CoalBedEnergyConsultants.

School of Underground Mining, Methane Session

CBM / CMM in Australia: Technical Success Factors

Prepared by: Scott Thomson

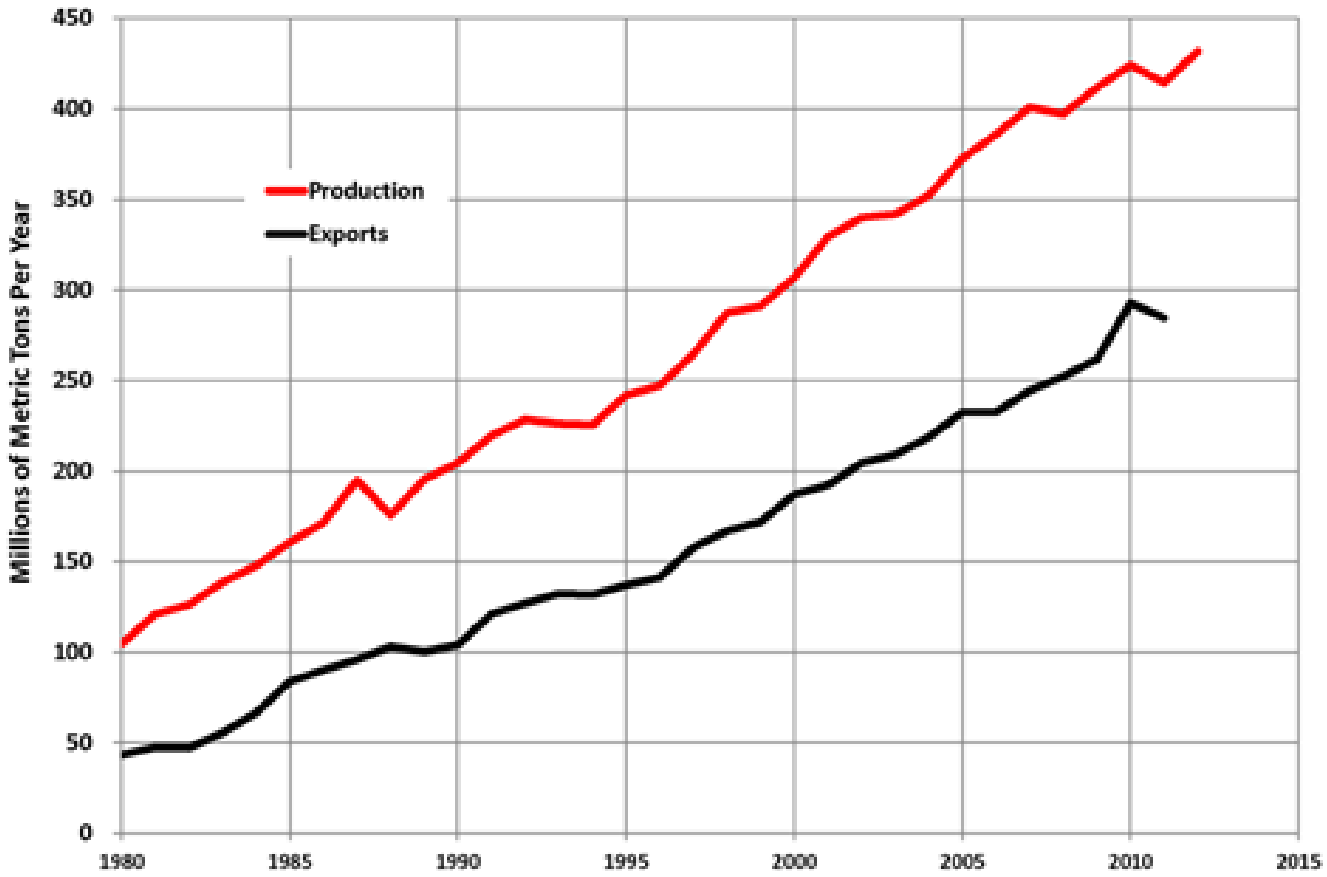
28th February 2018

CoalBedEnergyConsultants

Introduction to coal & CBM in Australia

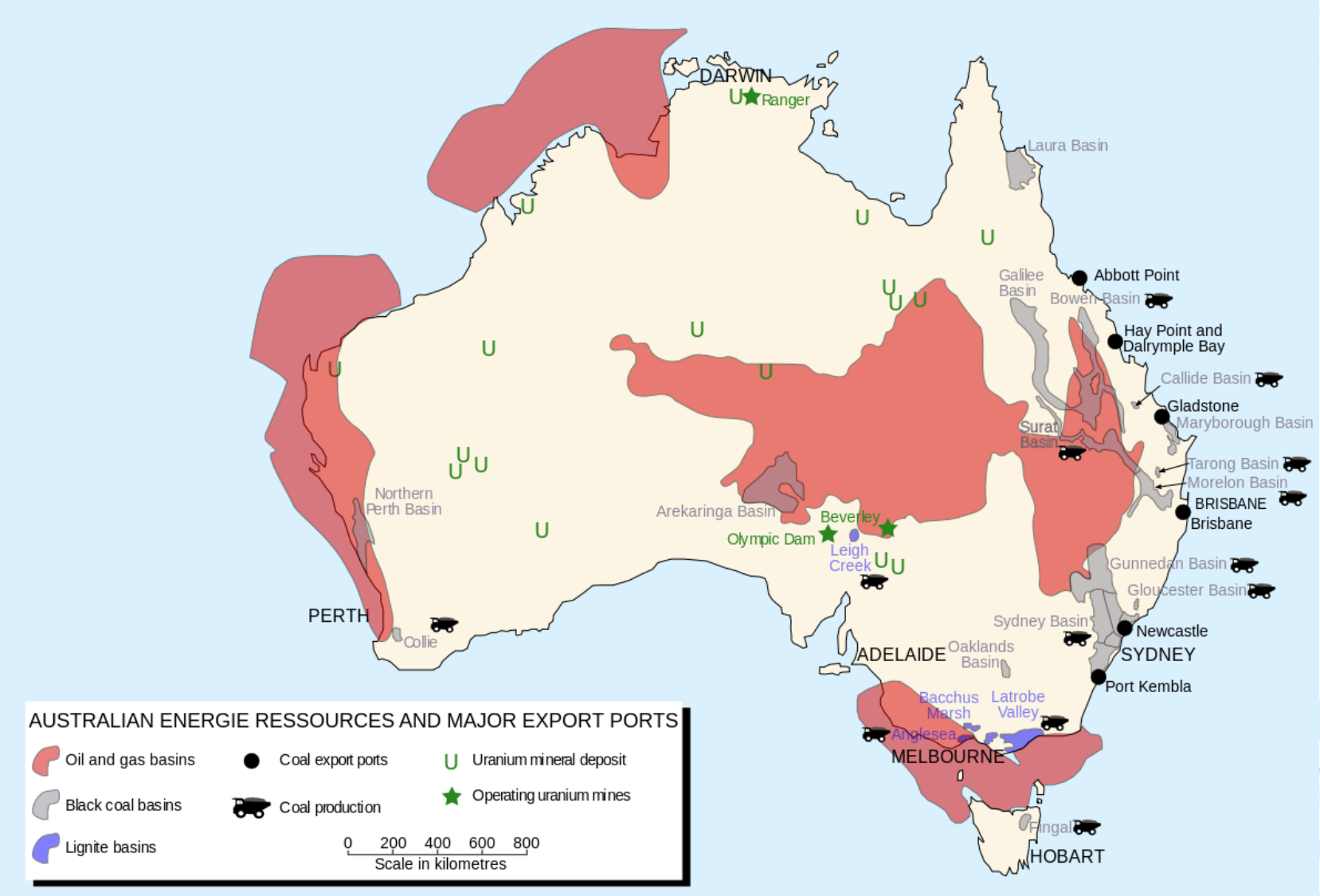
- Australia is the world's largest coal exporter (~400 Mt), and most of our domestic energy is supplied by coal (~70%). ~75% is exported.
- Coal has been mined since ~1803, and it is unrealistic to think that this will change significantly in the short term, *however <u>it is</u> under community pressure.*
- Coal is getting deeper, and this means more gas.
- Australia is also a significant producer of CBM, currently exporting ~ 19.3 Mtpa to Asian markets. All of this gas comes from one state (QLD) and two basins (Bowen & Surat – *mainly the latter*).
- The CBM industry is much younger than the coal industry, only really starting around 2000.

Coal in Australia



Still expanding, but for how long?

Where is the coal?



CoalBedEnergyConsultants

Coal / CBM: two strands interlinked by geology, technology and geography

- Overlap of ideas but plenty of mutual distrust and lack of understanding.
- Constant tension over access to resources, almost exclusively in the Bowen Basin. Few examples of complimentary activities.
- Purely a QLD issue as CBM is dead in NSW, *for non-technical reasons.*
- Many individuals who walk the divide, but these are a small percentage …
- *Some* cross-fertilisation of ideas.
- To miners gas is a menace, to CBM operators it is the main game.

