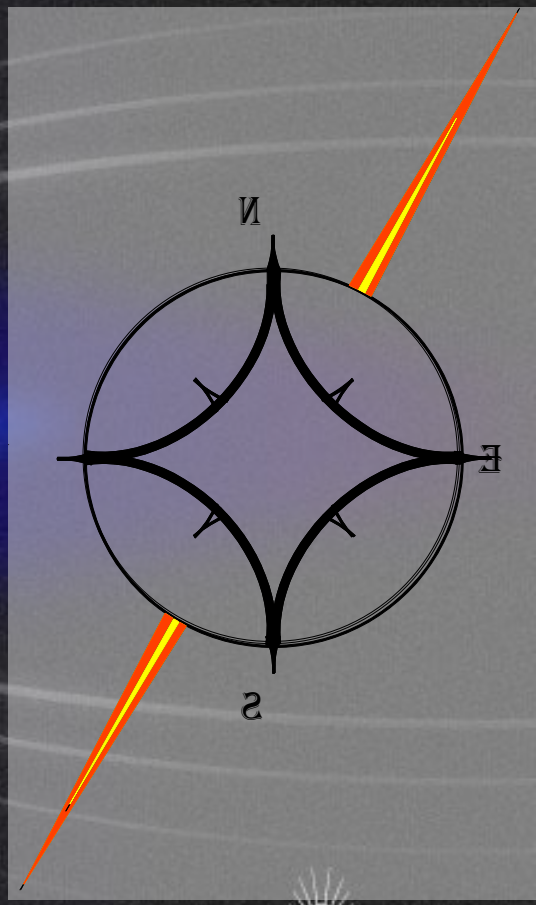
Coalbed Methane Extraction in the Sydney Basin



Gas and Coal Outburst Seminar

November 20, 2002

SYDNEY GAS COMPANY

Presentation Outline

- Sydney Gas Company
- What is CBM?
- Exploration Process
- Understanding the Rock Mechanics/Stress profiles
- Fracturing Process
- Conclusion

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- Public company listed on the Australian Stock Exchange
- 5,800 shareholders
  - 45% live in New South Wales
  - 25% of NSW shareholders live the south west of Sydney
- Aims to become a leading Australian gas producer through development of Coal Bed Methane (CBM) from the Sydney Basin

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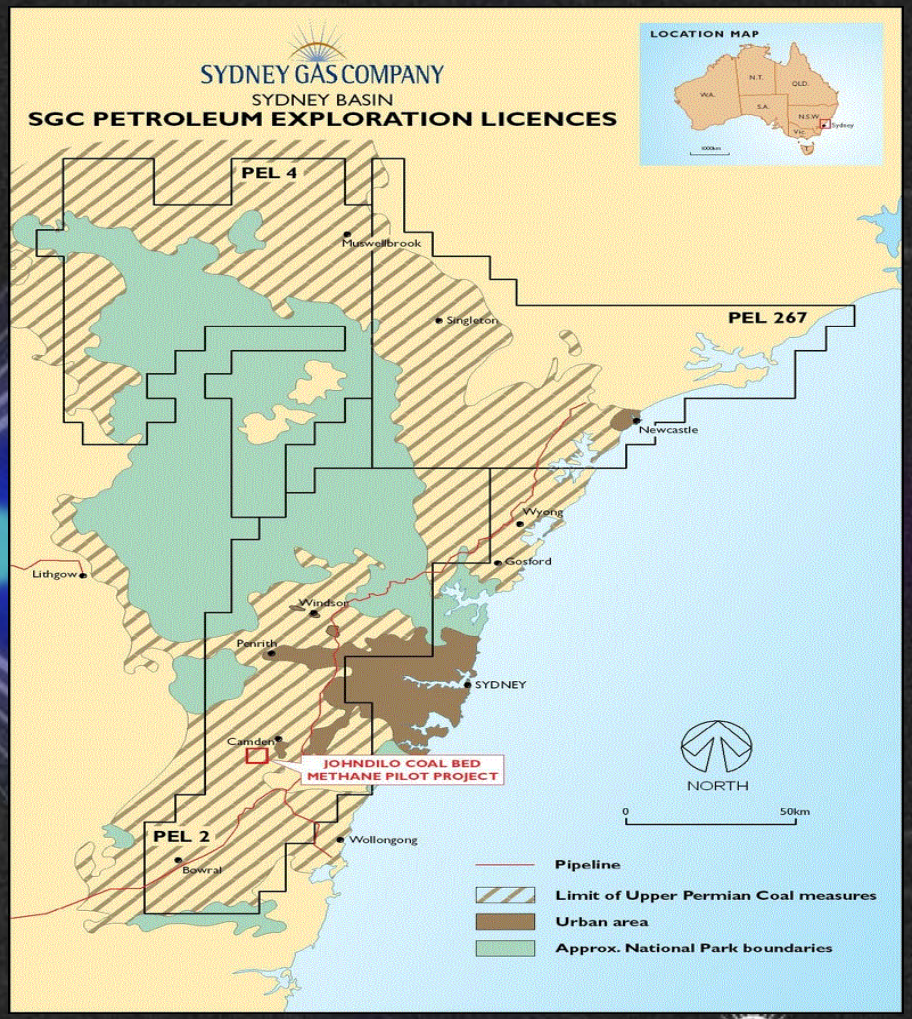
SGC's PROJECT

