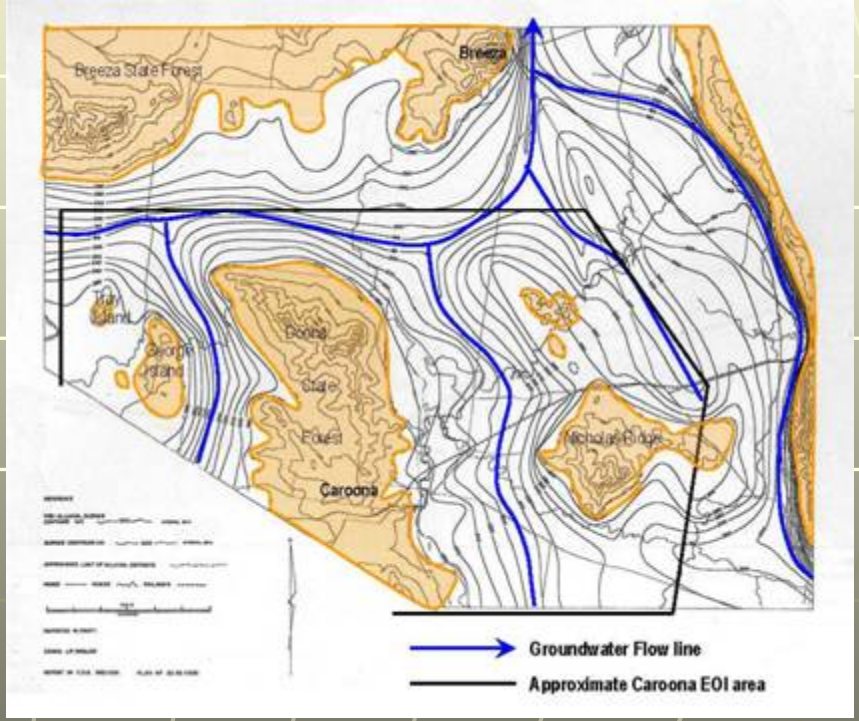
CAROONA COAL DEPOSIT

GROUNDWATER

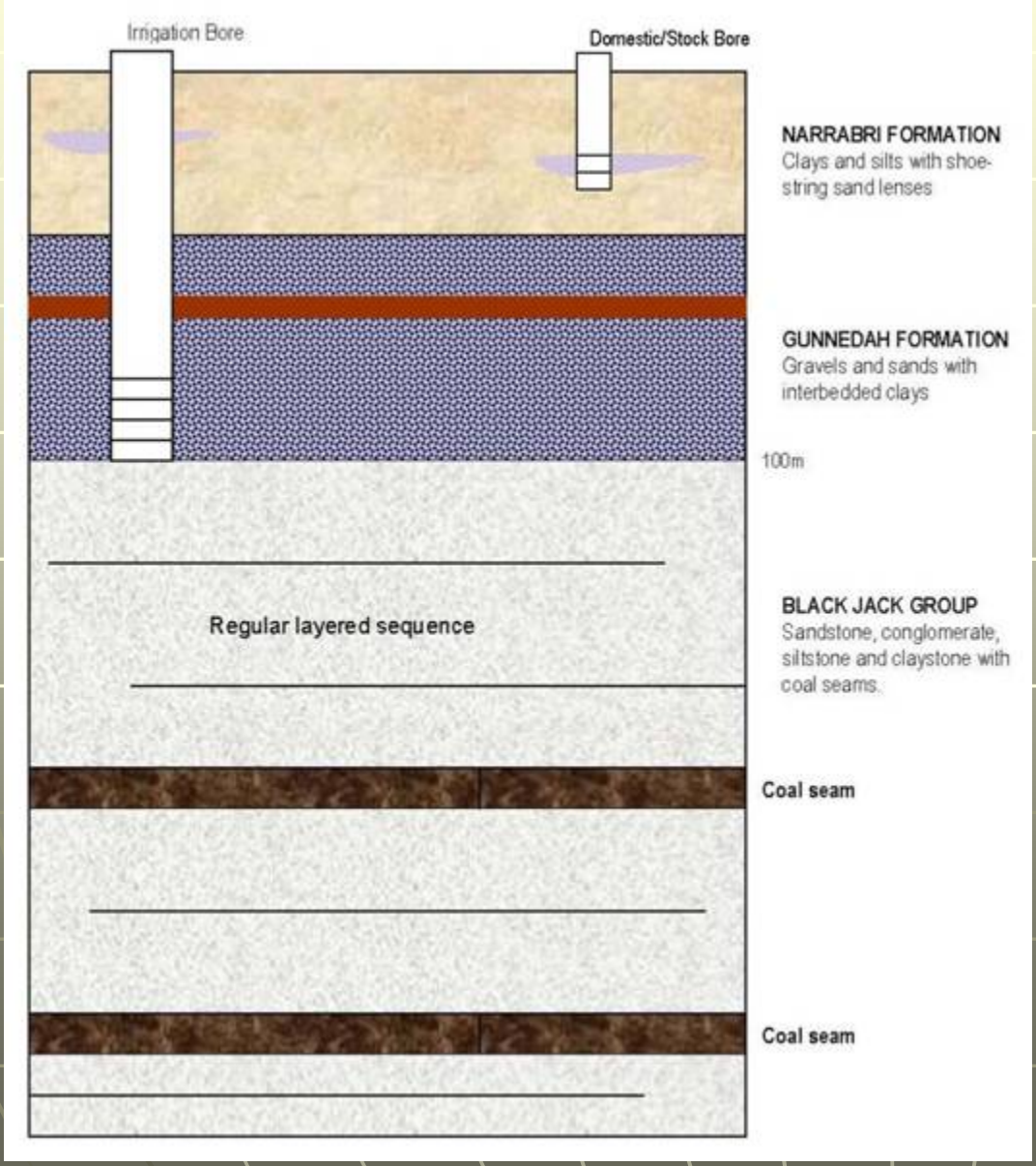
Groundwater Regime of the Caroona Area (preliminary understanding based on published data)