Peculiarities of this common space …

- Most of the CBM gas exported from Australia comes from the Surat Basin (Walloon Coal Measures), and the southern Bowen Basin (Comet Ridge area). *There is virtually no mining in these places, and few people.*
- The Bowen has much more gas in areas where mining is common, but little CBM development – a conundrum. Why? *Perm is the main issue.*
- Australia has a domestic gas supply crisis on the East Coast, at the same time as we export large amounts from Gladstone to Asian markets. *A political hot potato.*
- The pressure is on for miners to stop venting / flaring mine gas. The argument about fugitive emissions simmers away and again, is caught up in politics. *To have a carbon tax, or not to have … ???*

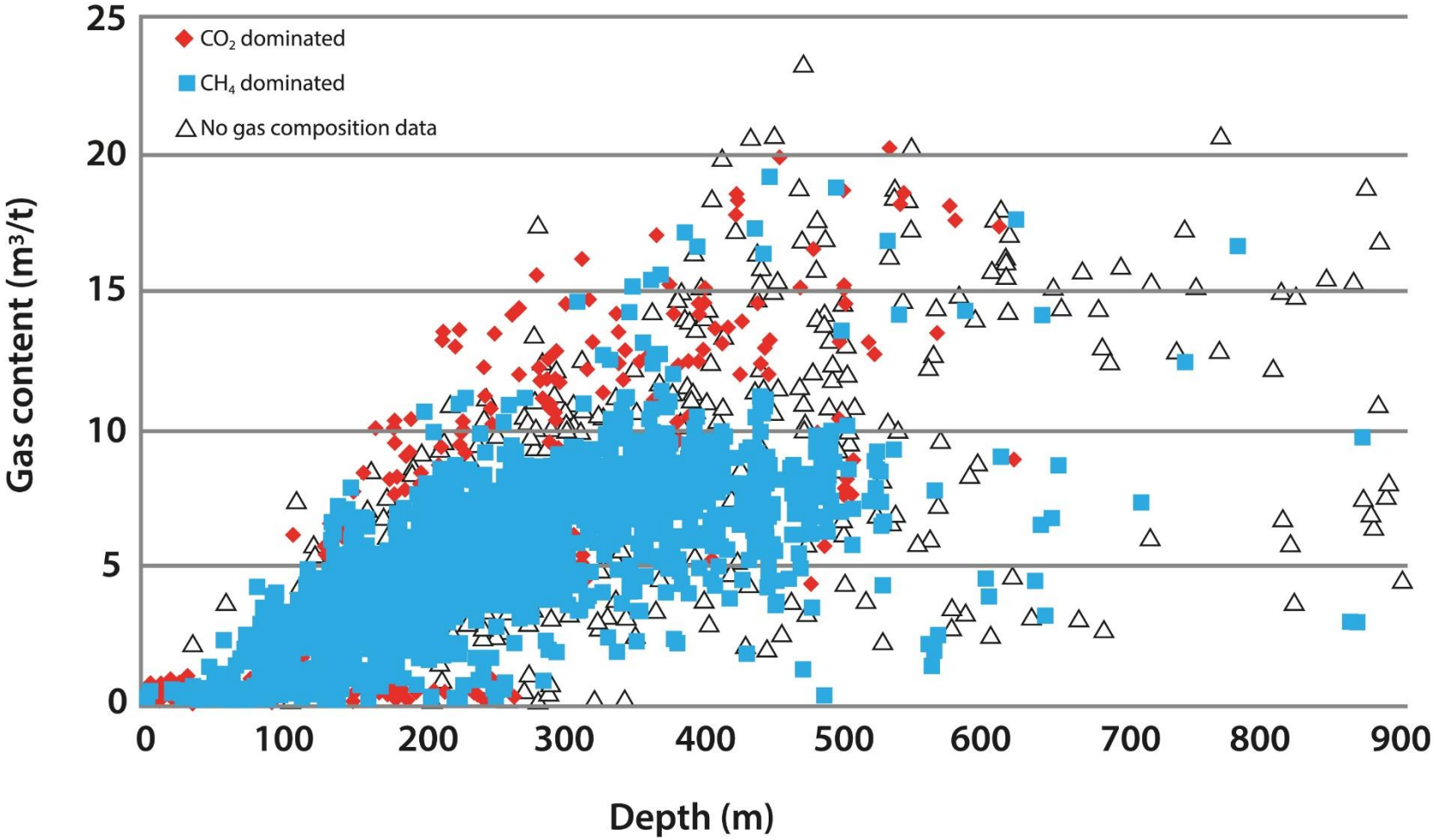
CoalBedEnergyConsultants

Technical success factors

- For CBM:
  - Access to large areas of agricultural land with as few (as possible) stakeholders.
  - High perm fairways (e.g. Comet Ridge, Undulla Nose, and Moranbah).
  - Scale. Many holes over vast distances.

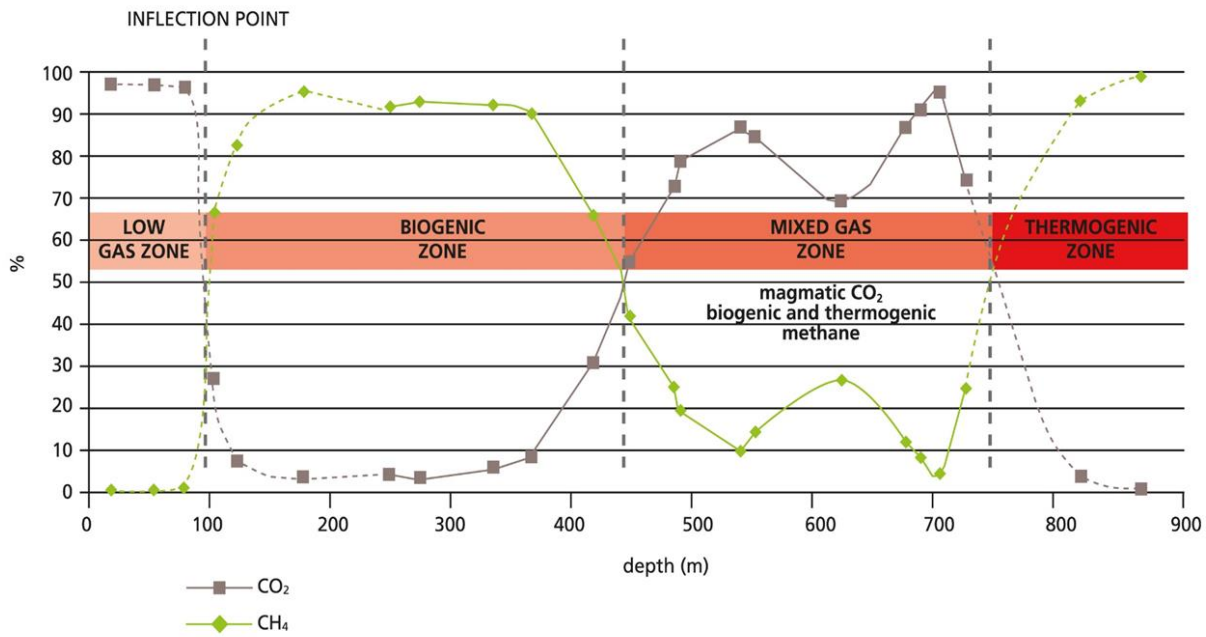
- For CMM:
  - Technology: successful drilling techniques (directional).
  - Strong operational experience in managing gas underground.
  - “Overengineering” … i.e. redundancy that errs on the side of safety.