- **Sydney Gas Company owns controlling interests in PELs 2 (100%), 4 (100%) and 267 (82.5%) in the Sydney Basin**
- **90% of the entire Basin area, exceeding two million hectares, enveloping the entire Sydney gas market**
- **Focused primarily on the Camden Gas Project. Stage 2 development has commenced with 10 new wells to drilled by Christmas, 40 wells by June**



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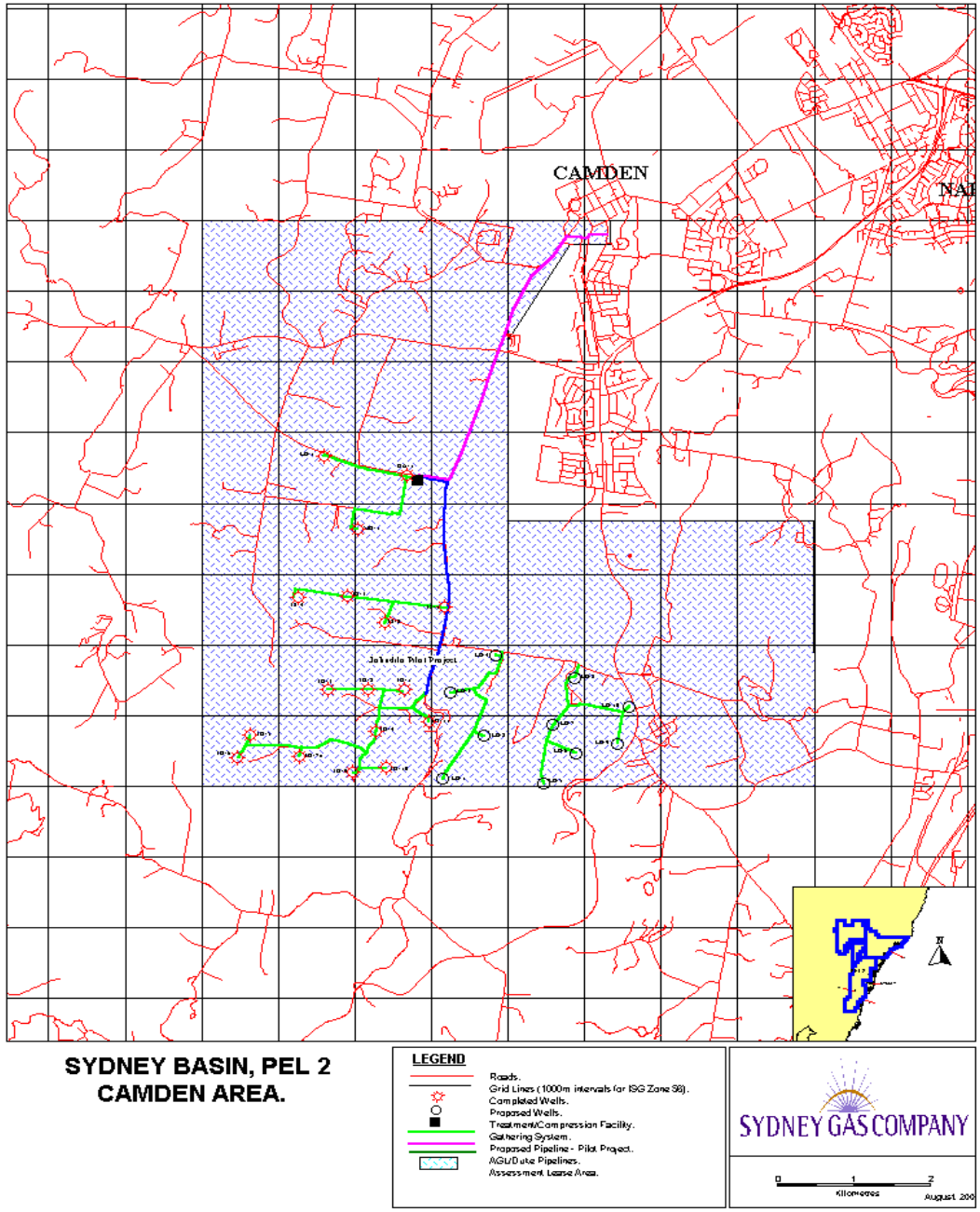
Camden Pilot Project



