THE UNIVERSITY OF MELBOURNE

Melbourne Energy Institute

MEI*network*22
Seminar #1

Conventional and unconventional natural gas

Speaker: Mr Steve Henzell, *Advisian*

Moderator: Professor Michael Brear, *Melbourne Energy Institute*

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MEI*network*22 Seminar Series

Seminar topic	Month
Conventional and unconventional natural gas	May
Liquefied natural gas (LNG) and export	June
Gas markets and gas retailing	July
Natural gas and hydrogen transmission and distribution	August
Green hydrogen as an alternative to natural gas	September
Blue hydrogen as an alternative to natural gas	October
Options for hydrogen export	November

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Conventional and Unconventional Gas

In the context of the Australian industry

- Town gas
- Natural gas (conventional gas)
- Coal seam gas
- Shale gas and tight gas

Town Gas

Town Gas

Town gas is manufactured by gasification of coal, oil or wood

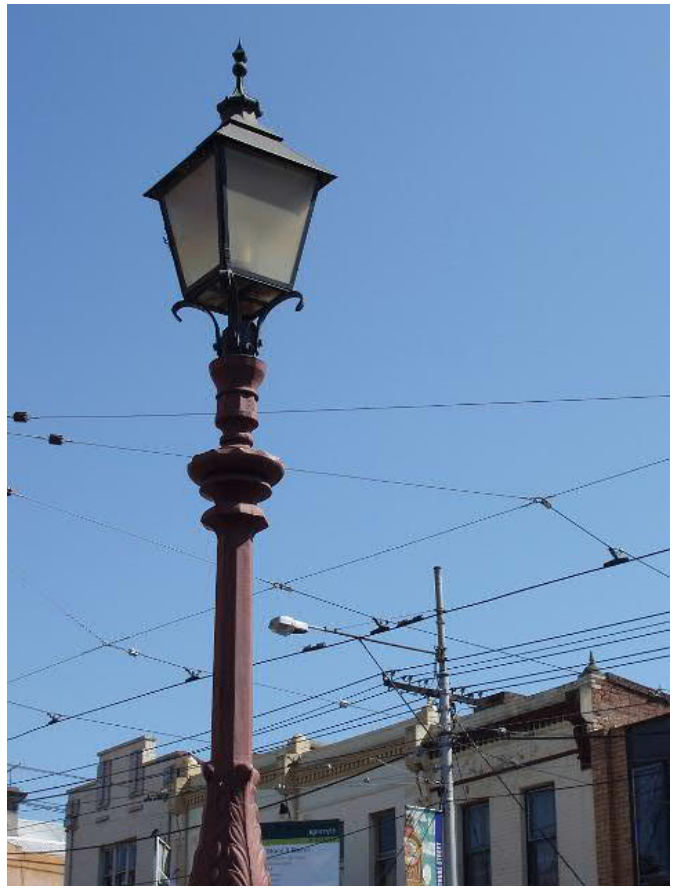
- Replaced animal based oils such as whale oil

Technology developed in Europe in the early 1800's, imported to Australia in the mid 1800's

- Coal crushed to a uniform size and fed into retorts
- Heated in the retorts where it was carbonised, giving off coal gas (town gas) and leaving coke at the bottom
- Mainly carbon monoxide, hydrogen, methane and ethylene
- The coal gas underwent further purifying processes including sulphide and ammonia removal

Town gas was initially used for street lighting

- Reticulated from a central storage tank



Port Melbourne Gas Works

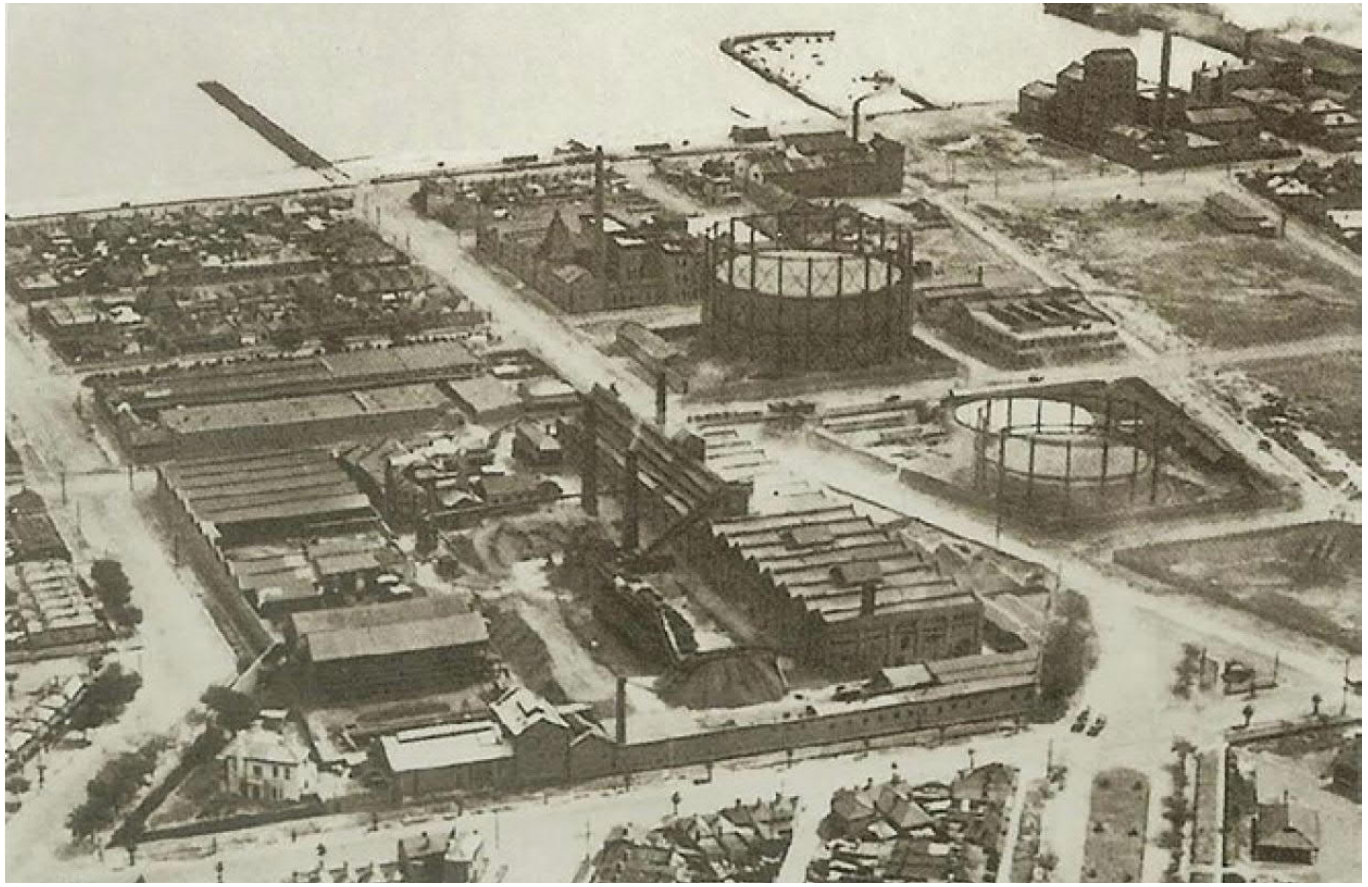
Coal was shipped from Newcastle to Port Melbourne and hauled by horse and dray to the gas works

Gas works operated continuously

Gas was stored in gasometers

The company was allowed to supply gas anywhere within an 8-mile (13-kilometre) radius of Princes Bridge

Initially for street lighting, but used by homes and industry



https://gasworks.org.au/about-us/history

Advisian Worley Group Industry Consolidation

Australian Gas Light was formed in 1837 to provide town gas to Sydney

Many other companies were formed as Australian cities developed

Many small gas works were needed initially because of distribution constraints

But the gas works were progressively amalgamated, as technology allowed gas to be transported over longer distances

Gas & Fuel Corp Victoria

In 1950, the Victorian Government formed the Gas and Fuel Corporation of Victoria to take over the manufacture and supply of town gas

The corporation opened the Lurgi Gasification Plant in Morwell in 1956, fuelled by brown coal in the Latrobe Valley

High pressure gas pipeline from Morwell to Dandenong and then into gas distribution networks through Melbourne

Morwell Historical Society

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Conventional versus unconventional gas