The data … gas content & composition

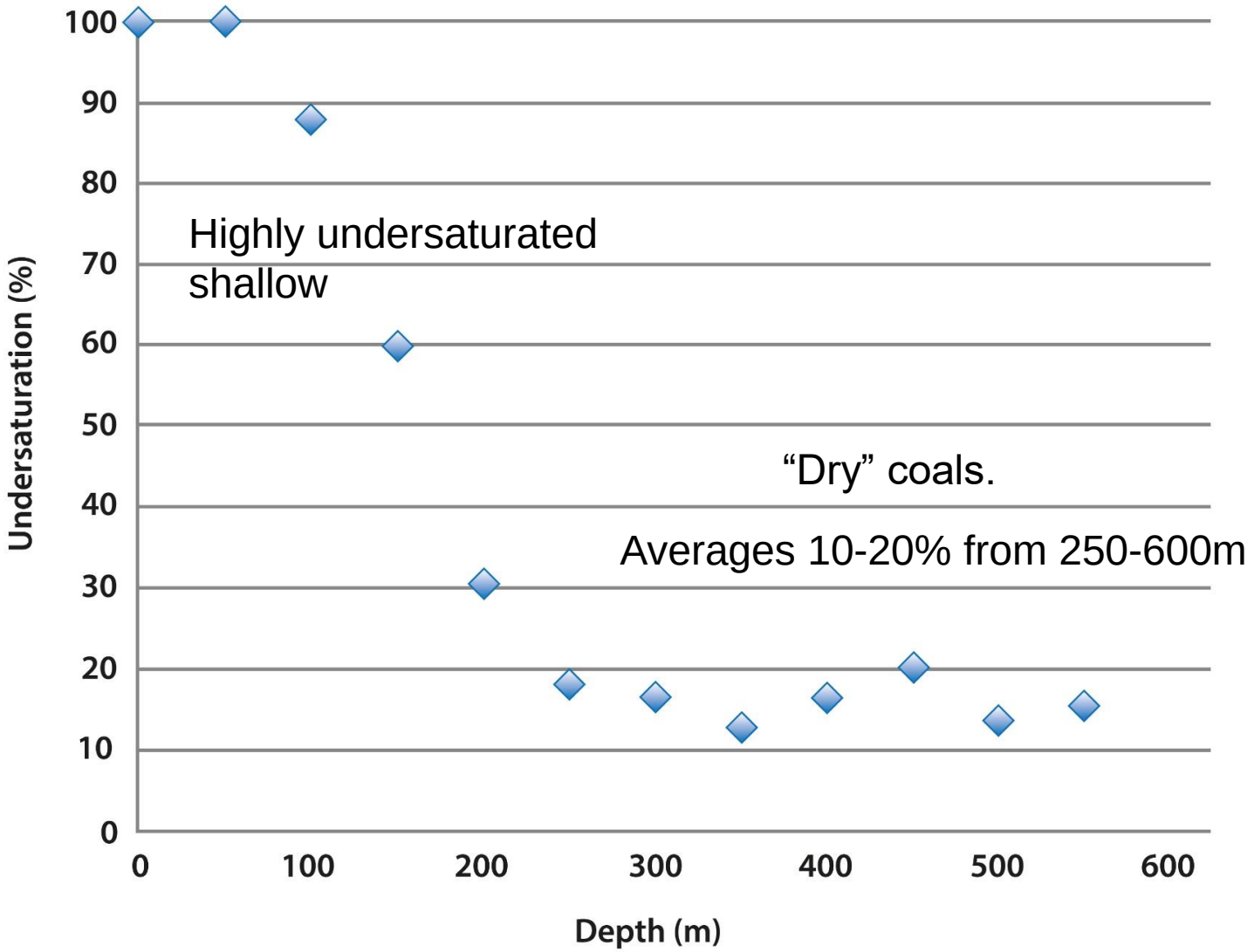


The same patterns are repeated throughout the Sydney – Bowen Basin complex

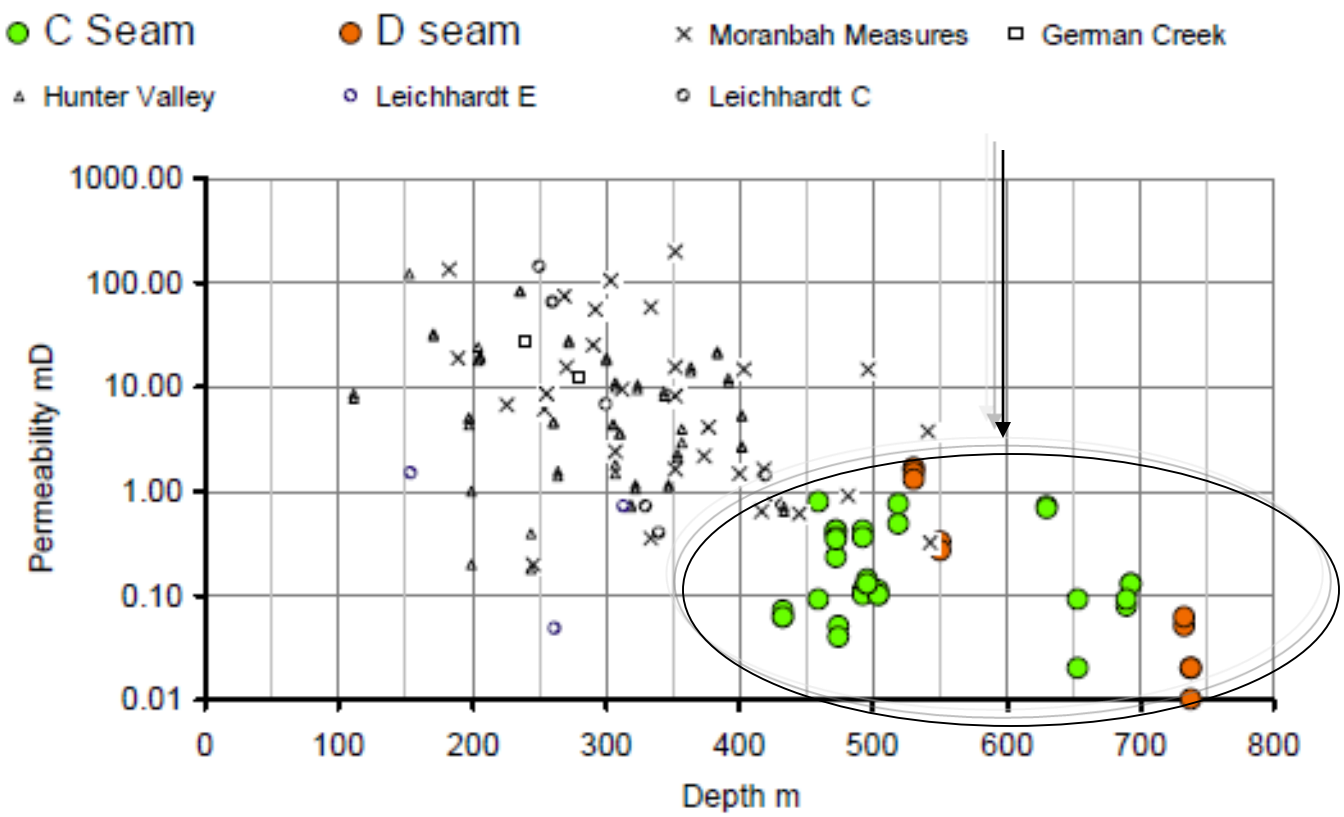
- CO2 dominance from 0-100m depth.
- CH4 starting to dominate thereafter, and usually almost 100% by 300m depth. This CH4 was biogenic in origin.
- After that a mixed gas zone of CO2 and CH4, with the CO2 gone by ~700m. These patterns independent of seam dip, i.e. gas layering has nothing to do with individual coal seams.



Level of undersaturation with depth

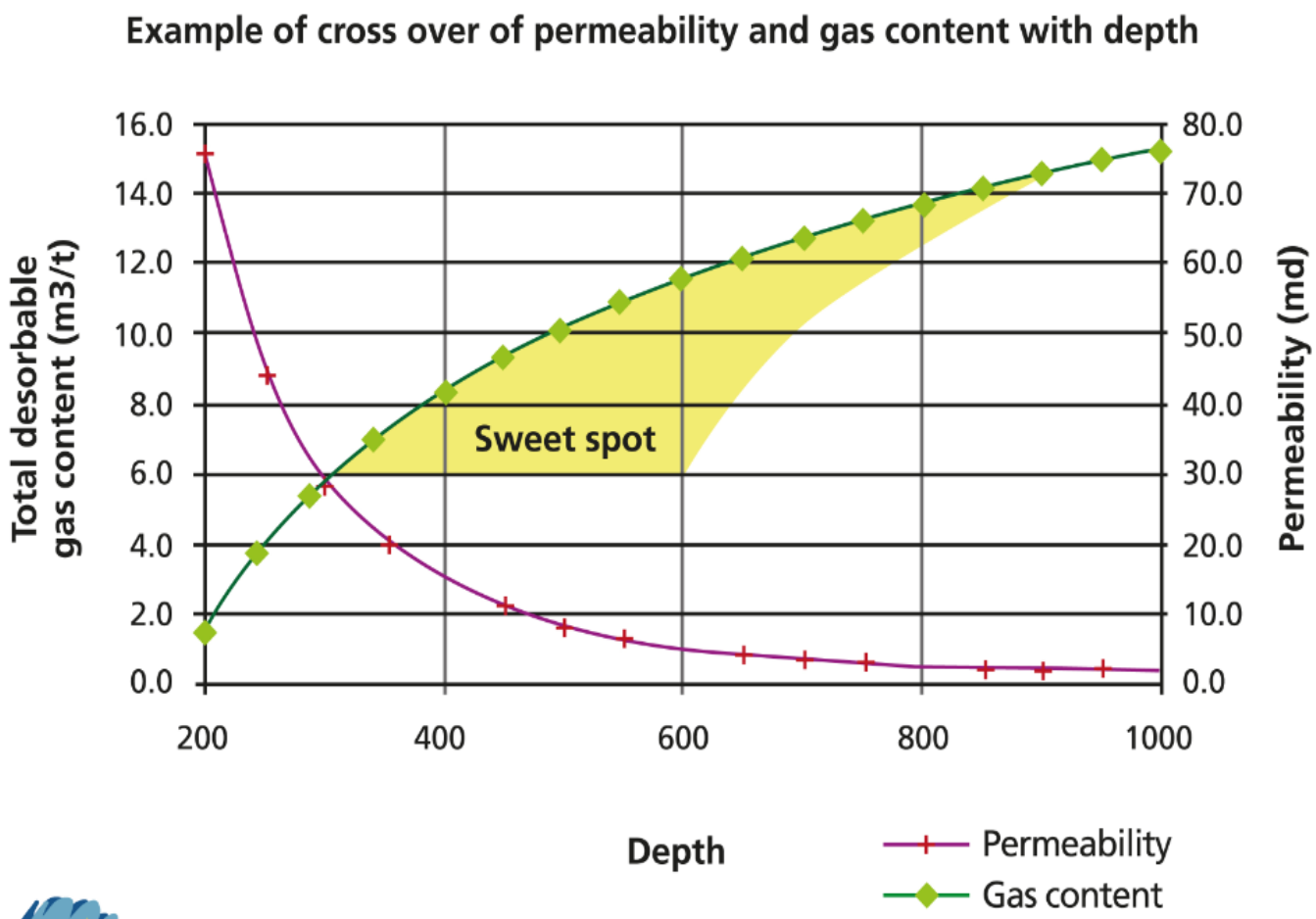


What about permeability data … ?



Typical Bowen Basin data – totally different in the Walloons

Permeability universally declines with depth



CoalBedEnergyConsultants

Implications for coal mining gas capture

- Perm will decline rapidly with depth, usually < 5mD from ~300m, and often < 1 mD.
- Gas content to increase from ~0m3/t at 100m to 5-10m3/t by 300m.
- Gas saturation usually high, ~80-90-% … not a lot of water to produce before CDP (Critical Desorption Pressure) is reached.
- Gas composition generally dominated by methane in shallow underground workings (and good perm) then a mixed gas regime of CH4 and CO2 thereafter.
- These patterns are generally consistent throughout the basin, with some minor local variations.
- Implications: 'easy' gas drainage until the perm starts to dive after 300m! More drilling, closer spacing … more cost!