- There are 2 aquifer systems in the Caroona area:
  - alluvial aquifers (most important)
  - fractured rock aquifers-
- An aquifer is defined as a groundwater formation that is capable of transmitting and yielding water in useable quantities.
- Alluvial aquifers occur as deep (>100m) infilled palaeochannels
- Fractured rock aquifers belong to the older sedimentary formations and the coal seams and some sandstone beds are the main aquifers.
- The fractured rock aquifers are generally poorer aquifers with respect to yield and often water quality, compared to the alluvial aquifers.
- Groundwater flow is from south to north.



CAROONA COAL DEPOSIT

GROUNDWATER



Groundwater Regime of the Caroona Area

Vertical Section

- The prime aquifer is the basal sand and gravel Gunnedah Formation which is highly transmissive.

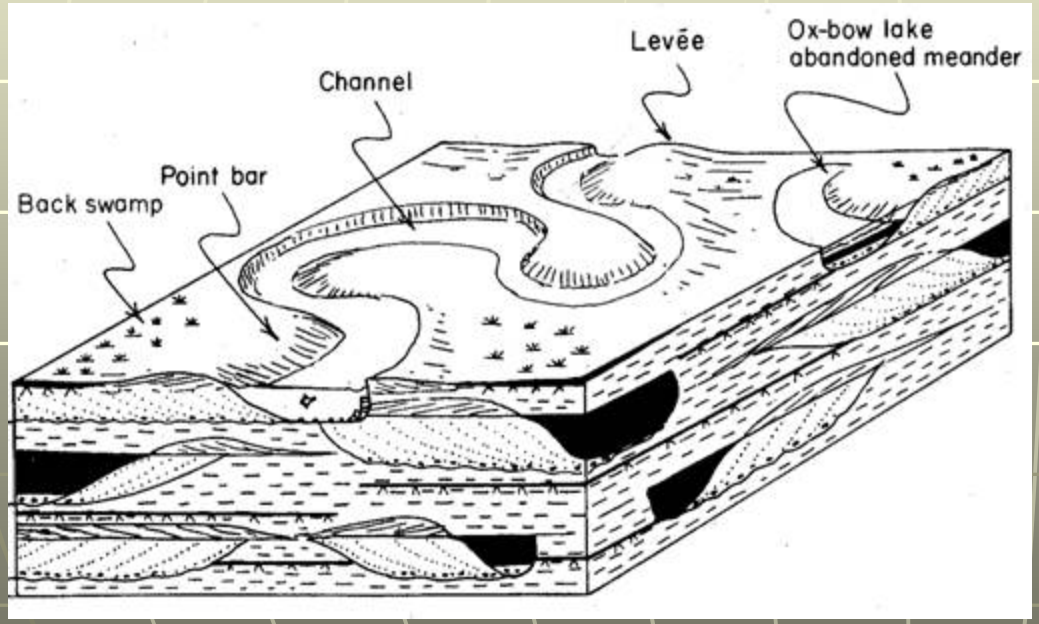
- Overlain by the Narrabri Formation consisting of clays and silts with shoe string sand lenses.