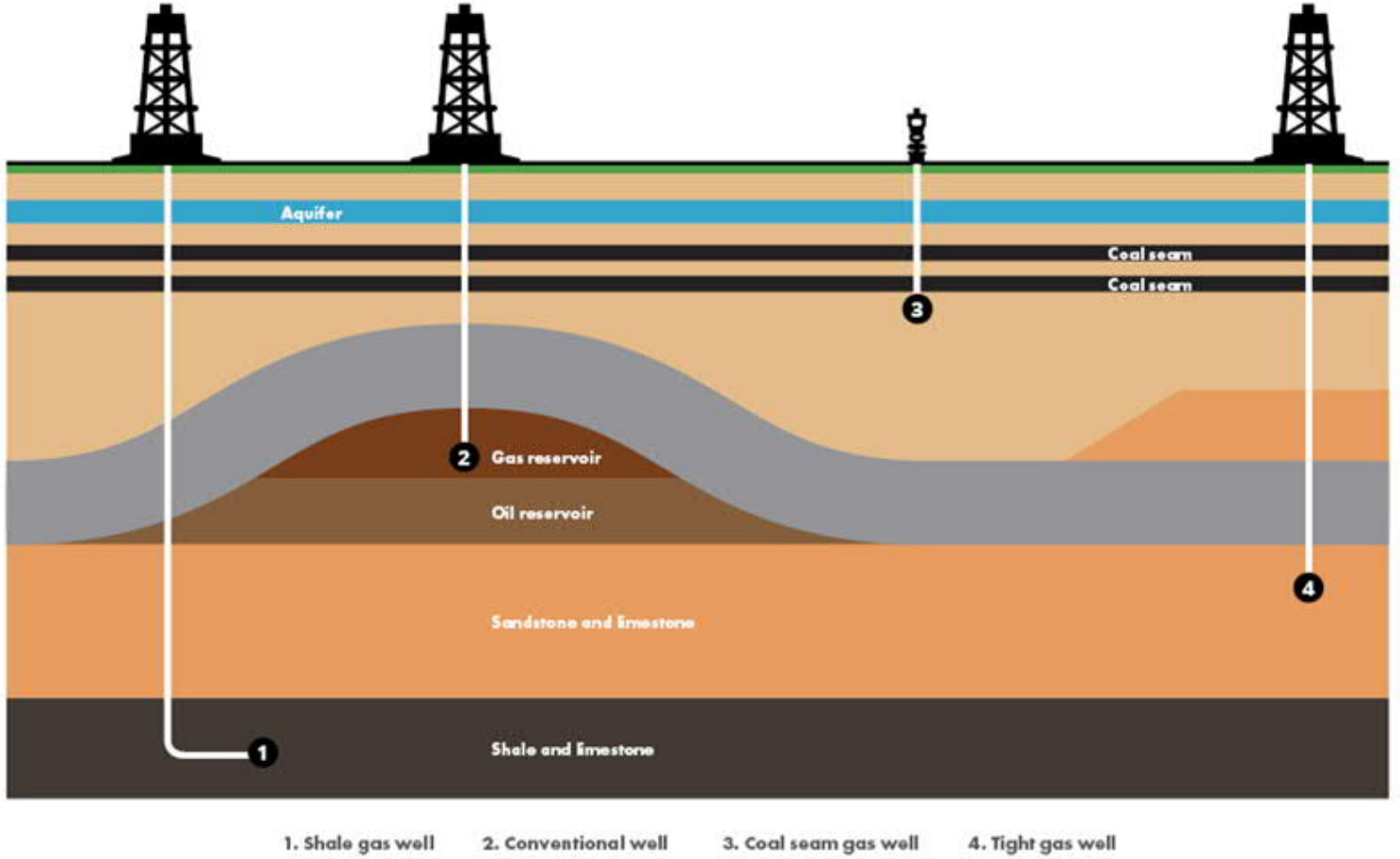
Advisian Worley Group Conventional vs Unconventional

Conventional ②:

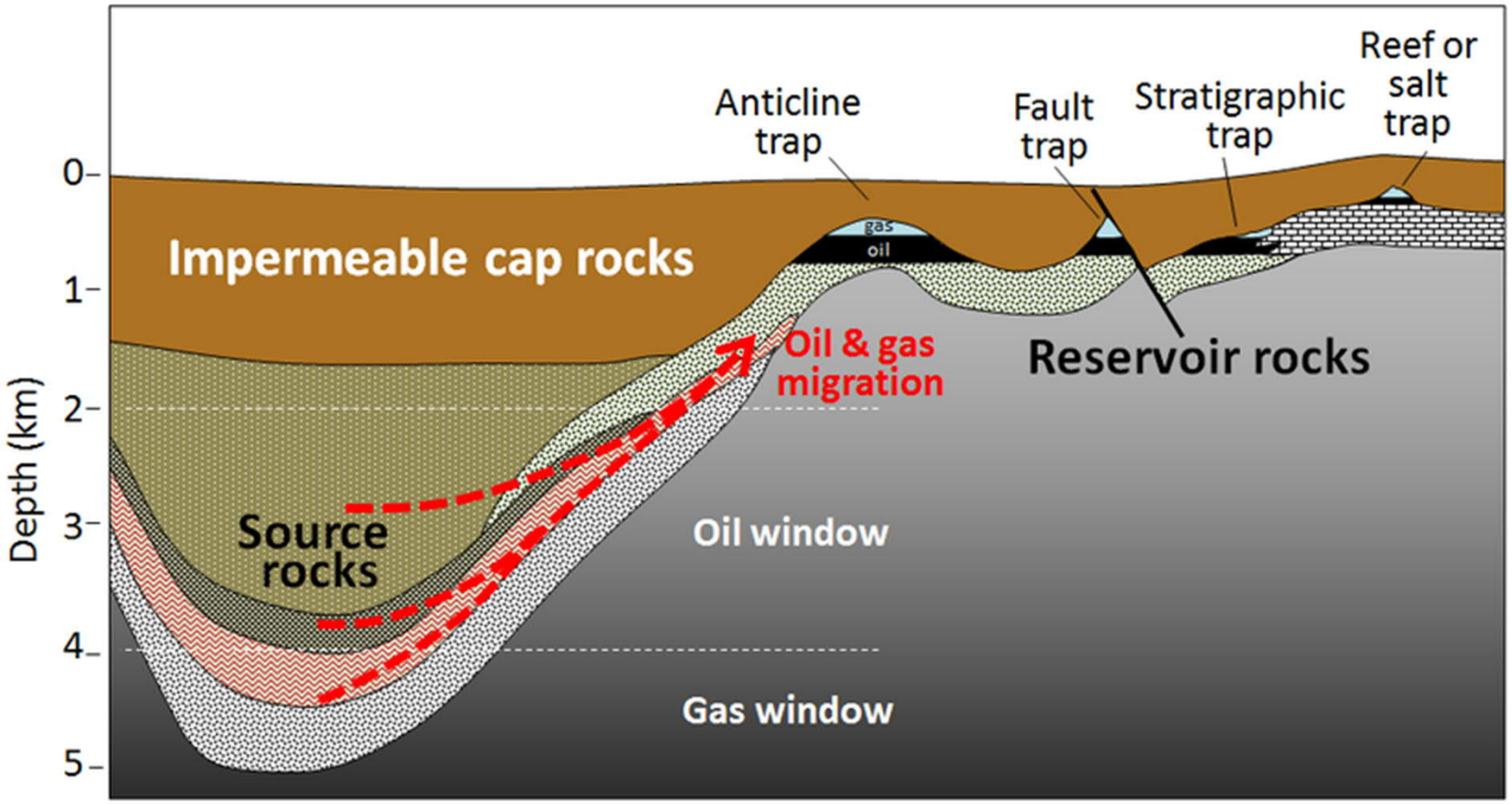
- Hydrocarbon vapour and liquid migrate from the source into a reservoir trap
- Permeable rock overlaid by an impermeable seal

Unconventional:

- Hydrocarbon vapour and liquid extracted from the source rock – no migration required
- Coal seam gas ③
- Shale gas ①
- Tight gas ④

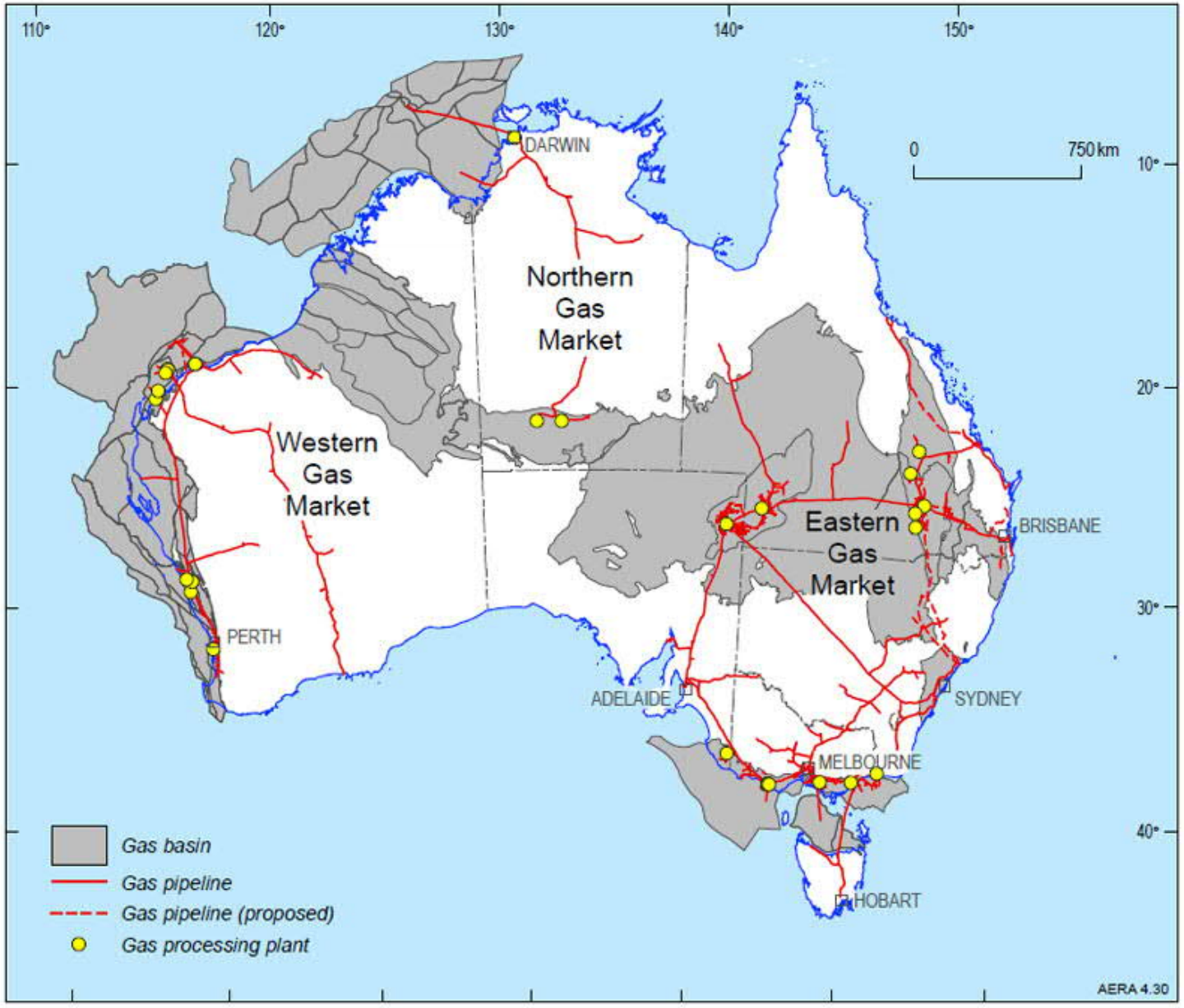


Conventional Natural Gas Reservoirs



Conventional Natural Gas

Sedimentary Basins in Australia



Geoscience Australia

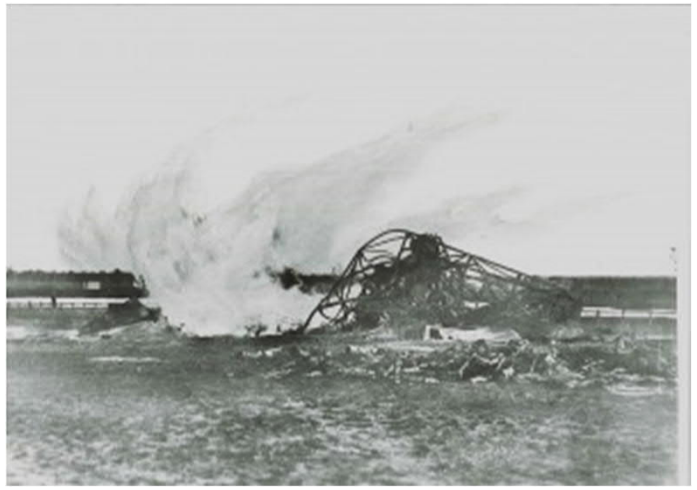
Advisian Worley Group Hospital Hill - Roma