CoalBedEnergyConsultants

Implications for the CBM operators (Bowen)

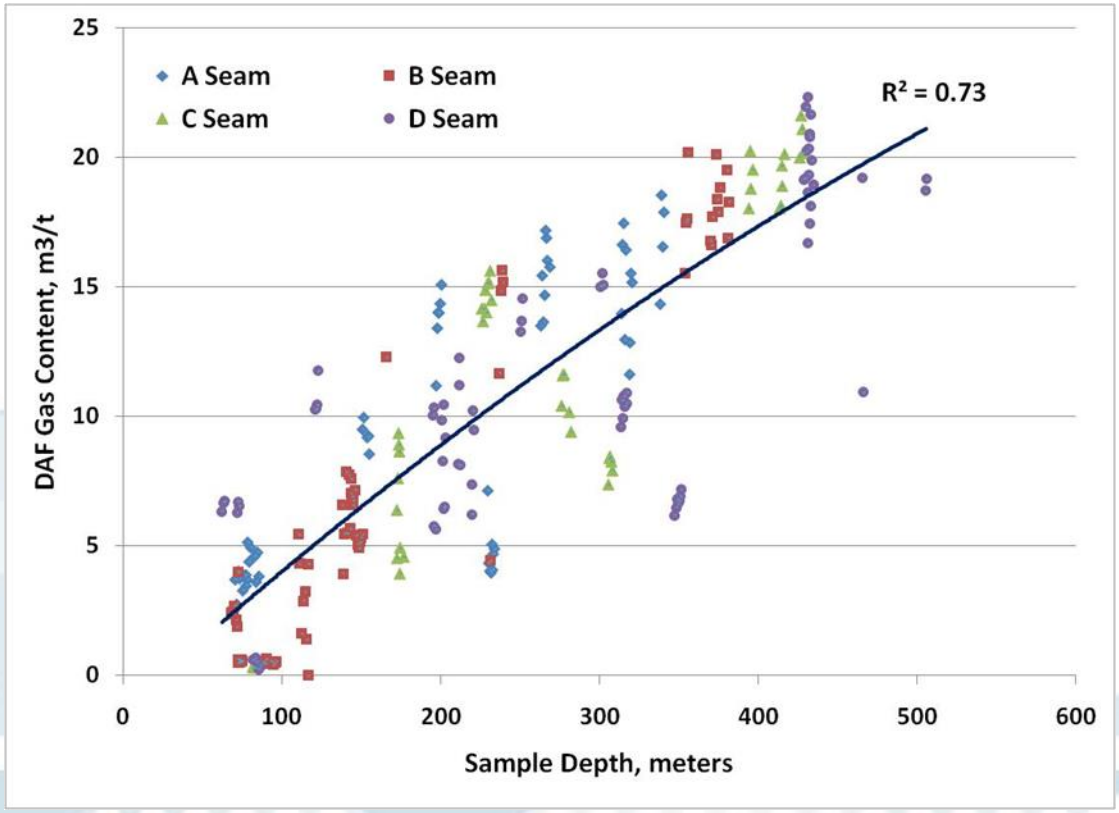
- A lot of the ‘easy’ gas resides in mining lease areas (where the shallow high perm exists), outside of this area can expect difficult extraction due to low perm.
- This observation applies almost universally for the Sydney – Bowen Basin in Australia, less so for the Surat (where little mining take place).
- This creates a source of tension between miners and CBM operators.
- To extract gas from a mining lease a CBM operator needs a “Co-development agreement”.

Example of overlap that appears to work …

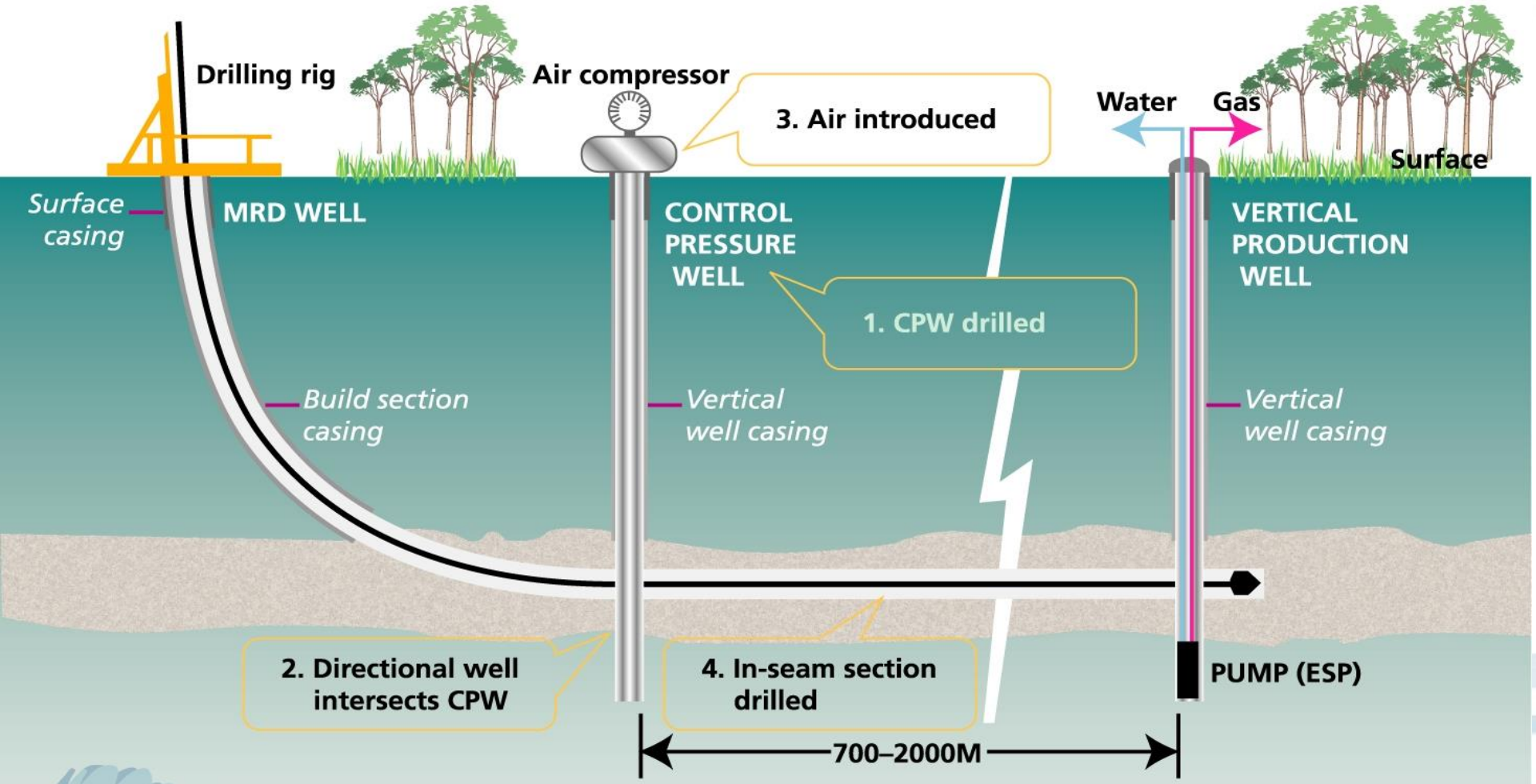
- CBM company extracting gas up to 5 years ahead of mining development.
- Use chevron pattern of extraction (2 SIS laterals to single vertical).
- Mining company supplements this drilling by UIS (Underground In-Seam) to ensure compliance with gas threshold levels.