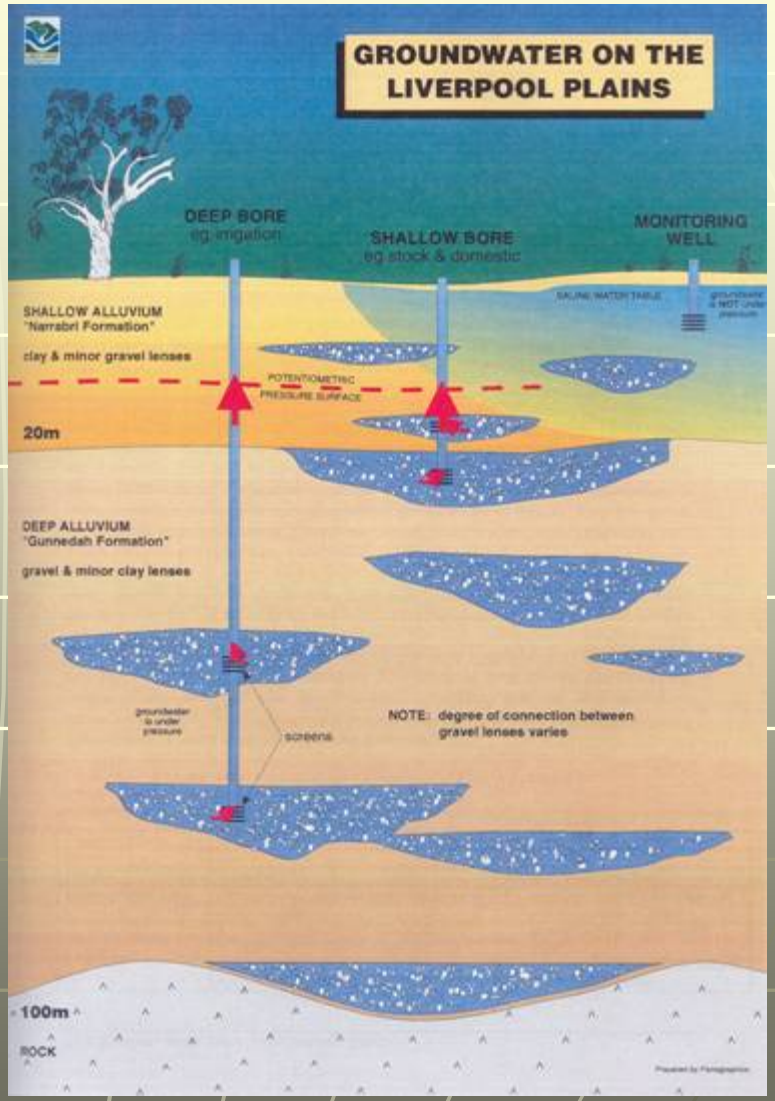
- Older sediments, the Black Jack Group, consist of sandstone, conglomerate, siltstone and claystone and contain coal seams

CAROONA COAL DEPOSIT

GROUNDWATER

Aquifers and aquitards are old rivers & plains





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CAROONA COAL DEPOSIT

GROUNDWATER

Groundwater Investigations

- **KEY ISSUES**
- Whether there are significant aquifers in the older rocks underlying the alluvium, apart from the coal seams, eg sandstone beds.
- the impact of subsidence from underground mining and whether this will provide hydraulic connectivity between the coal seams and the base of the alluvial aquifer;
- the potential for subsidence to capture stream flow;
- groundwater inflow to an underground mine from the coal seam;
- whether dewatering of an underground mine and depressurization of the coal seams and overburden will impact the alluvial aquifers;
- the impact on farm bores used for irrigation, stock and domestic supplies.

CAROONA COAL DEPOSIT

GROUNDWATER

Groundwater Investigations

Groundwater Investigations include:

- installation of monitoring bores in the aquifers and monitoring of water levels and water quality. The data is used to assess the degree on connection between the aquifer systems, if any, the direction of groundwater flow, and to obtain baseline data against which the impact of mining can be measured.

- Undertaking permeability tests on the aquifers and on the rock material that separates the aquifers. It involves either pumping water out of the aquifers or pumping water into the rock units under pressure and measuring various responses.

- Geotechnical tests are also undertaken on rock samples to assess the strength of the rock which enables the height of fracturing under mining conditions to be assessed.