WHAT IS COAL BED METHANE?

- **Coal Bed Methane (CBM) is a clean burning natural gas generated during the coal forming process**
- **For the mining industry it can be a pain in the backside that introduces safety, environmental and cost issues**
- **For a gas producer it is a clean viable energy source, typically a resource with technical challenges but is becoming a new growth industry not only in Australia, but many other countries.**
- **14% of all gas now consumed in the US is derived from CBM –2000PJ/year**
- **Total gas Consumption NSW 120 PJ**

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EXPLORATION PROCESS

- Define geological production fairway – critical process as this can make or break a CBM producer, use existing available data – DRM, core holes, multiphase testing etc
- Define well spacing, minimize interference while maximizing recoverable reserves
- Drilling technology that is geared for the shallow gas market, cost is critical
- Run casing program that allows access to multiple seams and can withstand high fracturing pressures
- Fracturing Issues

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Cleats and fractures developed in Bulli Seam, Wandinong #1

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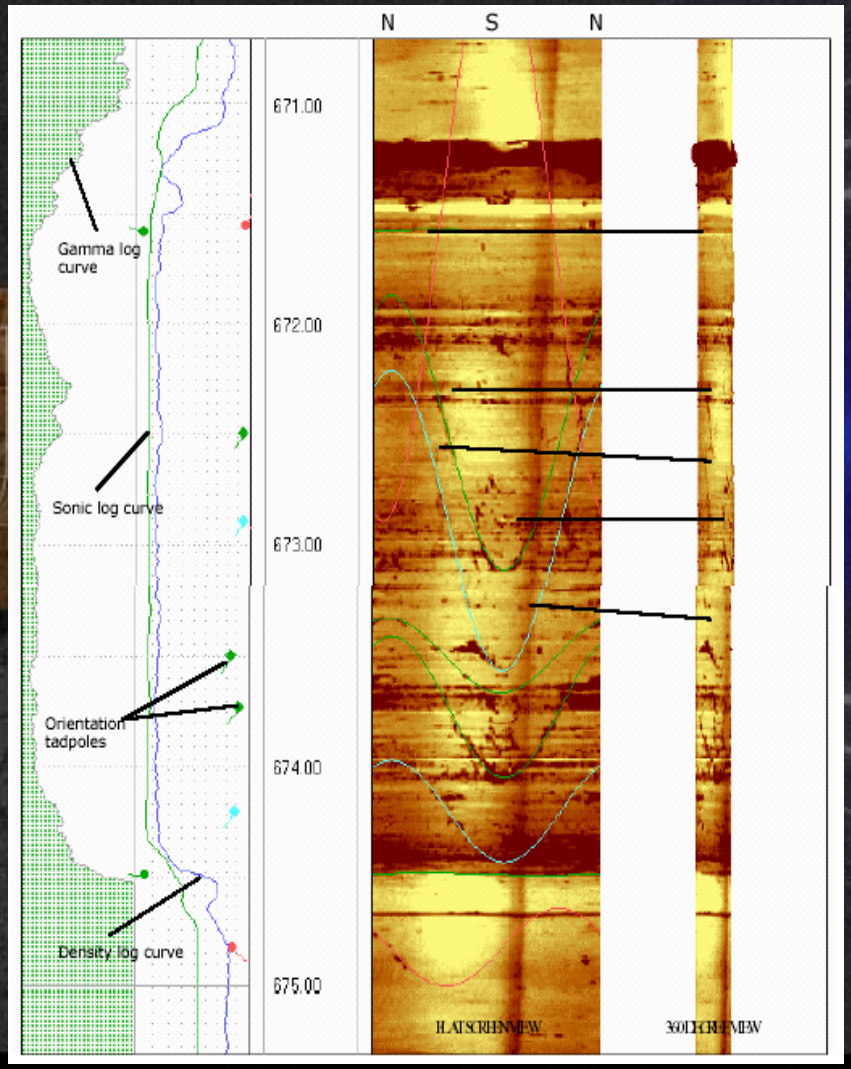
Acoustic scanner image of the Bulli Seam shows the flat screen and 360^0 wrapped view from Kay Park #1 well