Gas character of this "co-development" area

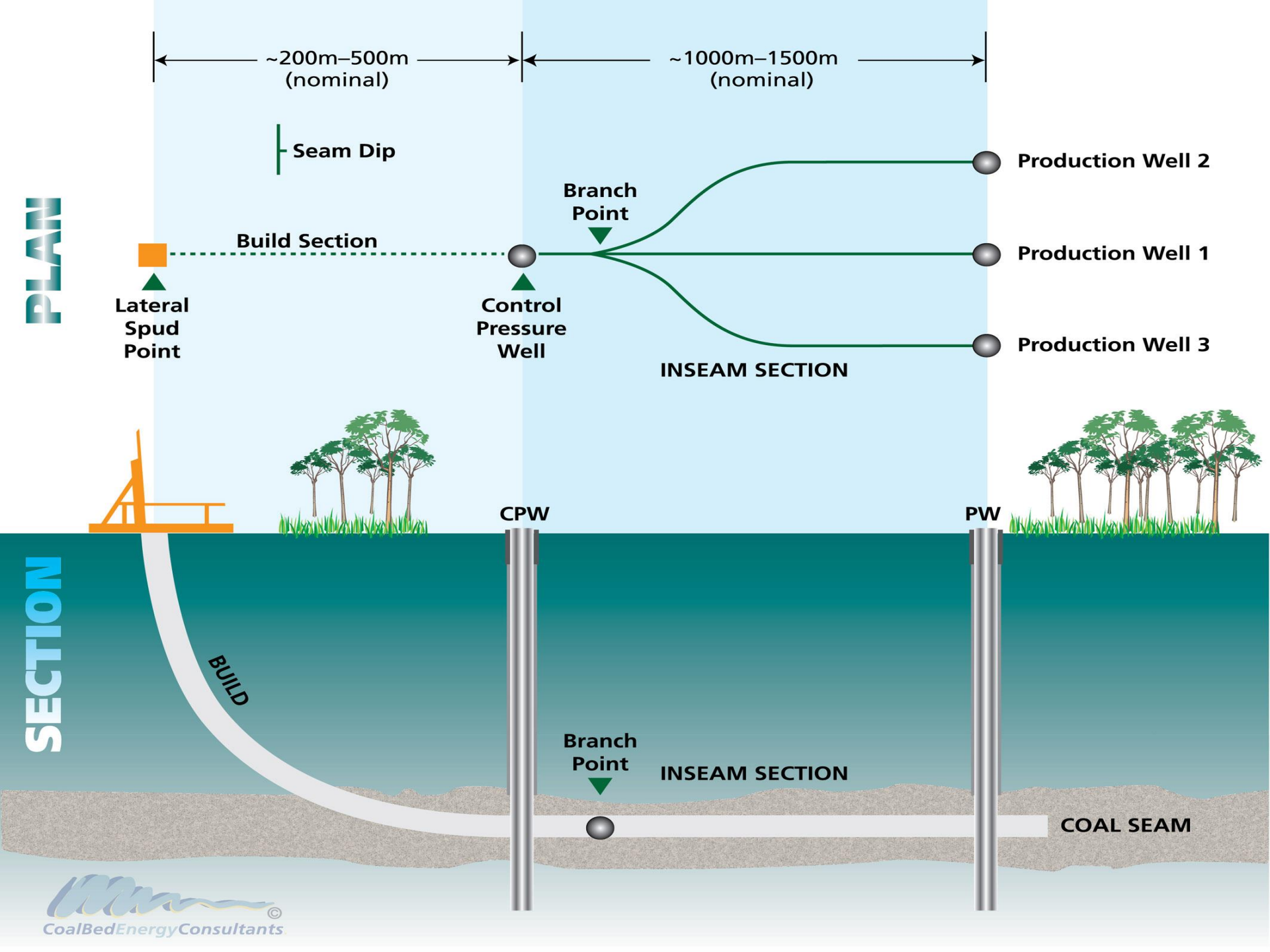
- Very rapid gas content increase with depth.
- Generally good perm until about 450m.
- All methane.



How SIS configuration might look



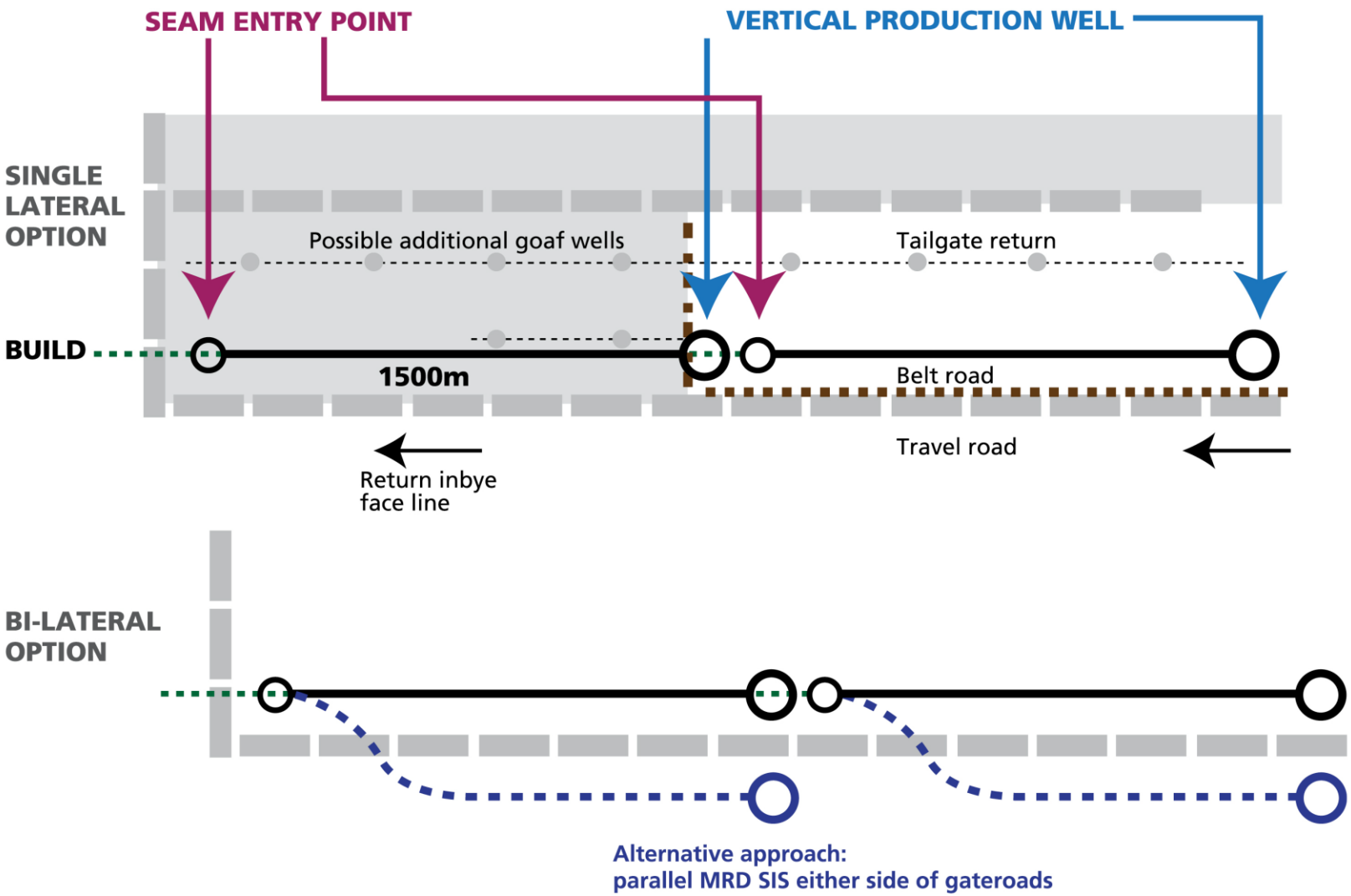
CoalBedEnergyConsultants ©


~200m–500m
(nominal)
~1000m–1500m
(nominal)
Seam Dip
PLAN
Branch
Point
Production Well 2
Build Section
Production Well 1
Lateral
Spud
Point
Control
Pressure
Well
Production Well 3
INSEAM SECTION
CPW
PW
SECTION
BUILD
Branch
Point
INSEAM SECTION
COAL SEAM
CoalBedEnergyConsultants

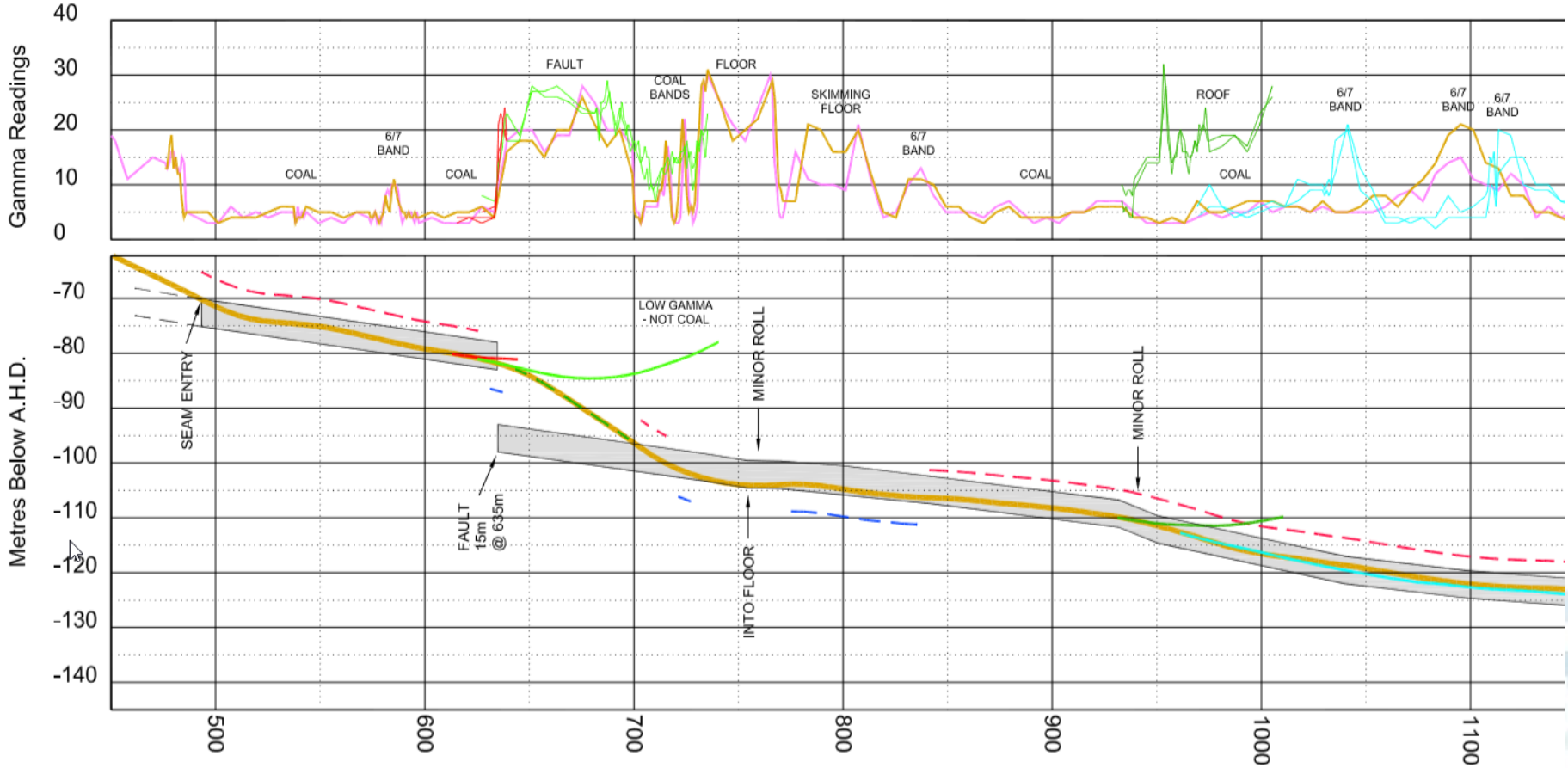
CoalBedEnergyConsultants

Advantage of this approach

- SIS provides long drainage time & orderly access to gas resources.
- May be used for on-site generation (48 MW power station in this instance).
- Valuable contribution made from SIS lateral for geological interpretation (improved geo model & lower longwall risk).
- Improved borehole management through Controlled Pressure Drilling (CPD).
- More expensive, but more effective.
- Possibility of multiple seam approach to deal with goaf gas.