CAROONA COAL DEPOSIT

GROUNDWATER

Exploration Drilling, Groundwater Monitoring and Prevention of Contamination of Aquifers.

- where a hole is drilled and completed for monitoring groundwater it is a requirement under the Water Act 1912 that the hole be drilled by a licensed water driller. In this situation where there is likely to be drilling through multiple aquifers a NSW Class 4 licensed driller is required.

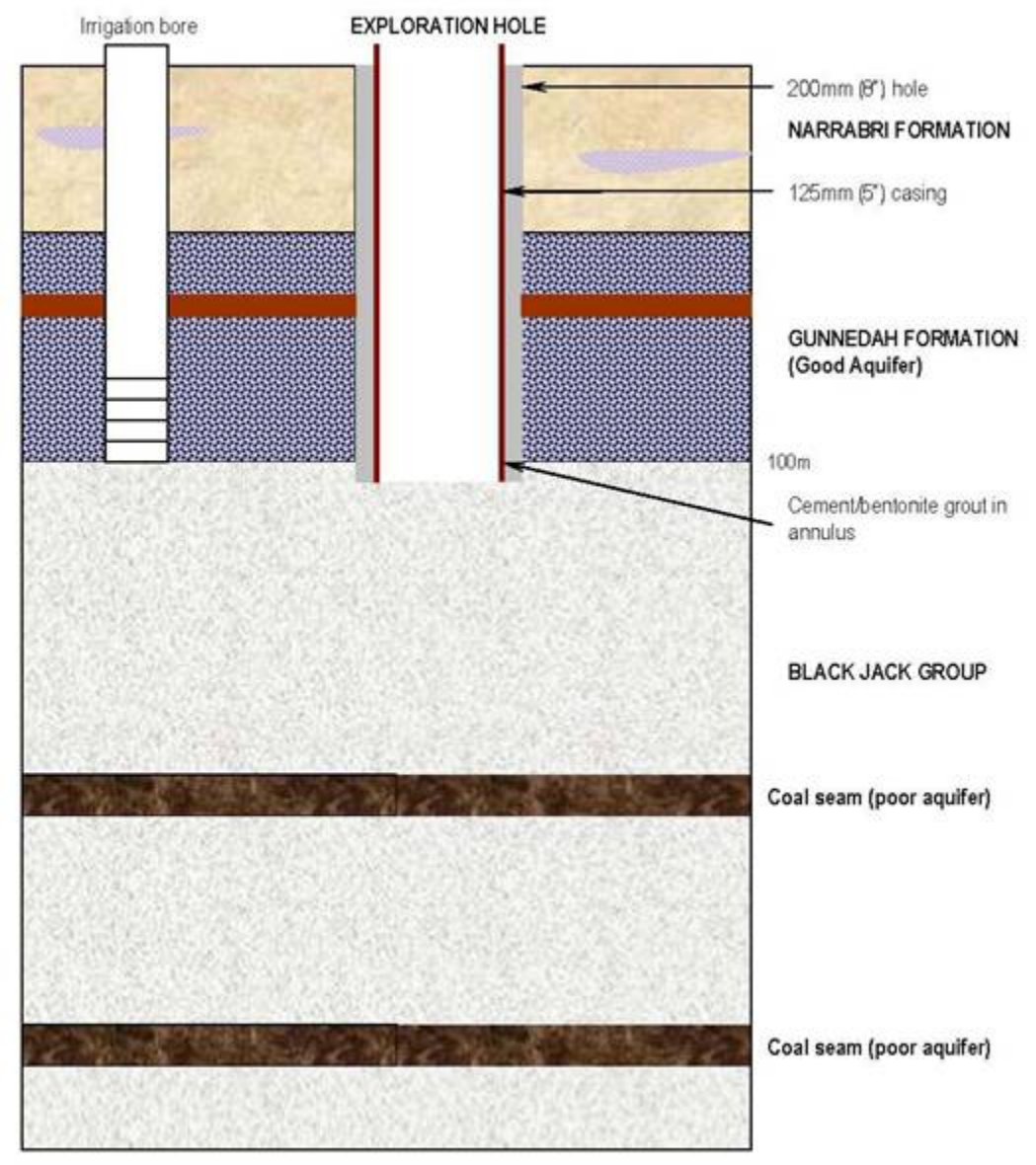
- It will be necessary that all the holes are drilled and bores constructed in such a way as to prevent any ingress of water into the hole which would allow for cross contamination between aquifers.