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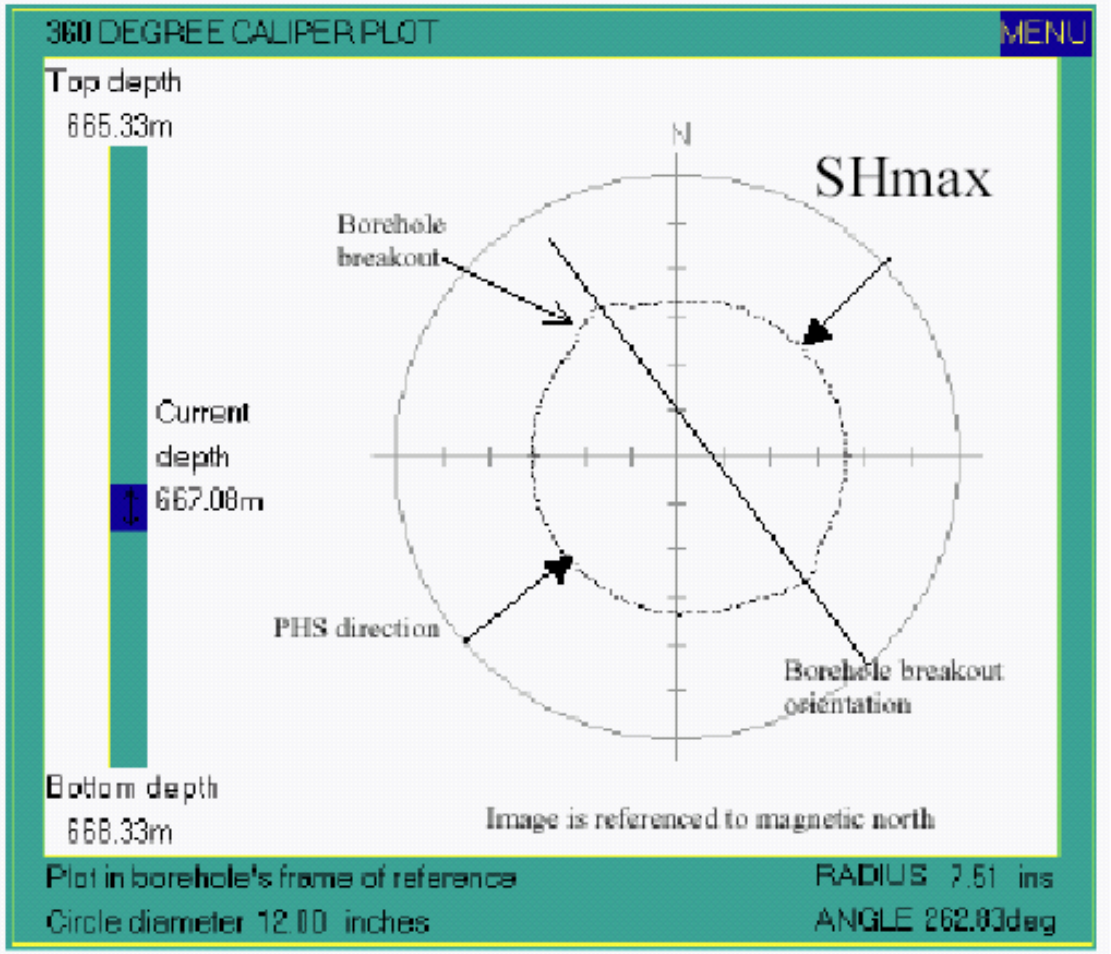