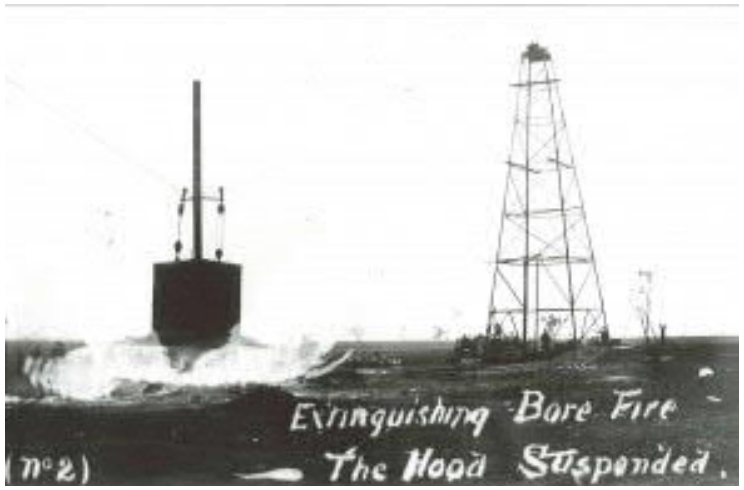
A false start in 1910 at Roma

Gas found in water wells near town

“Skullduggery” at play

Gas supply to Roma Power Station in early 1960s





Source: Wikipedia, Hospital Hill Fire

Advisian Worley Group 1960s

The initial hunt was for oil

The 1960s saw gas discoveries throughout Australia

- Roma in Queensland
- Gidgealpa and Moomba in South Australia
- Barracouta and Marlin in Victoria (offshore in Bass Strait)
- Dongara in Western Australia

Delhi camp manager Norm Dixon at Gidgealpa-2, site of SA's first hydrocarbon discovery. February 1964

(Sandy Jay collection)

Source: Blue Flames, Black Gold, The Story of Santos

Victoria's Gas Industry

Victoria's Sedimentary Basins

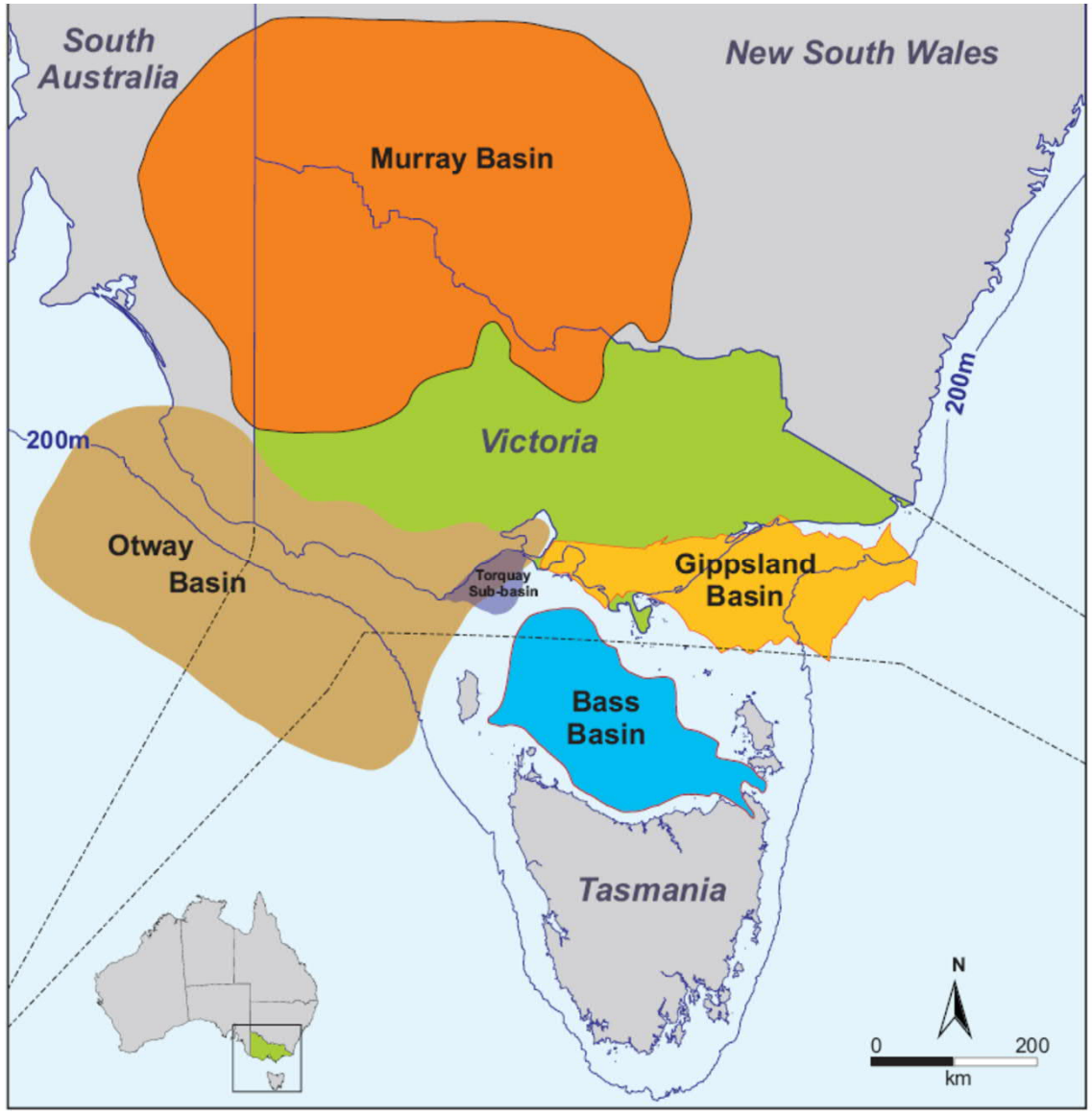
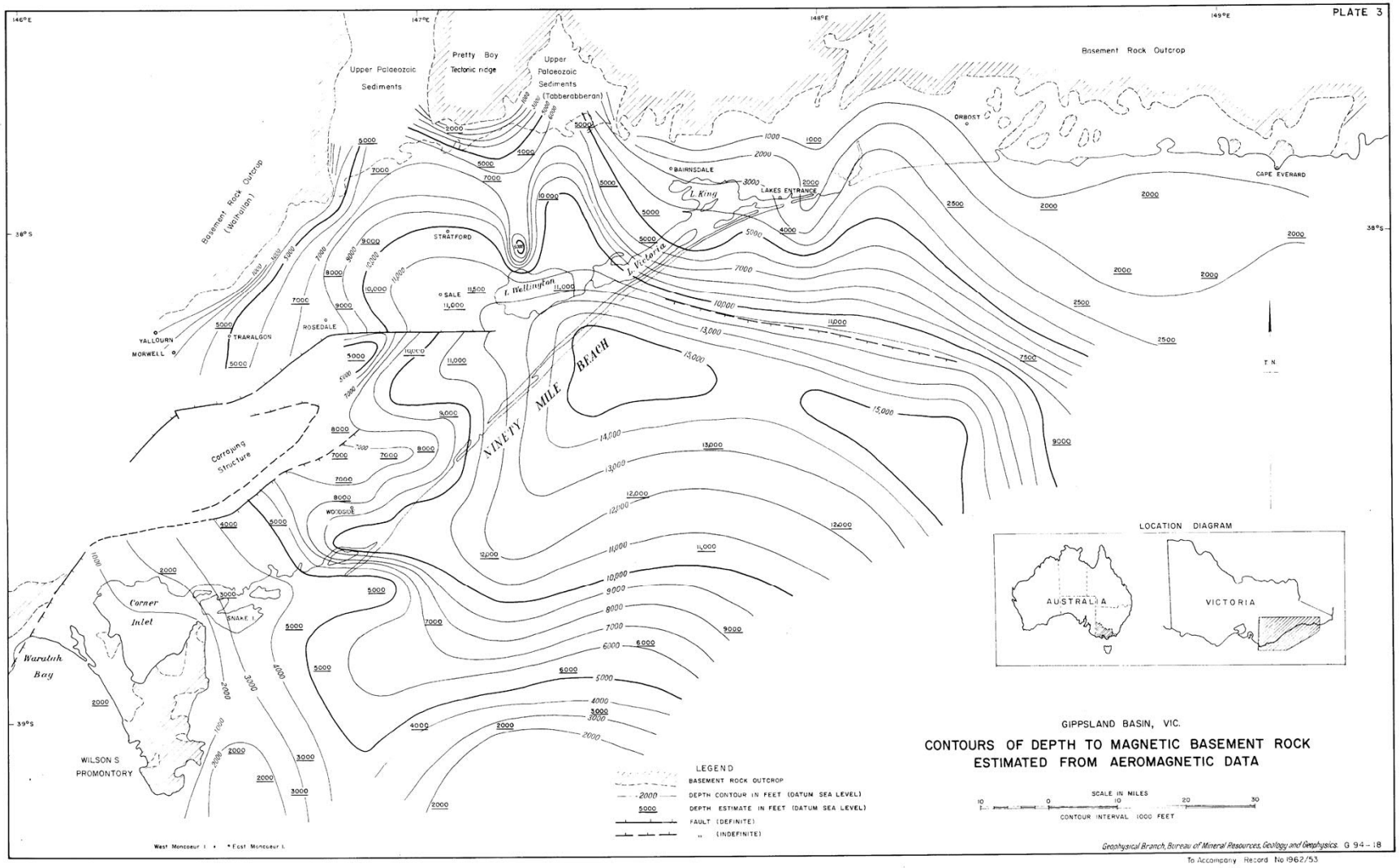