- It will also be necessary that on completion of any hole which is not to be used for groundwater monitoring purposes, that is which is abandoned, that they are grouted to avoid any migration of groundwater or possible interaction between aquifers.

- All groundwater monitoring bores will constructed in accordance with:
  "The Minimum Construction Requirements for Water Bores in Australia"

CAROONA COAL DEPOSIT

GROUNDWATER



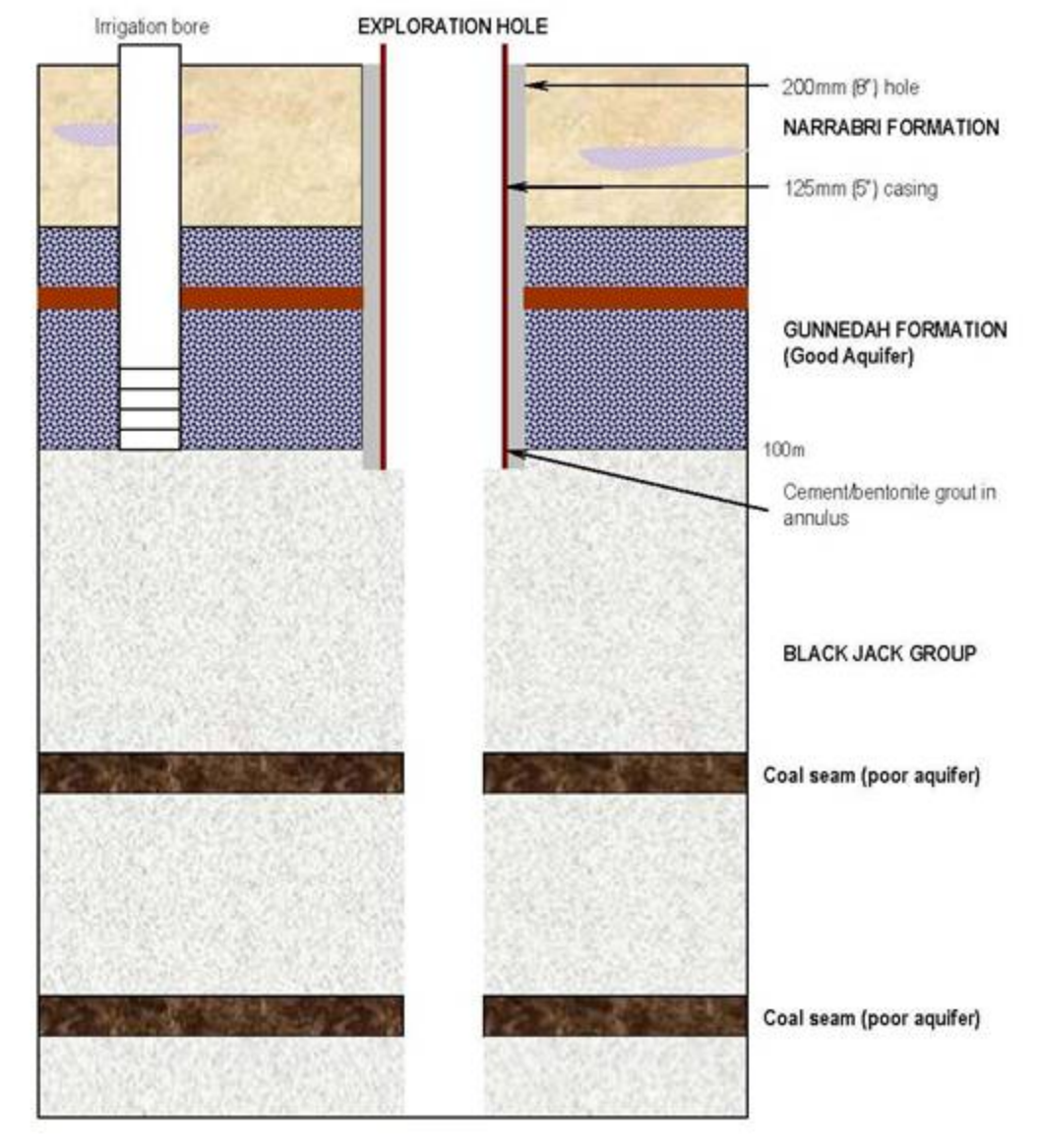
Exploration Drilling, Groundwater Monitoring and Prevention of Contamination of Aquifers.