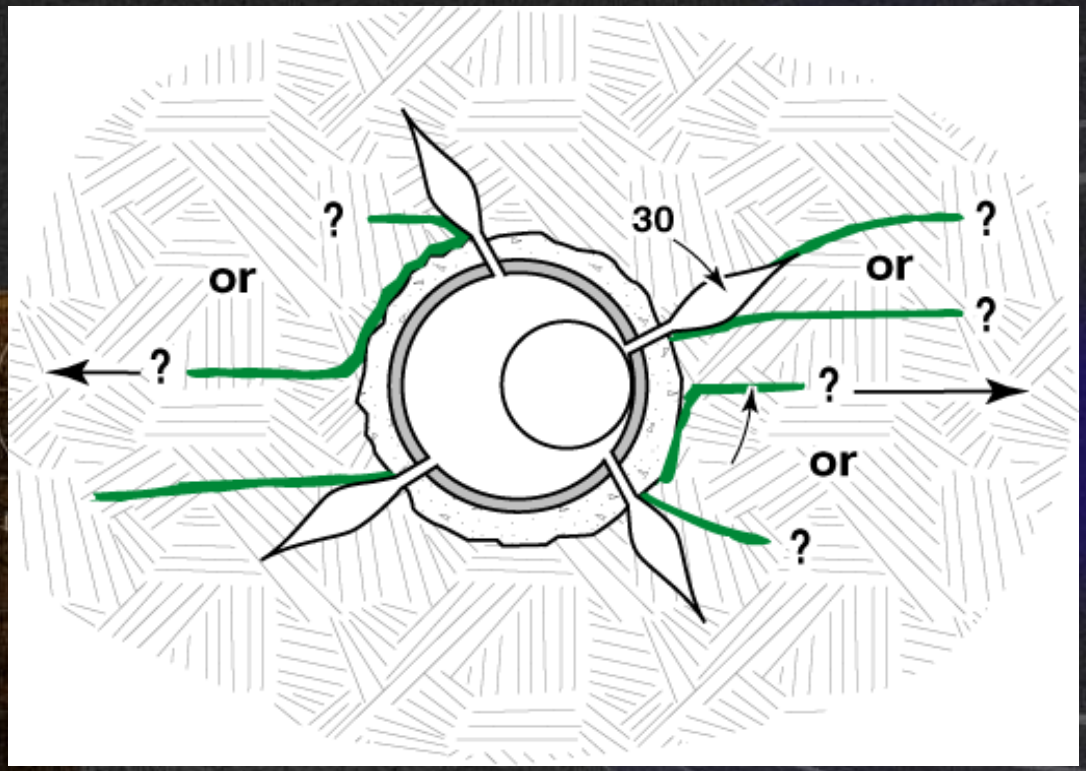
Logan Brae-5

Logan Brae-5 was drilled with air/foam/oil. Exact MW is not known.