Image
Department of Primary Industries

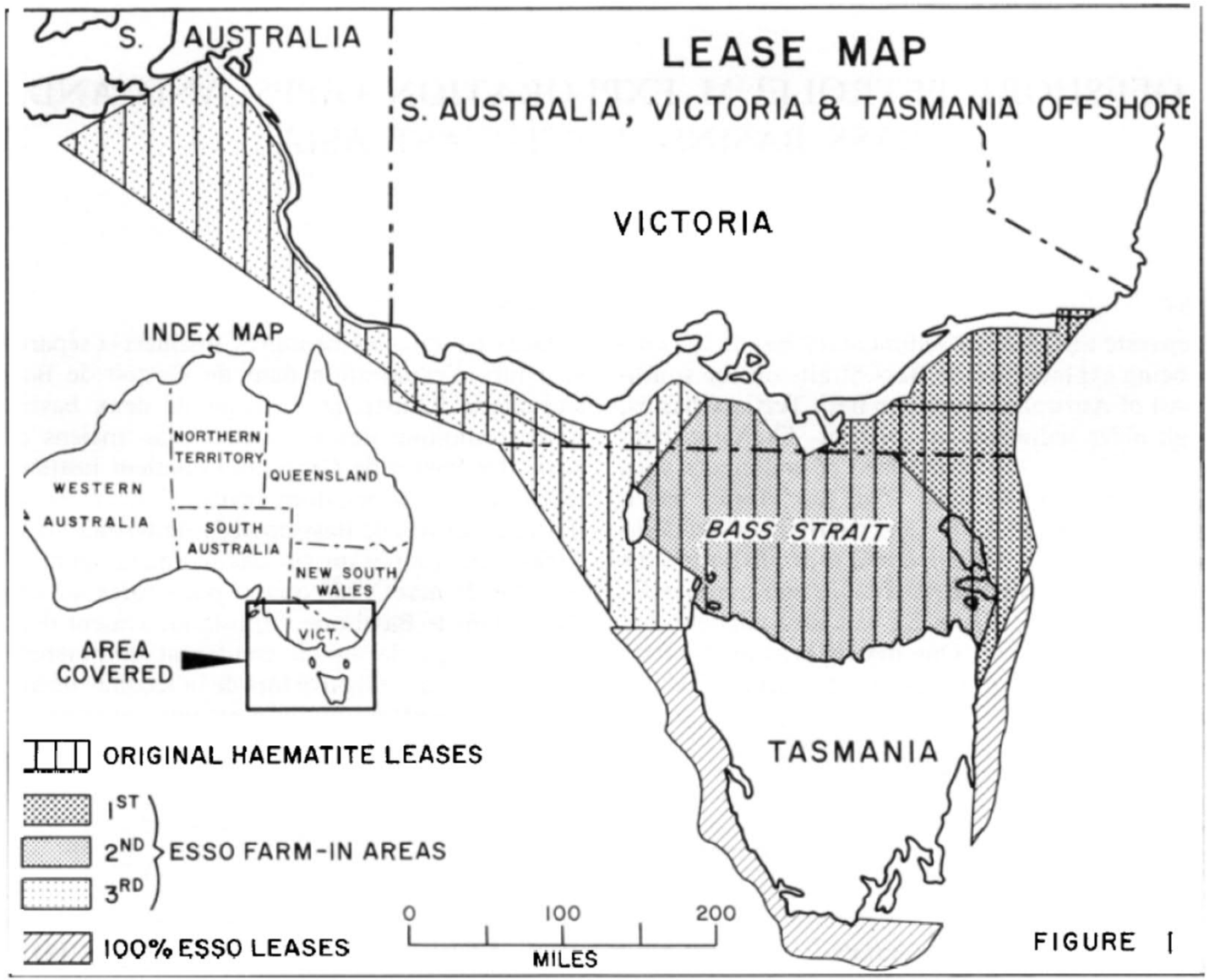
1956 Aeromagnetic Survey

BHP led the charge in pursuing the hunt for oil and gas into the harsh Bass Strait waters once surveys showed the Latrobe valley sediment extended and thickened offshore



Source: Bureau of Mineral Resources, Geology and Geophysics Archives

BHP Leases



Source: Offshore Petroleum Exploration Gippsland and Bass Basins-Southeast Australia - WPC Conference Paper 1967

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1961

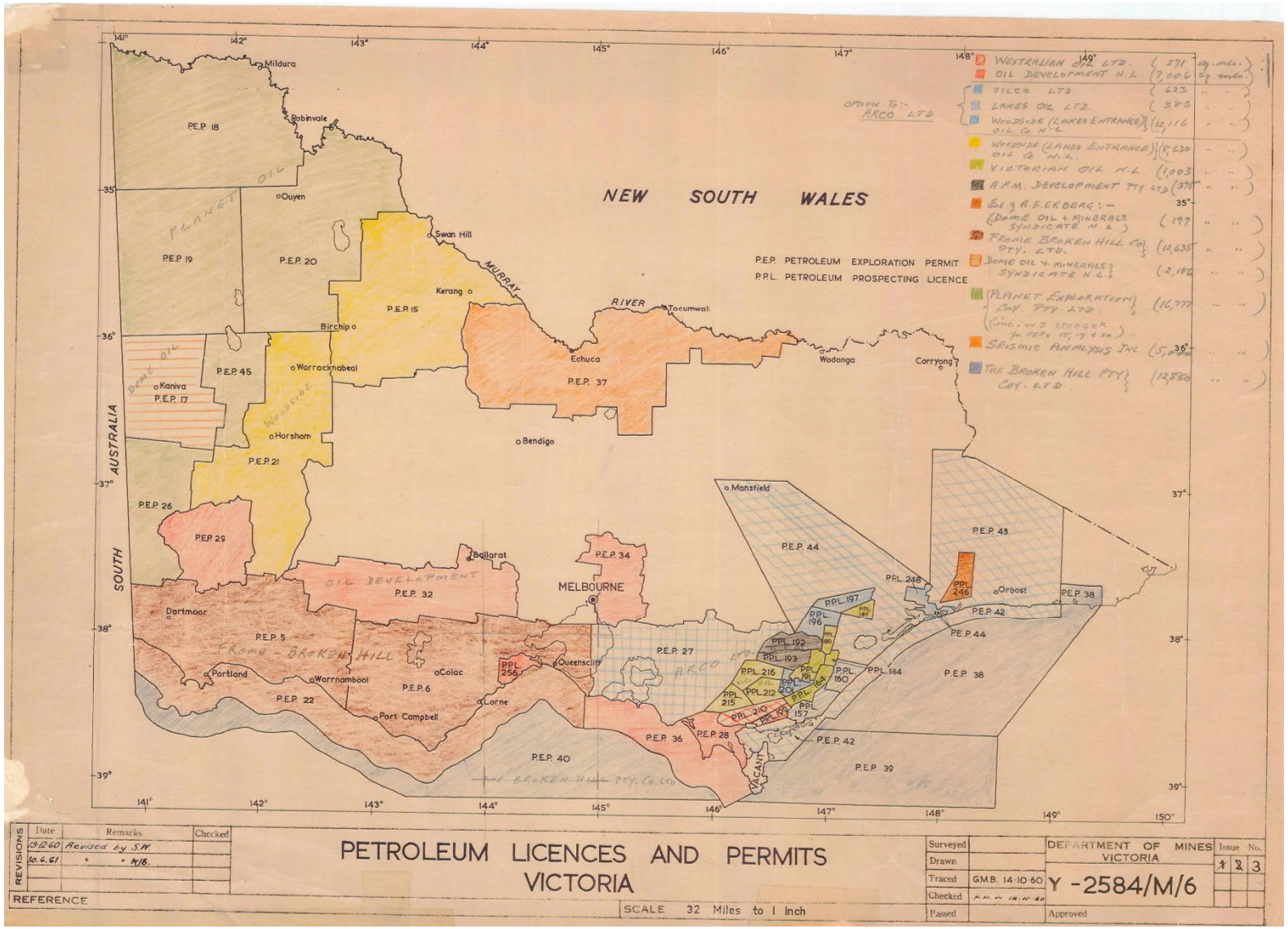


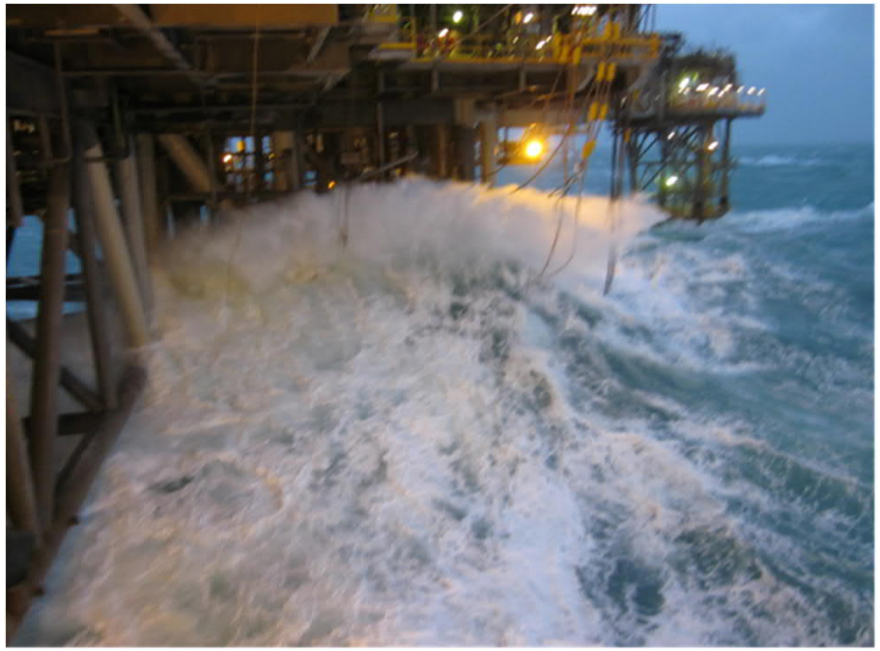
Image courtesy of Department of Primary Industries