Vertical Section

- Alluvium drilled by rotary mud method and then cased off with steel casing.
- Initial drill hole will extend 3-5m into solid bedrock beneath the alluvium and the steel casing will similarly be extended into the bedrock before grouting the annulus between the casing and the hole wall.
- The alluvium is isolated by grouting in the steel casing before drilling ahead into the coal seams

CAROONA COAL DEPOSIT

GROUNDWATER



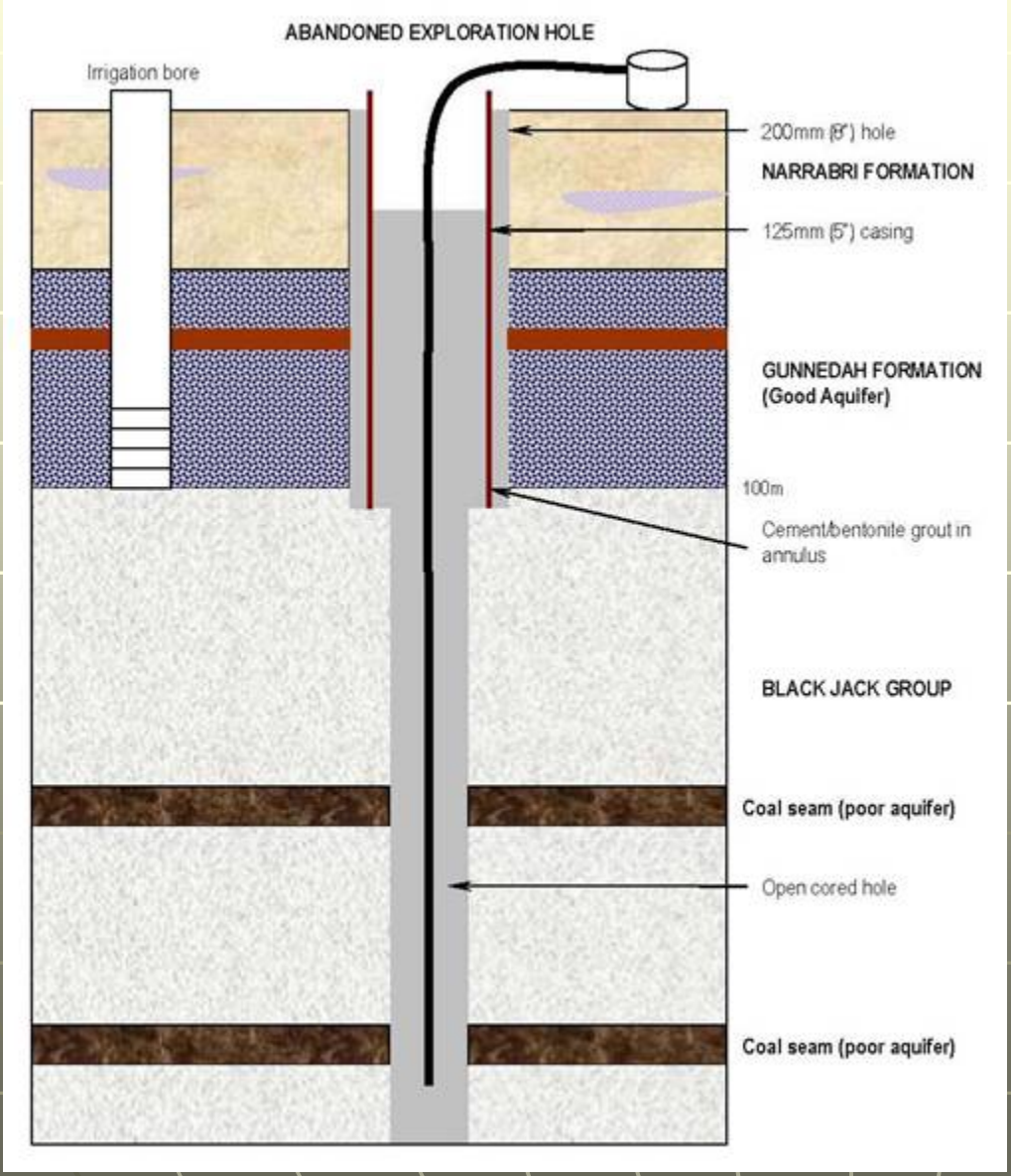
Exploration Drilling, Groundwater Monitoring and Prevention of Contamination of Aquifers.

Exploration Bores

- Hard rock either hammer drilled using air or cored.
- Cored samples are taken to obtain sections of the rock and coal seams for testing
- Water pressure (packer) tests are undertaken along sections down the hole to find out how permeable or impermeable the rock mass is.