Hydraulic Fracture Initiation



"Effect of Perforations on Fracture Initiation" SPE 20661

"Theoretical Model and Numerical Investigation of Near-Wellbore Effects in Hydraulic Fracturing" SPE 30506

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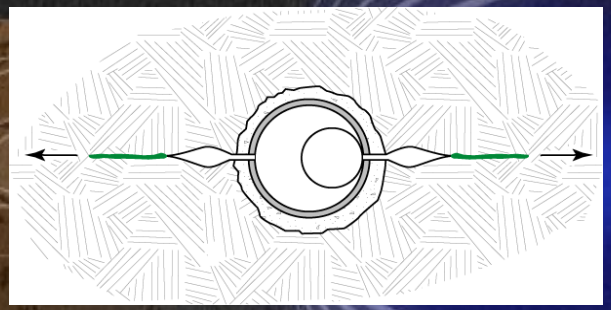
Hydraulic Fracture Improvement

- Orient the perforations in the direction of the maximum horizontal stress



- Create a single, bi-wing fracture in the Preferred Fracture Plane (PFP)
- Reduce near-wellbore complexities (tortuosity)
  - multiple, competing fractures
  - microannulus effects (pinch points)

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Coal Seam Fracture Stimulation

- Main purpose of hydraulic fracture treatment is to connect the wellbore with the the cleat system
- A highly conductive fracture must be created under in-situ conditions to minimize bottomhole producing pressure and effectively dewater the coal
- Due to complexities when fracturing coals, the Engineer must be prepared to make changes on the fly
  - complex fracturing as a result of stresses, shear slippage, coal fines, poroelastic effects
- Optimization of fracture treatments should focus on costs
  - observe trends
  - fluids/proppants
  - remove near wellbore tortuosity to lower treating pressures

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Fracturing Process

- Coalseam is perforated or slotted, API casing rated to 5000 psi with good cement behind casing
- Start pumping down casing, observe formation break, Increase rate – Pad fluid
- Pump at 8000 to 8700 litres/min. Pressure range 3000 to 4500 psi (21000kpa – 31000kpa)
- Start the addition of frac sand (API 16/40mesh)at concentrations between 60 to 140 kg/m3.
- Amount of frac sand – typically 10T/m of pay
- When using water as the carrying fluid, may have to perform the job in 2 to 4 stages with flush treatments
- Shut Down monitor pressure – initiate flow back through choke