Advisian Worley Group Offshore Gippsland Basin

Frontier territory in the early 1960s

- Water depths
- Storm magnitudes
- Offshore technology was still novel

The North Sea was still another 5 years away from commencing



Advisian Worley Group Glomar III

One of the first specialised self-propelled floating rigs

- 268 ft drilling vessel
- Its novelty lay in its 'moonpool'

70 day voyage from Houston to Port Welshpool under its own power

Photo courtesy of Esso and BHP Billiton

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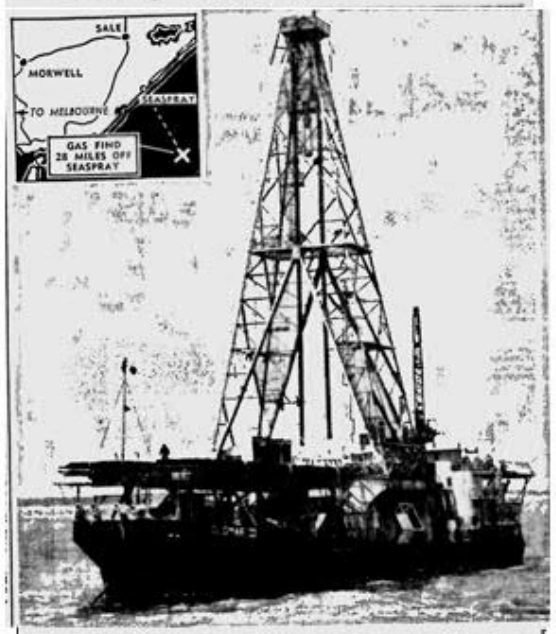
Success

The Age

No. 34,295 MELBOURNE, FRIDAY, APRIL 9, 1965 28 PAGES PRICE 4d. (AIR 6d.)

Big Gas Flow in Bass Strait; Hopes of Commercial Field



A STRONG natural gas flow which is expected to prove a commercial field has been discovered in Bass Strait, 28 miles off-shore from Seaspray, in Gippsland.

The discovery, announced last night, has been made in an Esso-B.H.P. well being drilled from the exploration ship Glomar III, pictured above the spot.

The well is only about 50 miles from the end of the Gas and Fuel Corporation's Morwell pipeline, which supplies Melbourne's gas. Gas from the well could be fed into this pipeline.

Esso Exploration, the operating company, last night reported a flow of three million cubic feet of gas a day from a three and a half hours test of the well.

The company described the gas as high quality, and said there were negligible impurities.

The indicated "wet" petroliferous gas would be ideally suited to mix with the present Lurgi plant gas manufactured at Morwell.

Interested

The chairman of the Gas and Fuel Corporation (Mr. A. E. Chadwick) said last night the corporation was hopeful of developments and had a very live interest in the discovery.

In shaping its expansion in recent years the corporation had in mind the possibility of using natural gas.

Last year, Mr. Chadwick said the corporation would take advantage of natural gas if adequate supplies became available and added that the prospect of discovering natural gas appeared very promising.

So far the drilling company has tested only one interval of the well.

The zone which produced the gas flow is about 500 feet above an interval where a strong gas "blow" was encountered in drilling during February.

This interval has not yet been tested.

The well is the first off-shore well to be drilled in Australia and the discovery comes at a time when the State and Federal Governments have been attempting to resolve who owns the rights to off-shore leases.

The joint Australian partner in the well is Broken Hill Proprietary Co. Ltd., Australia's largest public company and the only iron and steel producer.

Under an agreement, B.H.P. and Esso are carrying out a programme in an off-shore area covering almost 40,000 square miles of ocean extending across Bass Strait to Tasmania.

All other Australian discoveries of natural gas so far have been in relatively remote areas of Queensland, South Australia and Central Australia.

● Further details, page 8.

Advisian 1965

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Prime Minister Robert Menzies

National conscription starts for Vietnam war

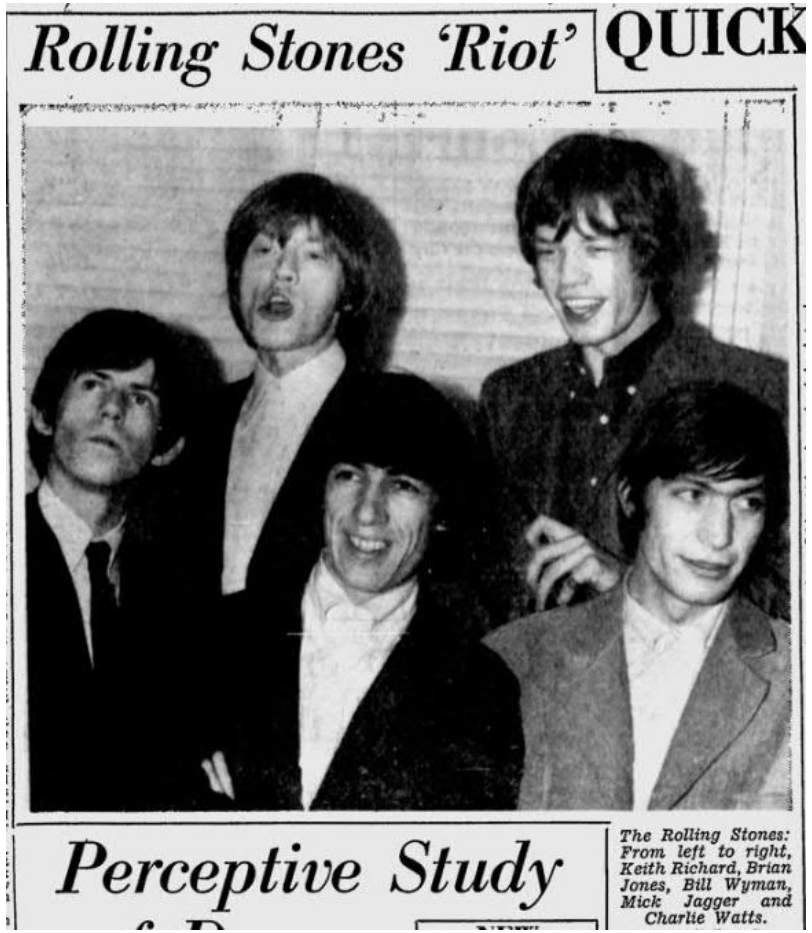
Rolling Stones tour Australia

Cosmonaut Aleksei Leonov the first person to walk in space

Main communications:

- Telex (electric typewriter that delivered typed messages along telegraph lines)
- Telegrams
- Letters
- Operator-connected national and international calls

Pounds, shillings and pence


Rolling Stones 'Riot' QUICK

The Rolling Stones: From left to right, Keith Richard, Brian Jones, Bill Wyman, Mick Jagger and Charlie Watts.

Perceptive Study

Advisian Worley Group Gas Developments

- First gas discovery 1965
- Gas development Letter of Intent 1967
  - Replace all town gas with natural gas
- First gas required in 2 years
  - Offshore platforms
  - Drilling
  - Pipelines
  - Gas plants
  - Export facilities
- Exclusive arrangement between gas producers and government
  - Gippsland Basin JV gas could only be sold to G&FC
  - G&FC would only buy gas from Gippsland Basin JV