SEAM ENTRY POINT
VERTICAL PRODUCTION WELL
SINGLE LATERAL OPTION
Possible additional goaf wells
Tailgate return
BUILD
1500m
Belt road
Travel road
Return inbye face line
BI-LATERAL OPTION
Alternative approach:
parallel MRD SIS either side of gateroads

How SIS has been used to assist geological interpretation

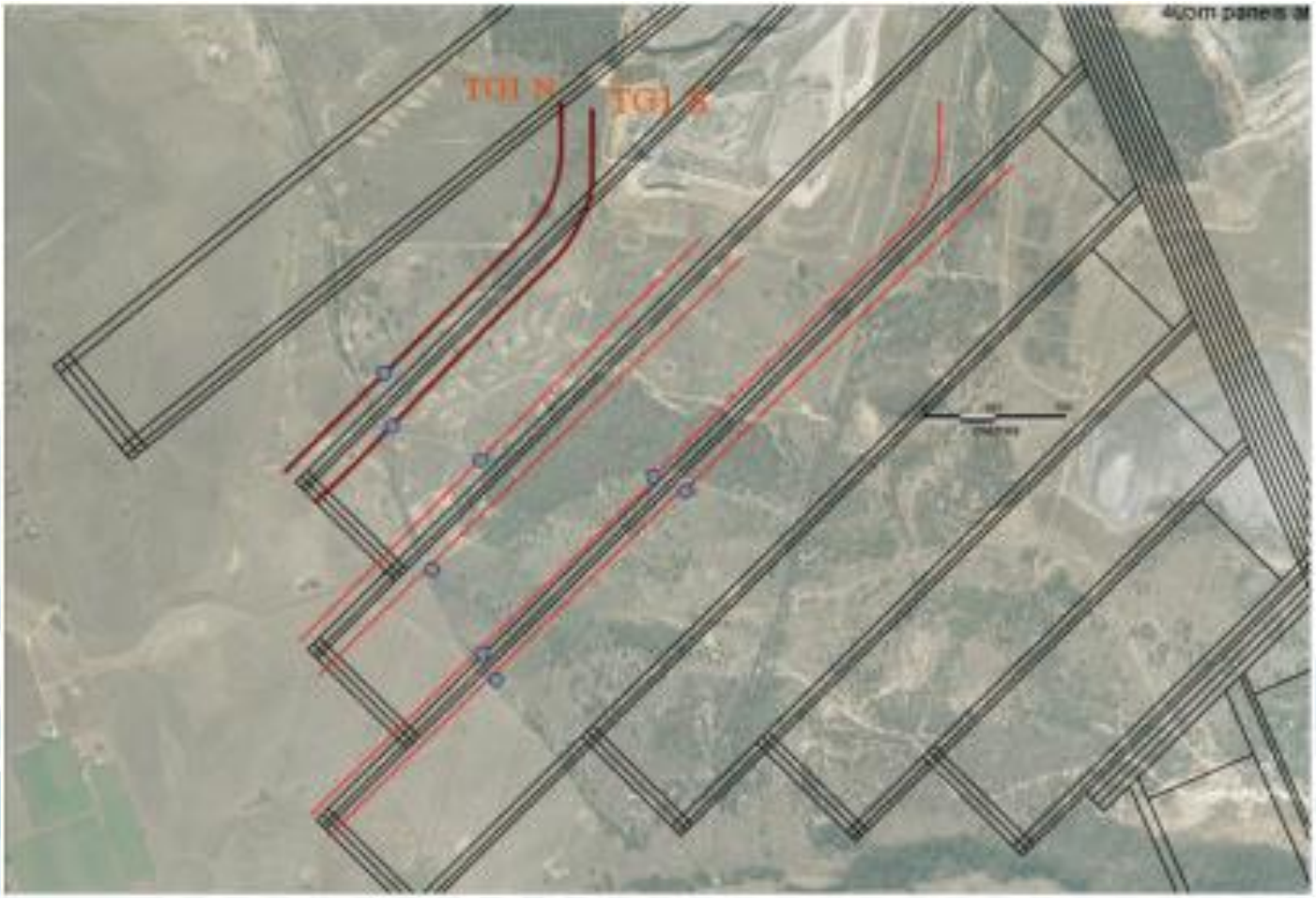


CoalBedEnergyConsultants

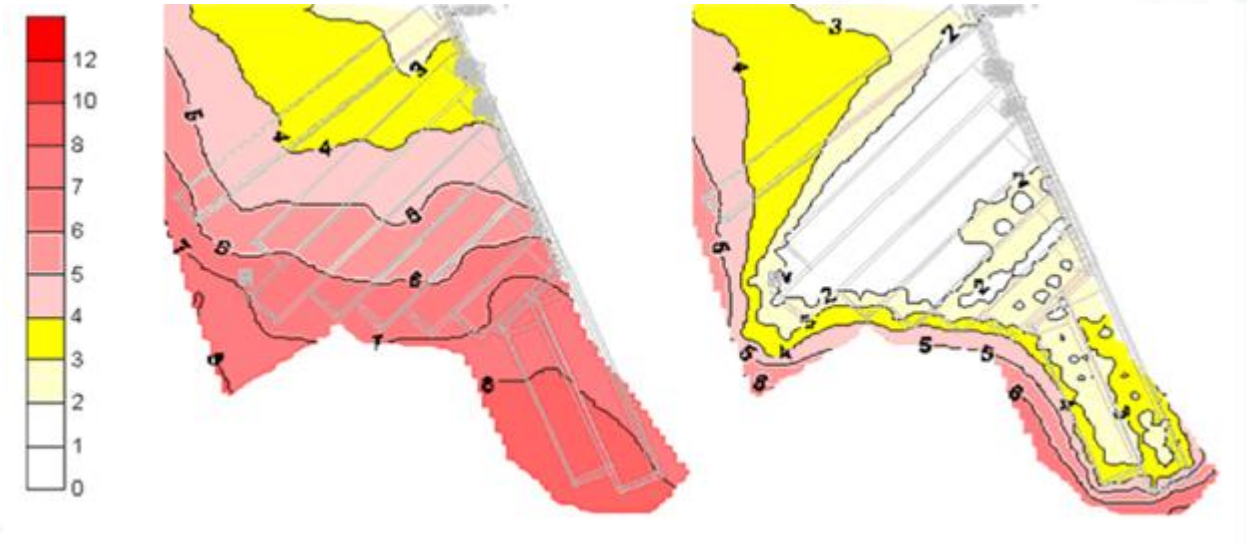
May include high capacity rig applications