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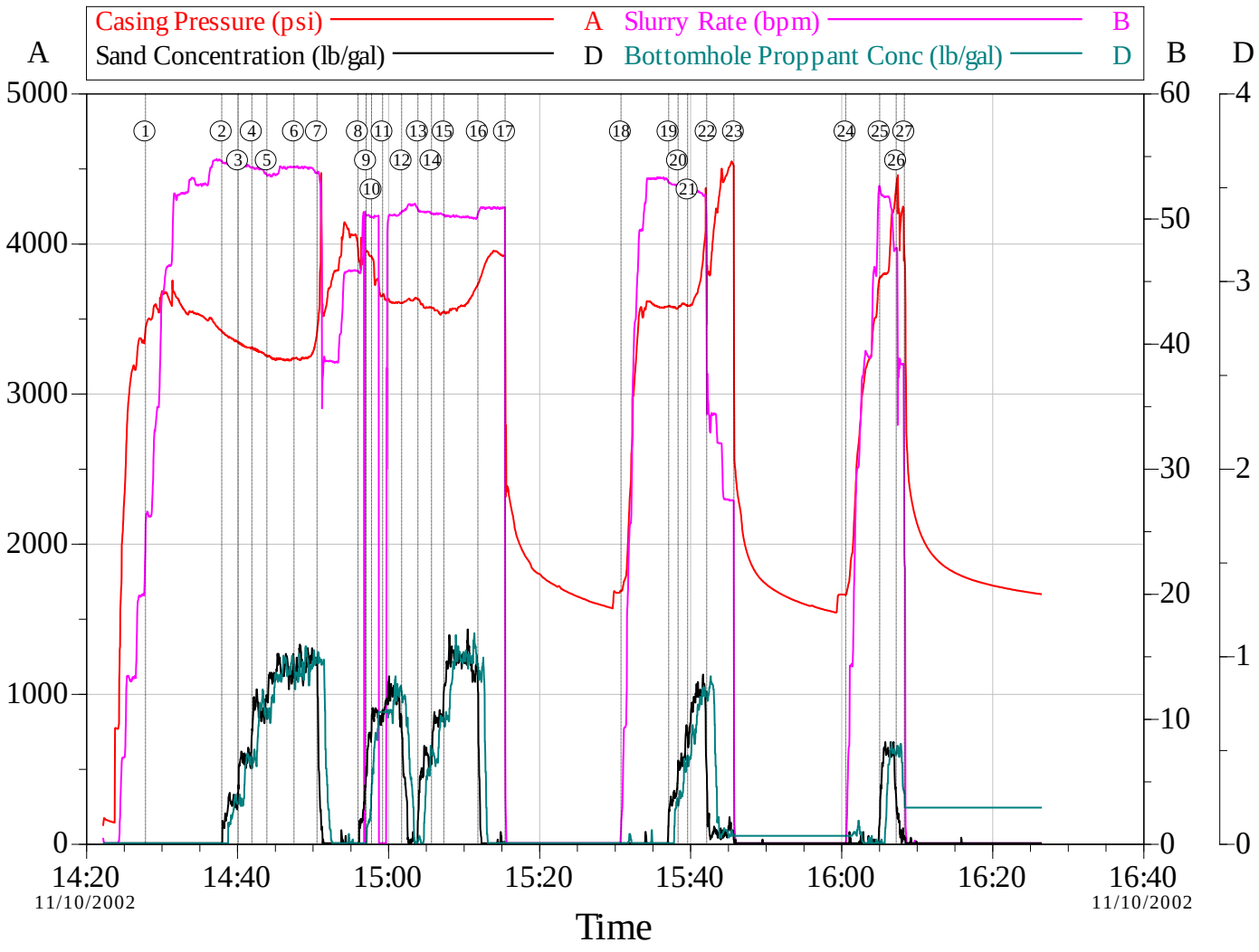
Kay Park 1 - Sydney Gas

Bulli Coal Seam - Water Frac



Stages

1	Start Pad	14:27:57
2	Start Sand @ 0.25 ppg	14:38:03
3	Increase Sand to 0.5 ppg	14:40:13
4	Increase Sand to 0.75 ppg	14:42:02
5	Increase Sand to 0.9 ppg	14:44:01
6	Increase Sand to 1 ppg	14:47:37
7	Sweep	14:50:41
8	Start Sand @ 0.25 ppg	14:56:05
9	Increase Sand to 0.5 ppg	14:57:10
10	Increase Sand to 0.75 ppg	14:57:53
11	Increase Sand to 0.85 ppg	14:59:21
12	Sweep	15:01:52
13	Start Sand @ 0.5 ppg	15:04:02
14	Increase Sand to 0.75 ppg	15:05:50
15	Increase Sand to 1 ppg	15:07:27
16	Sweep	15:11:58
17	Stop, Flow Back	15:15:34
18	Start Pumping	15:30:55
19	Start Sand @ 0.3 ppg	15:37:14
20	Increase Sand to 0.5 ppg	15:38:29
21	Increase Sand to 0.75 ppg	15:39:45
22	Sweep	15:42:16
23	Stop, Flow Back	15:45:53
24	Start Pumping	16:00:41
25	Start Sand @ 0.5 ppg	16:05:11
26	Flush	16:07:21
27	Stop, Monitor Decline	16:08:26

Customer:	Job Date:	Ticket #:
Well Description:	UWI:	

HALLIBURTON

TG Version G3.2.1
11-Oct-02 17:03

Potential Fracturing Problems

- Tortuosity caused by fracture reorientation
- Pinch points and micro annulus
- Narrow fracture widths
- Early screen outs
- Higher pumping pressures
  - higher HHP charges ($)
- Fracture job not optimized