Barracouta Ready for Transport

Photo courtesy of Esso and BHP Billiton

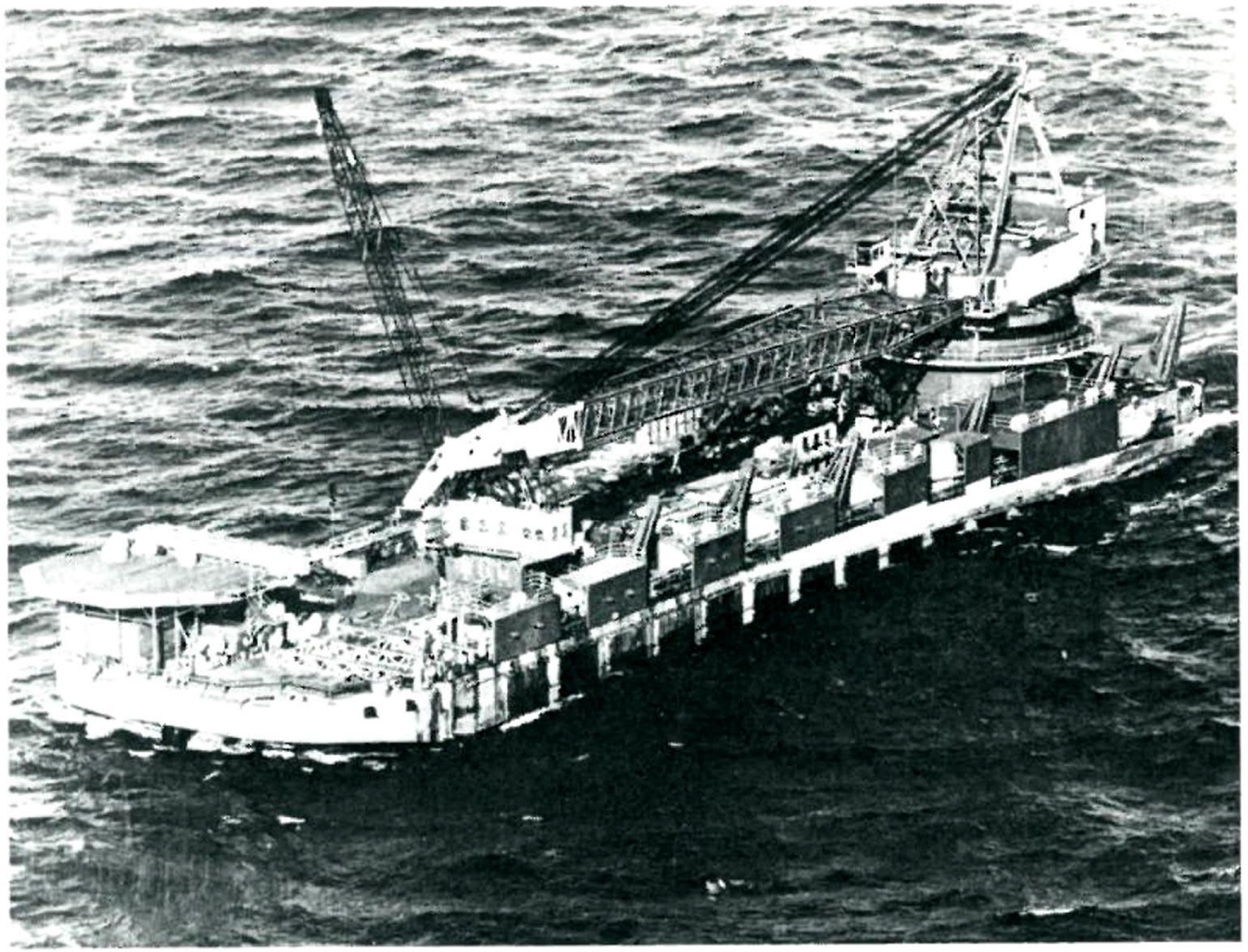
Barracouta Jacket Tow Out

Photo courtesy of Esso and BHP Billiton

Barracouta Topsides

Photo courtesy of Esso and BHP Billiton

State of the Art Crane Barges



Ingram's derrick barge No. 7 at work on early Bass Strait platform construction. The barge could lift 700 tonnes.

Source: A Thirst for Burning, Rick Wilkinson

Pipelaying Adjacent to Barracouta

Photo courtesy of Esso and BHP Billiton

Gas Plant 1 at Longford

Photo courtesy of Esso and BHP Billiton

Long Island Point Fractionation Plant

Photo courtesy of Esso and BHP Billiton

The Longford Explosion

Catalyst for Change

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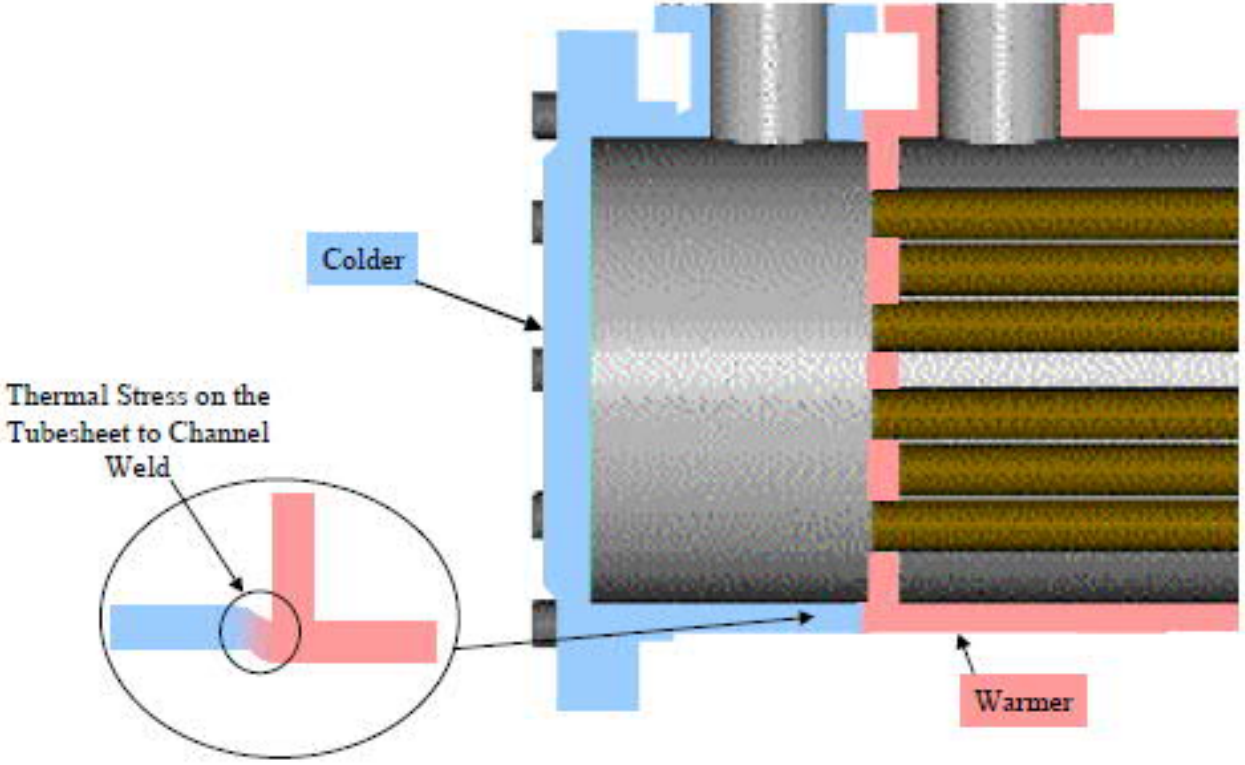
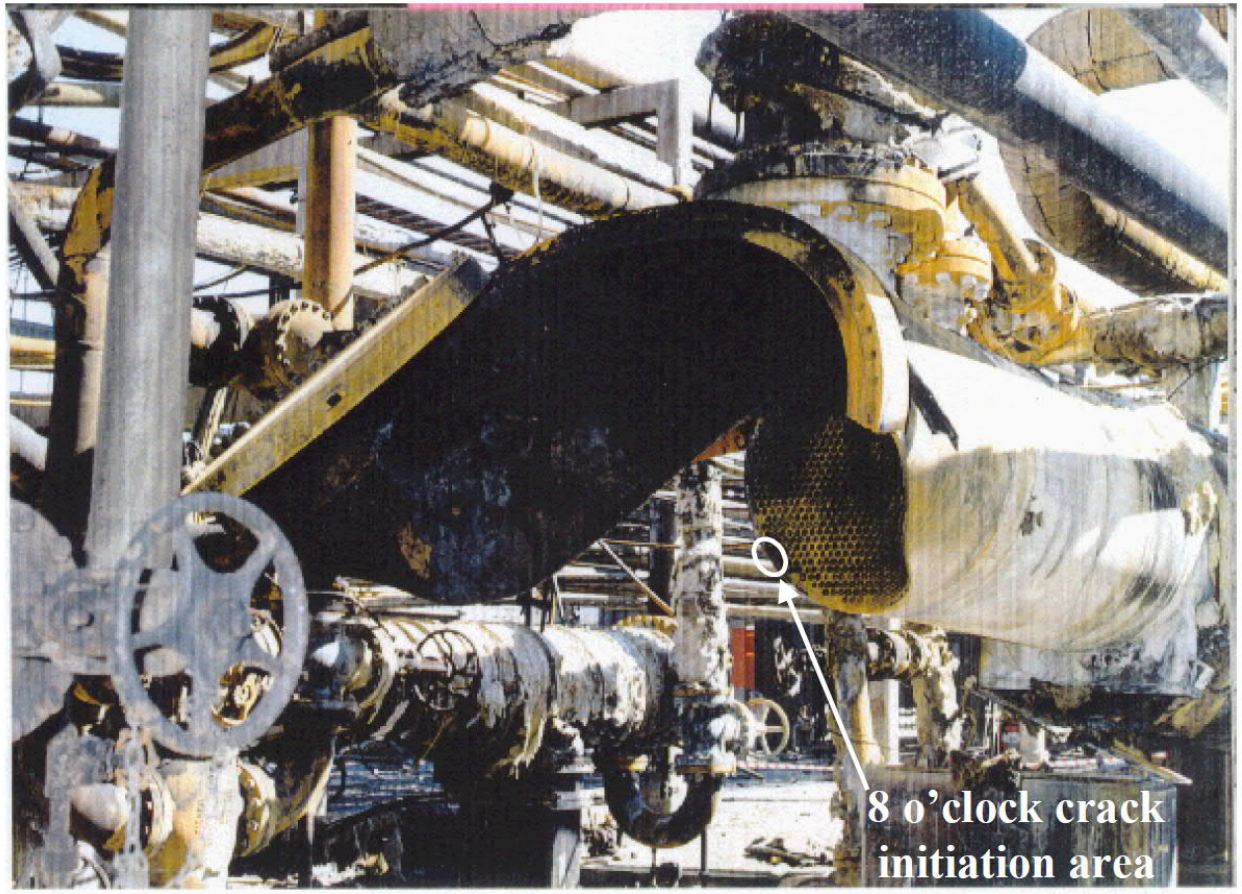
Fire in GP1, September 1998

Advisian Worley Group GP905 heat exchanger was thermally shocked





Source: Longford Royal Commission

Explosion and Subsequent Fires

Source: Longford Royal Commission

Advisian Worley Group Consequences

- 2 dead
- 8 injured
- No gas production for 9 days
- Full gas production restored after 19 days

Changes in the Industry

- Safety cases
- Control rooms brought out of the plants
- Retrospective HAZOPs
- Alarm rationalisation and management
- Improved training
- Improved operating procedures

And changes in the Australian gas market

Start of a National Gas Grid

Advisian Worley Group Restore Gas Production to Victoria

Longford

- Allow gas production from Gas Plant 2 and Gas Plant 3
- Expand GP2 and GP3 production for winter 1999
- Restore gas production from GP1

Import gas from New South Wales (ending the original exclusive agreement)

- Pipeline
- Compressor stations

Alternate gas supplies in Victoria

- Otway gas fields

Advisian Pipeline Expansion

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Advisian Worley Group Iona Gas Storage Facility