CAROONA COAL DEPOSIT

GROUNDWATER

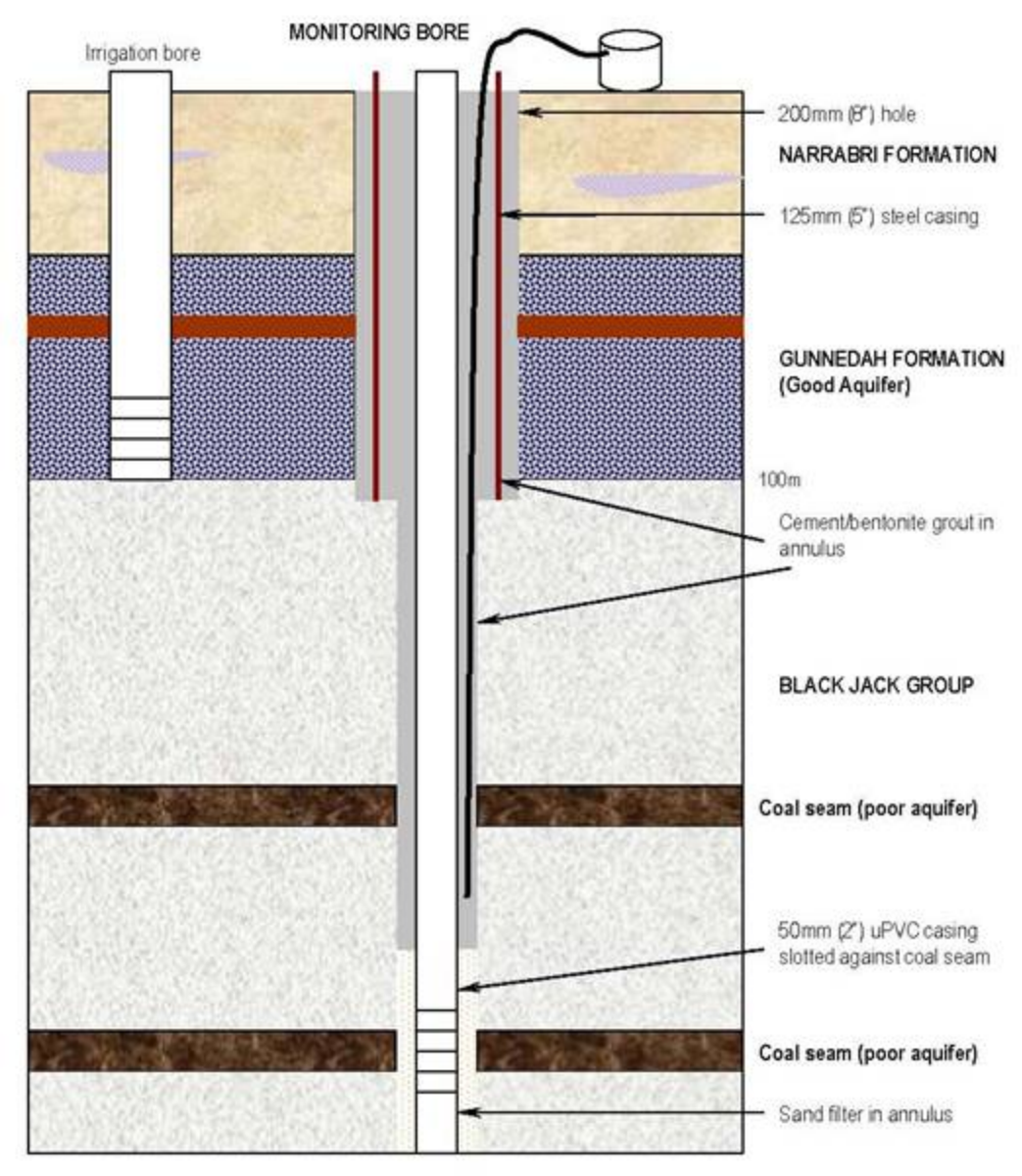


Exploration Drilling, Groundwater Monitoring and Prevention of Contamination of Aquifers.

Abandonment of Exploration Bores

CAROONA COAL DEPOSIT

GROUNDWATER



Exploration Drilling and Groundwater Monitoring and Prevention of Contamination of Aquifers.