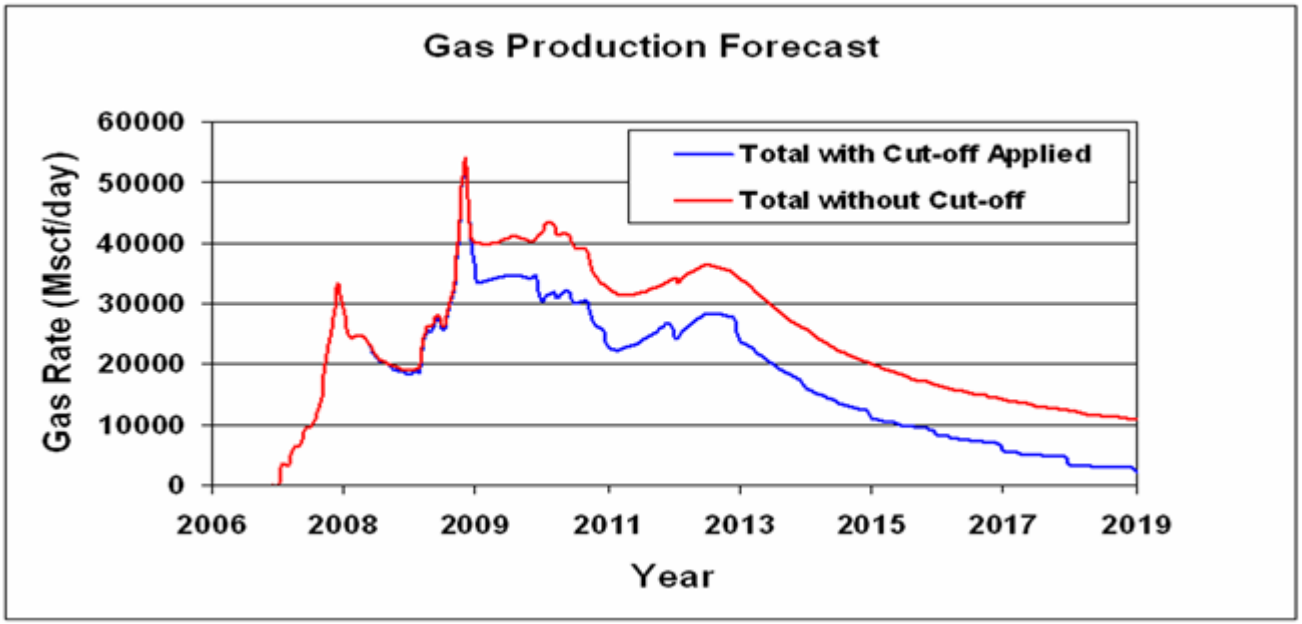
Use of oilfield drill pipe

Example of application parallel to gateroads



Linked to petroleum style modelling



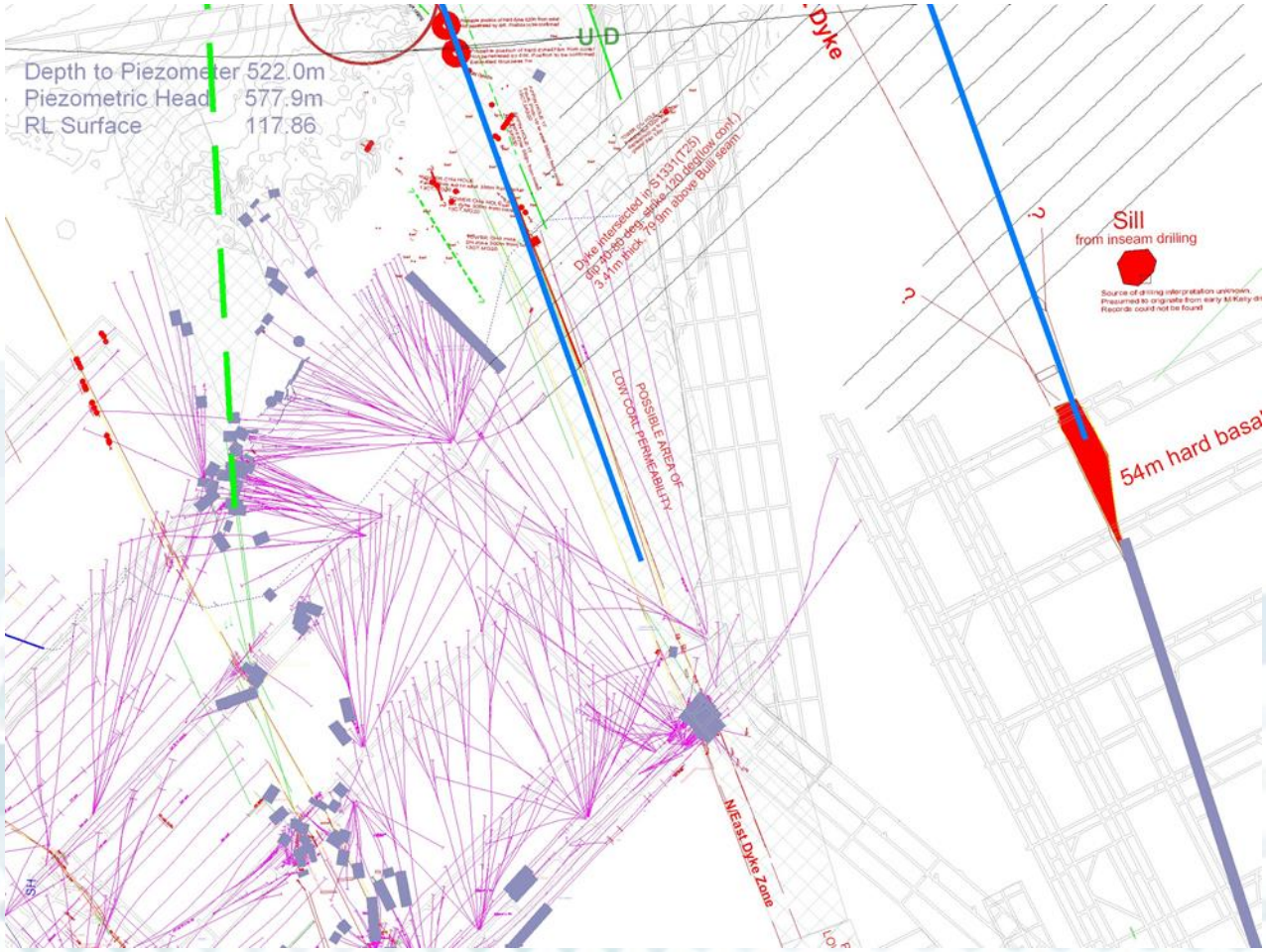


Use of SIS in Australia

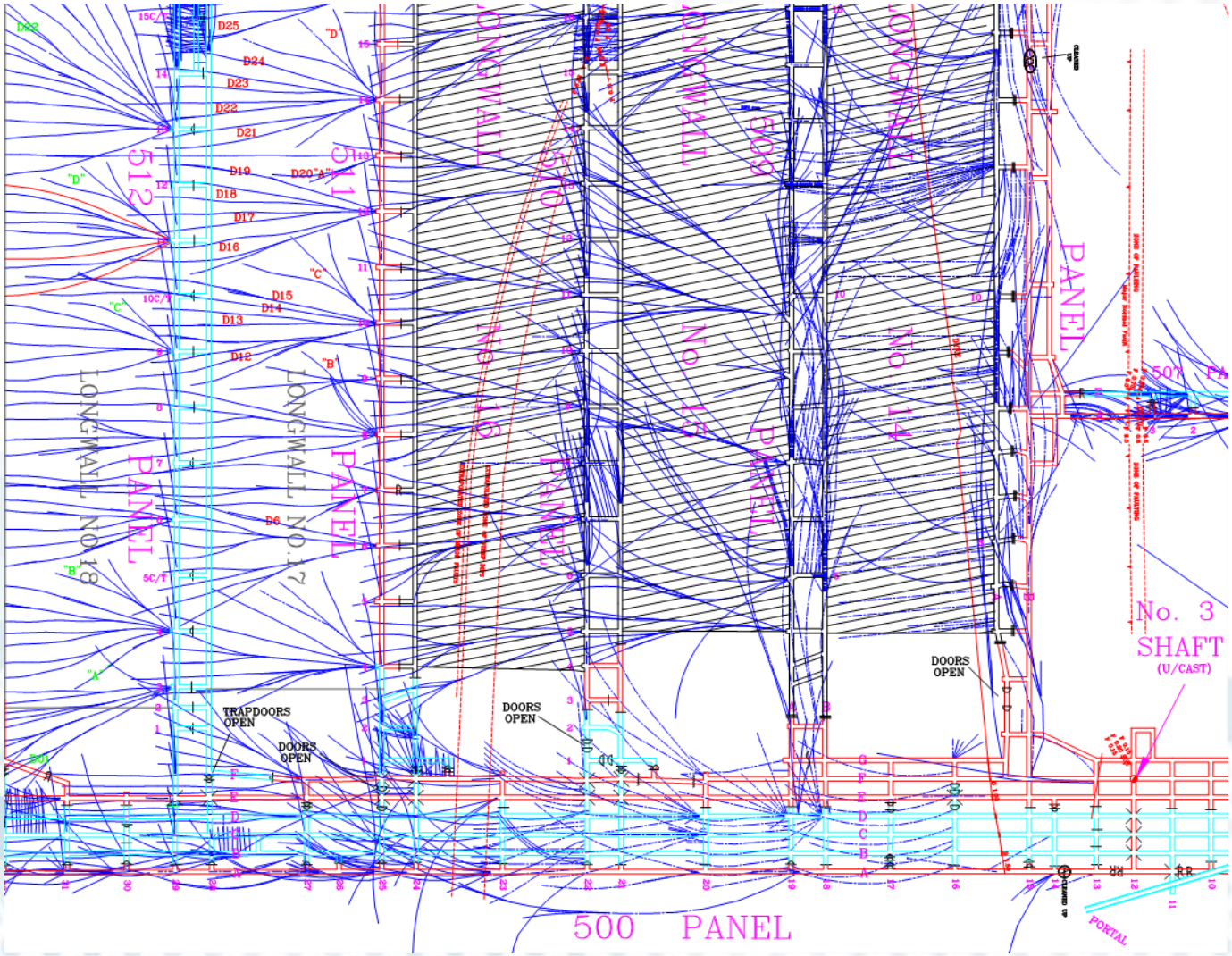
- Favoured approach provided:
  - Surface access is not a major issue.
  - Up front capital is available.
  - Utilisation of mine gas a consideration.
- Overlooked in circumstances such as:
  - 'Traditional' approach at site is UIS (e.g. South Coast, NSW).
  - Major issues with surface access.
  - Preference is to delay capital expenditure and treat gas management as an operational issue.
  - Low gas contents.
  - Short term perspective.