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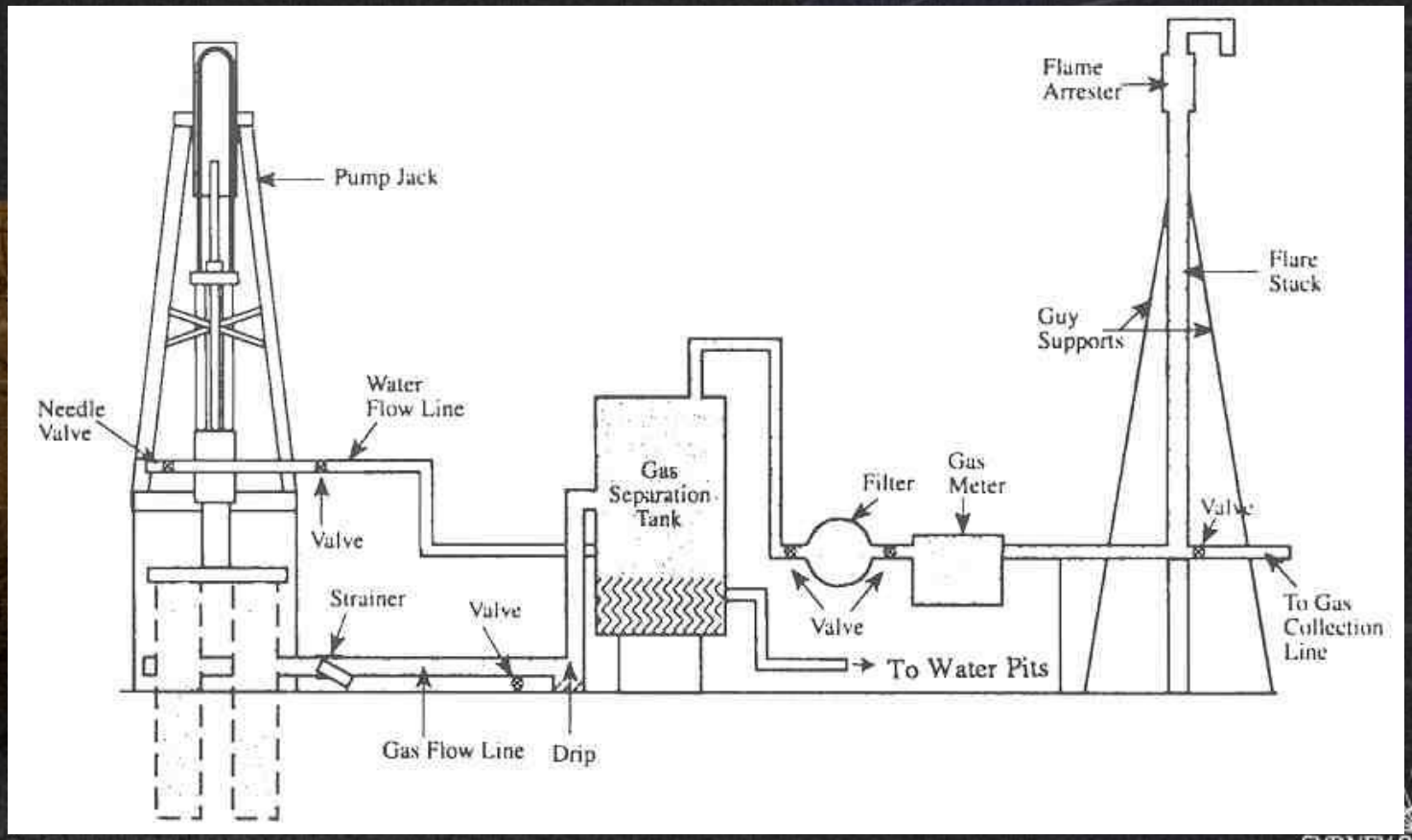
Production / Dewatering Well



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Conclusion

- Similar technologies used between the mining industry and the petroleum industry with different objectives
- A good understanding of the Geology, stress profiles,geophysical data, and gas/water compositions are required
- Most coal seams need to be stimulated in some way to enhance production: fracturing, inseam drilling, cavity completion
- CBM gas producer focuses on a production fairway with high permeability and will drill on tight spacing to deplete the resource

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