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QSN Pipeline

Advisian Gas Trading

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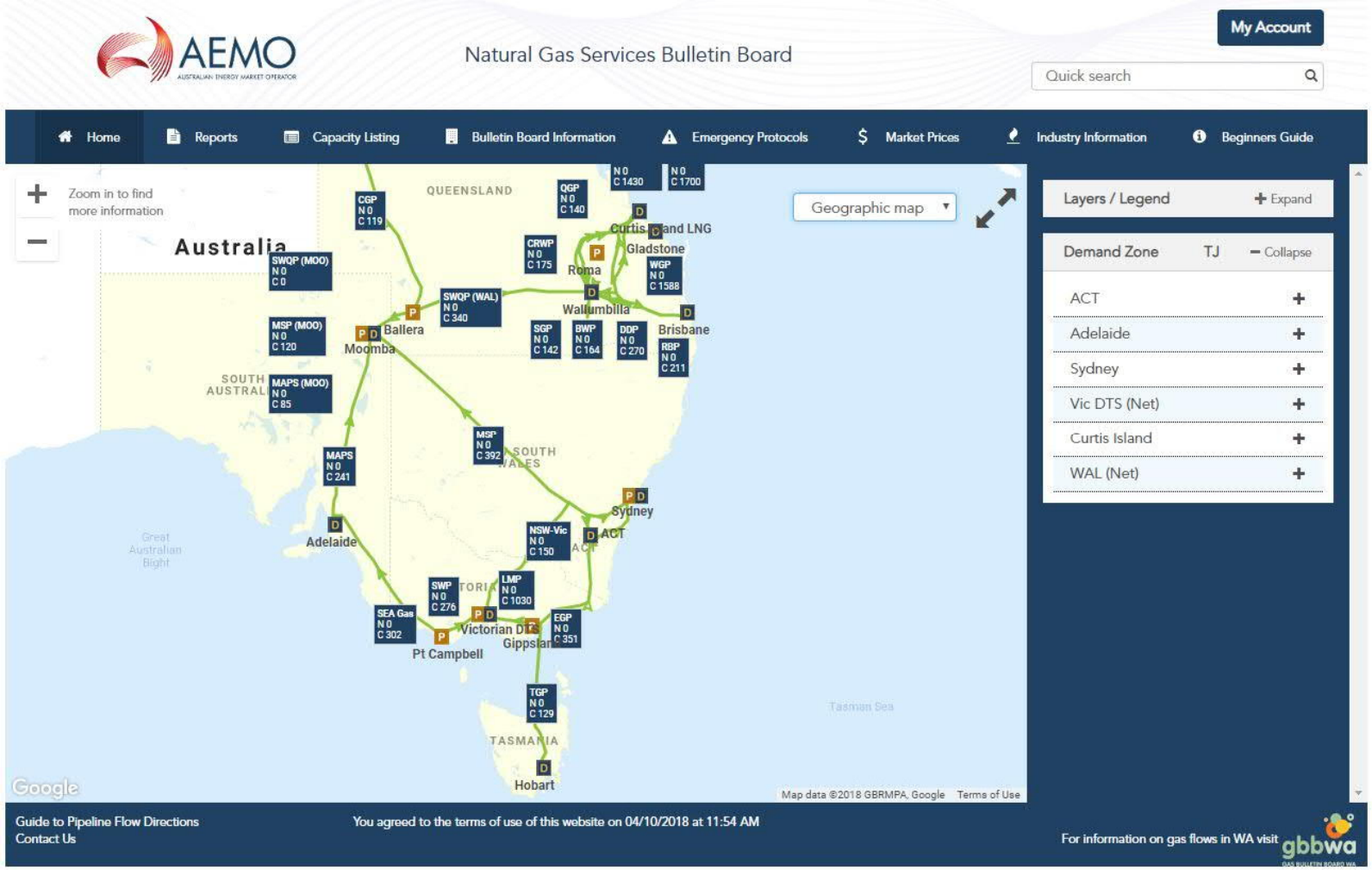
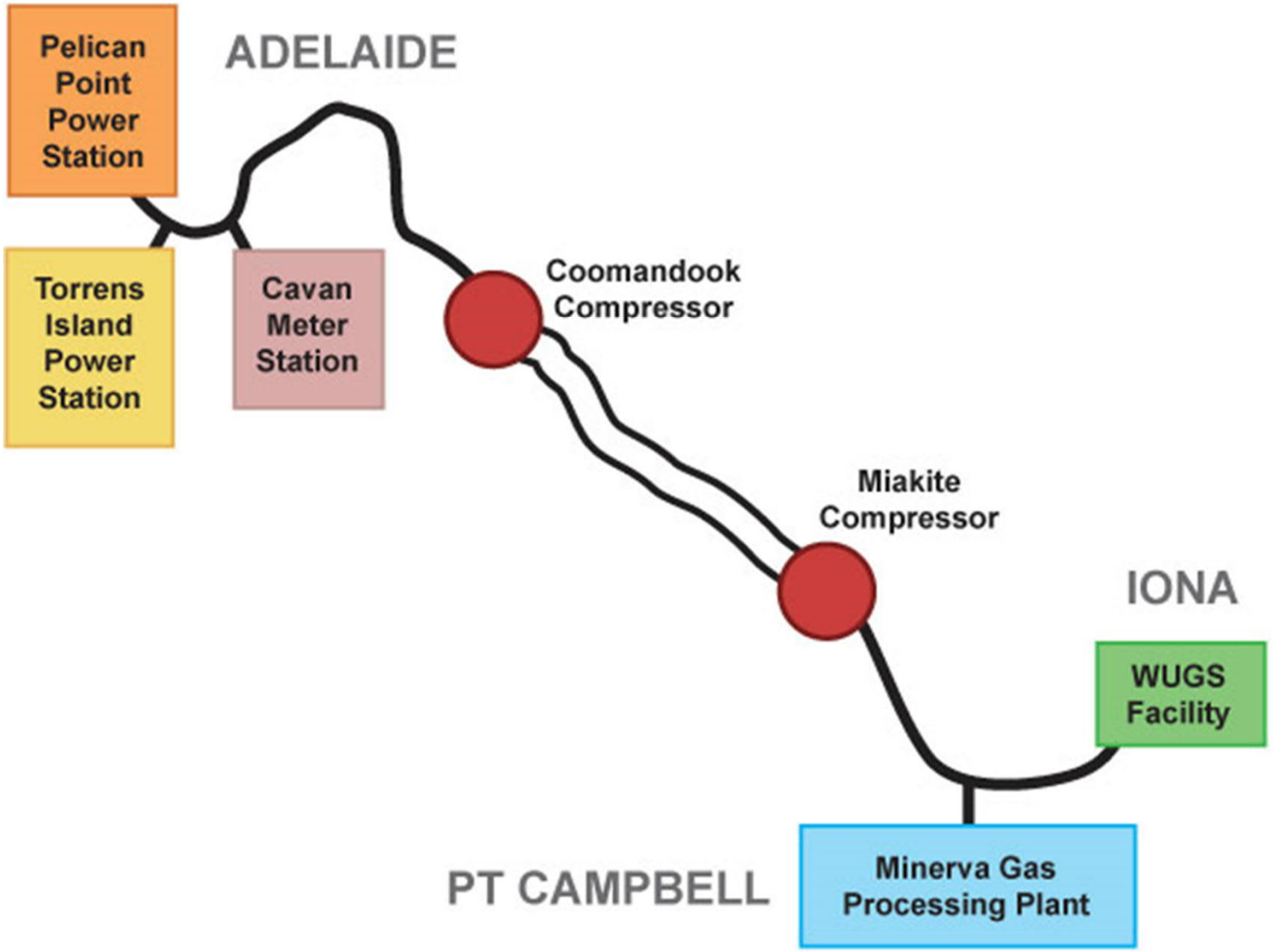
- Gas storage
- Victorian gas trading
- Expansion to East Coast gas trading



https://aemo.com.au/energy-systems/gas/gas-bulletin-board-gbb/data-gbb/interactive-map-gbb