UIS in Australia

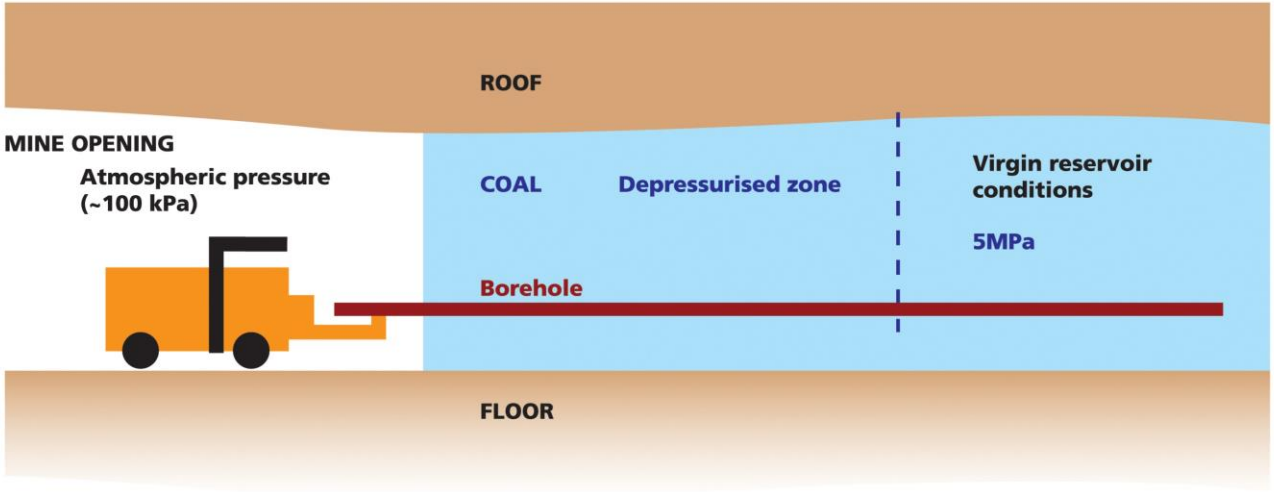
- At its worst, it is reactive and subject to crisis management.
- Huge amounts of redundancy due to bad practice / lack of time.
- A multitude of sins hidden by poor operator.

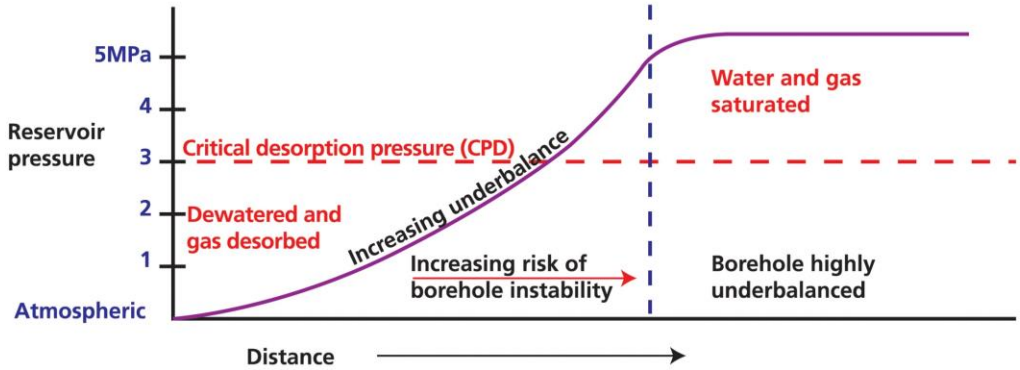


Here you can see the development of order …



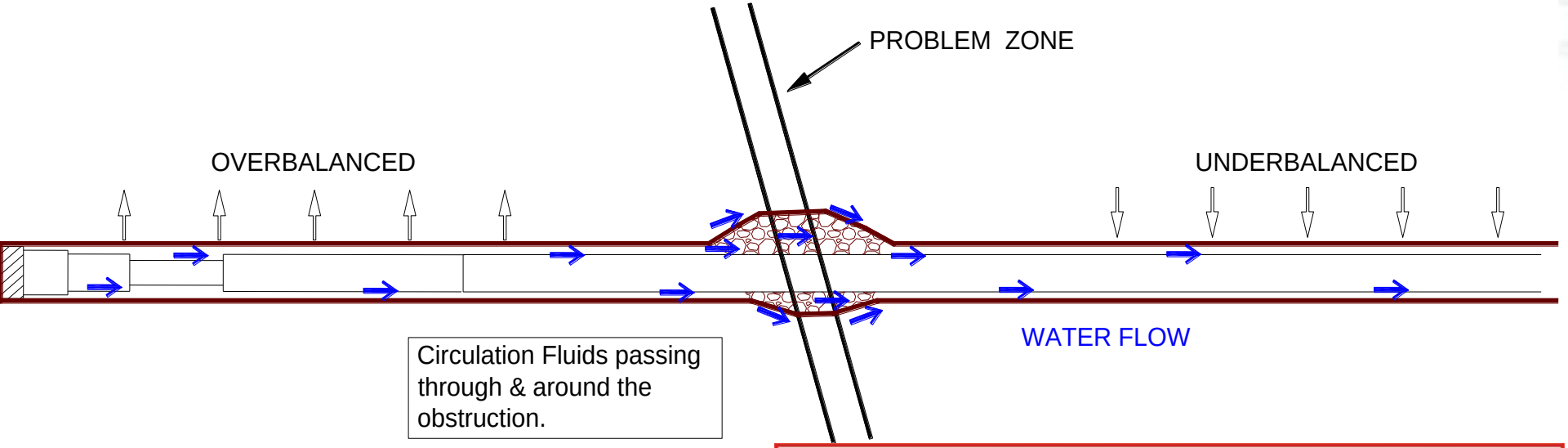
Limitation to UIS



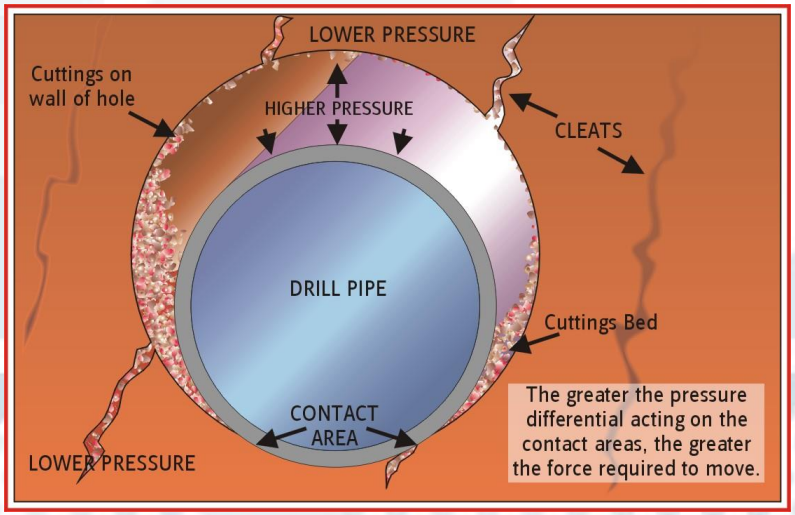


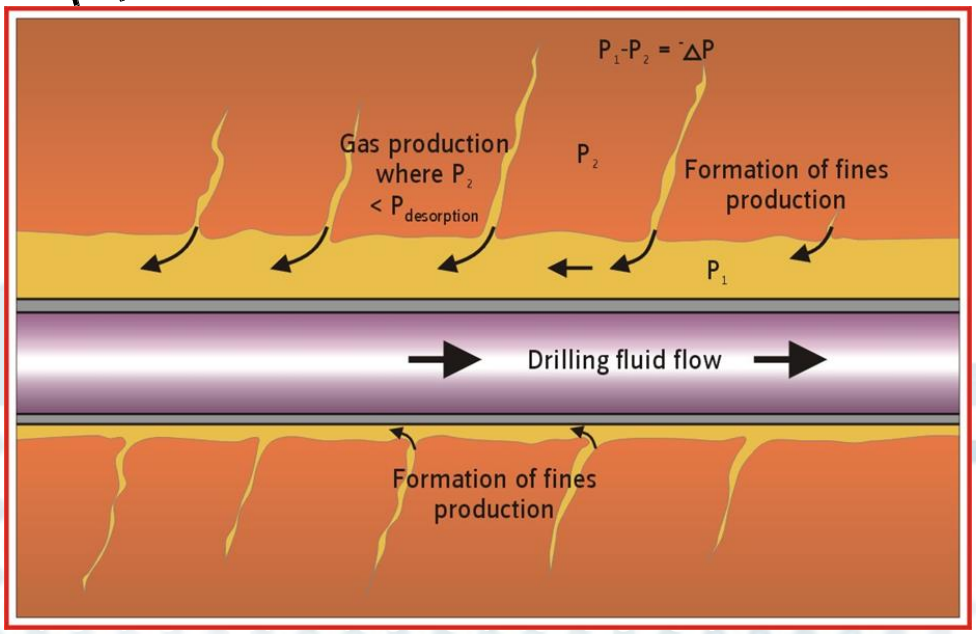
CoalBedEnergyConsultants ©

CoalBedEnergyConsultants



Circulation Fluids passing through & around the obstruction.





Where we are at presently

- Technical success factors for CBM & CMM do not currently overlap much, some of the problems (i.e. low perm) do.
- SIS and UIS are complementary drilling techniques that assist gas management in Australia.
- CBM technology (mainly drilling) and expertise (reservoir modelling, completion understanding) have assisted the improvement of knowledge in CMM.
- Some way to go however due to entrenched operational systems.
- Both CBM & CMM (ultimately) face the same technical hurdles, in particular low permeability with depth.
- Pressure is on to improve coal mine gas utilisation, and on-site generation like to be the norm moving forward.
- Questions ???