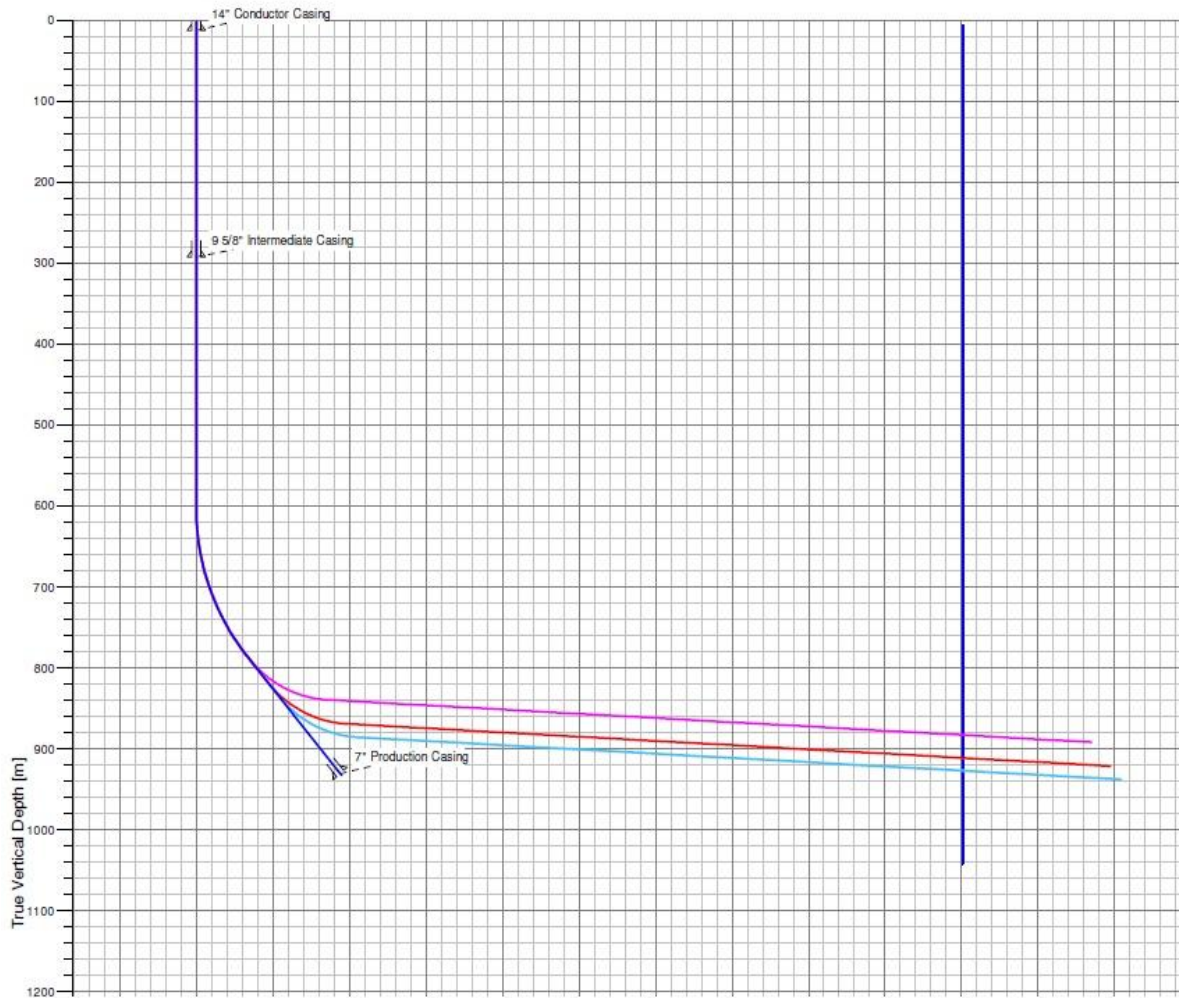
- This forms a second barrier to isolate the well bore from the shallow aquifers

Cement is pumped down inside and then up around the outside of the casing

Horizontal wells - a 6-1/8" hole is drilled through the side of the casing. The hole is drilled to intercept a vertical well. Several horizontal wells may be drilled

- This is known as the production hole

Pilot wells – vertical and horizontal



Ongoing well monitoring

- Santos has a monitoring programme for wells post drilling
- Regular integrity and maintenance inspections
- Santos currently monitors the wells in the existing Pilot Projects near Narrabri remotely in real time
- Asset Integrity Management System (**AIMS**) recently introduced in Santos
- Dedicated Santos Well Integrity Group

Plugging and abandoning a well

- An abandonment includes filling the entire wellbore from bottom to surface with cement in cement 'plug' stages.
- Individual cement plugs are limited to 200m in length.
- All open hole 'plugs' are left to set and tagged to confirm placement before the next one is pumped.
- Once a cement 'plug' top is inside casing, it is left to set, tagged to confirm placement and pressure tested to confirm isolation.
- Cement 'plugs' are then pumped one by one to surface.



Rehabilitating the site



- After this process has been completed, the wellhead is cut off 1.5 m below ground level
- An abandonment marker is welded to the casing and the cellar is pulled
- The site fully rehabilitated back to its original use

Questions

- Questions