Construction of Monitoring Bores

Coal Seams and / or Sandstone Aquifers

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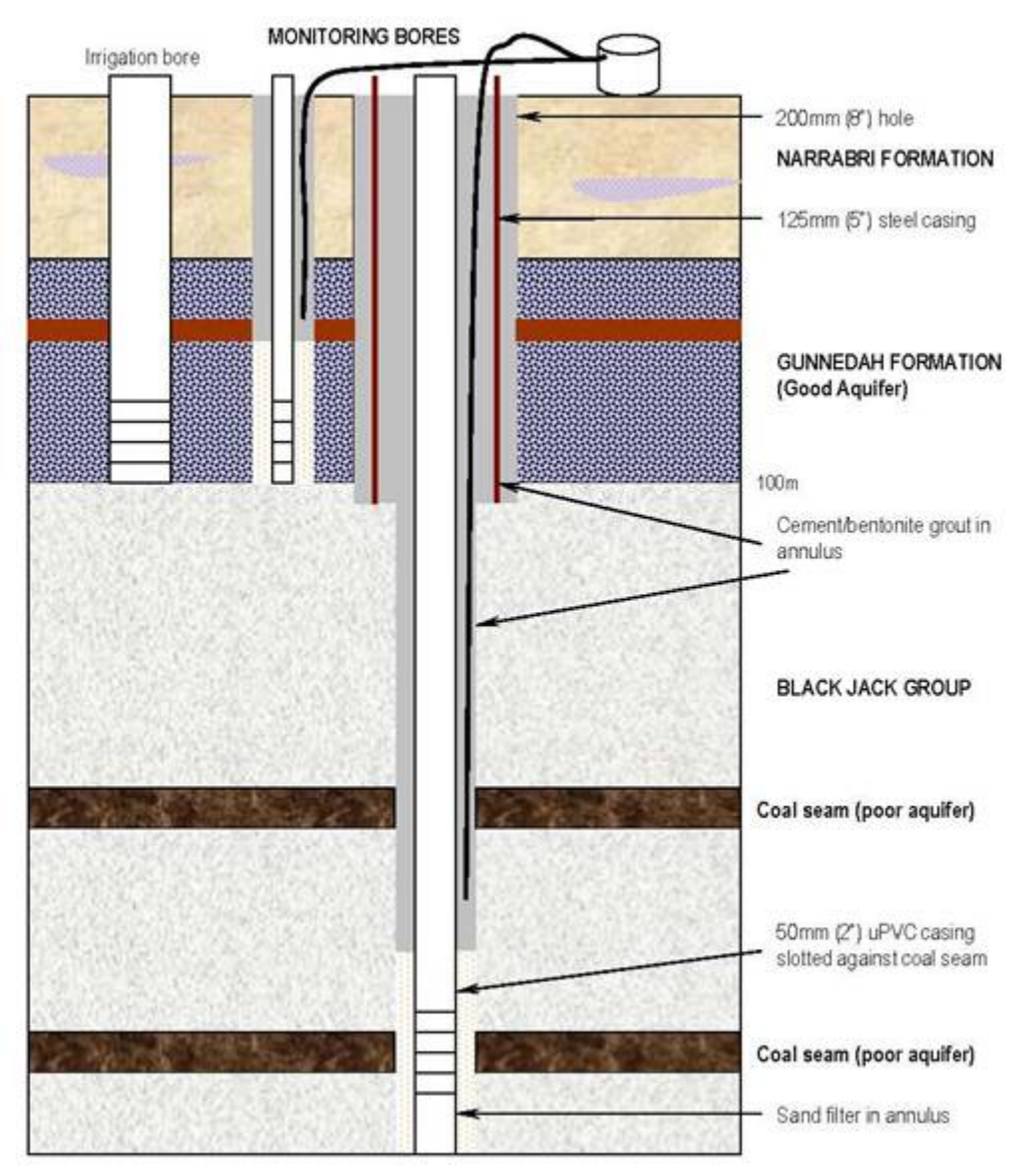
CAROONA COAL DEPOSIT

GROUNDWATER



Exploration Drilling, Groundwater Monitoring and Prevention of Contamination of Aquifers.

Construction of Monitoring Bores

Alluvium

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GROUNDWATER

Typical Monitoring Bores

- 50mm diameter uPVC casing to about 1m above ground level.
- Photo does not show steel protective pipe with lockable cap that is cemented in around the uPVC casing
- Monitoring bores will be placed along fence lines rather than in the middle of a paddock.

CAROONA COAL DEPOSIT

GROUNDWATER

VW Piezometer (top) and VW Push-In Piezometer (bottom).