Advisian Worley Group SEAGAS Pipeline



Advisian Worley Group Moomba Explosion

Fire in cold box January 1, 2004

SEAGas pipeline commissioned Jan 1, 2004

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Coal Seam Gas

Coal Seam Gas

Coal beds typically 100's of metres underground

- Too deep for open cut mining

Methane is bound to the coal matrix

Released when water pressure is reduced

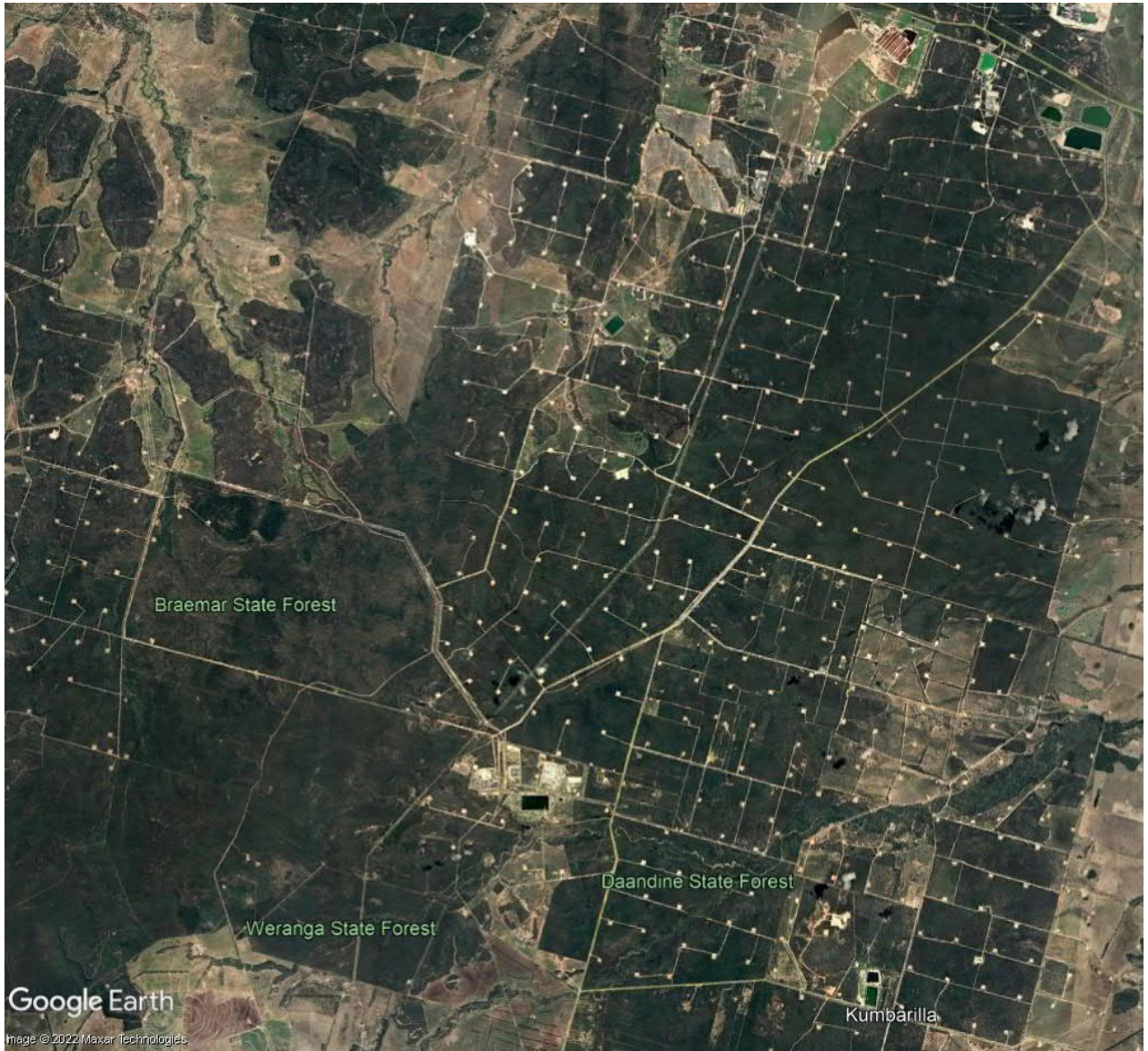
Initial period of dewatering the well

Followed by gas production

Some coal measures require fracking to provide adequate flow paths, but not all

Advisian Worley Group Coal Seam Gas Wells

Limited area drainage so many wells required



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Coal seam gas processing is:

- Simple
- Repeated
- Distributed

Field Compression

Central Processing

Water Management

Advisian Worley Group Coal Seam Gas industry - Triggers

- Key Triggers
  - 1997 The Gas Code – third party access to declared gas transmission pipelines
  - 1999 Gas trading starts in Victoria and is extended to the East Coast
  - Small gas parcels able to be sold
  - Deregulation of the electrical generation industry
  - Peaking power generation using natural gas
  - Experimentation identifies the path to commercial coal seam gas recovery
- Coal seam gas took 20 years to become an overnight success

- Surat and Bowen basins in Queensland
- Camden in New South Wales

Advisian Worley Group Coal Seam Gas

The success of the coal seam industry created a huge gas resource

Realised by the LNG export projects from Gladstone

Which will be covered by a later seminar in the series

Shale Gas & Tight Gas

Shale Gas and Tight Gas Rely of Fracking

Fracking:

- Injection of high pressure water with “proppant”
- Establishes fractures in the tight rock to allow gas flow
- Proppant holds the fractures open

- Large water injection
- Large water backflow
- Contamination of backflow water

Advisian Cooper Basin

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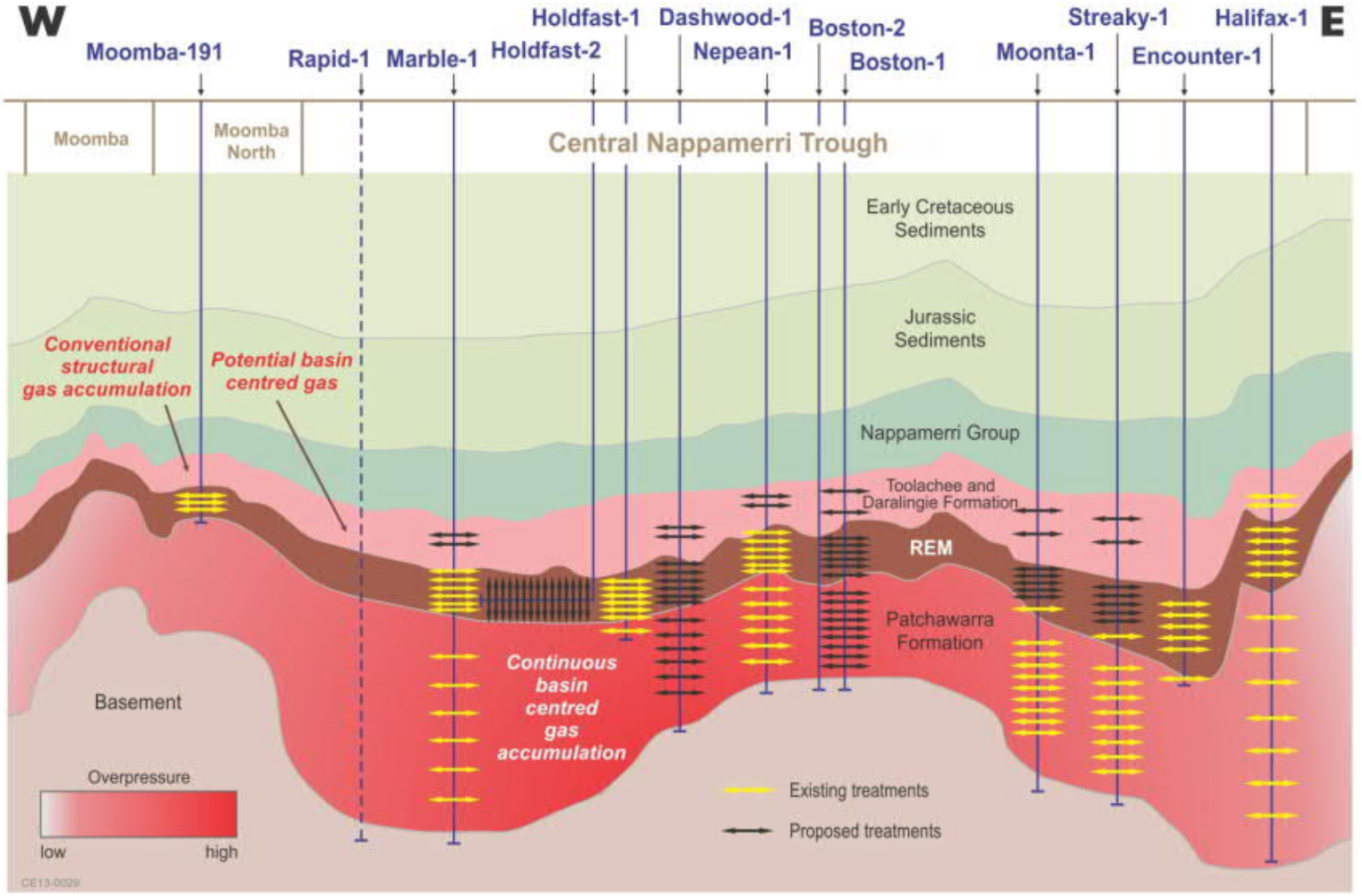
Not just repeating US formula

Learning required even in mature basins

Moomba 191



Source: Beach Energy

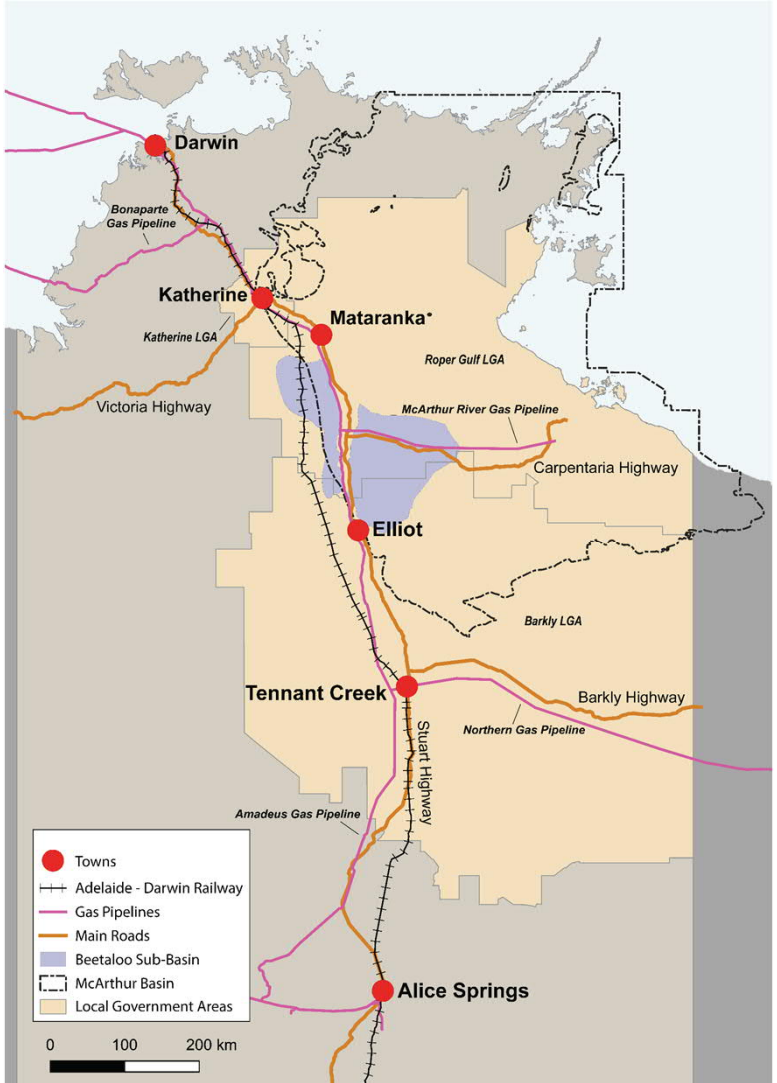
Advisian Worley Group Beetaloo Basin

The Beetaloo seems to be the other major area for potential shale gas development

Presence of thick, organic-rich shale units that are mature for gas

Exploration and appraisal stage

Access to east coast gas market



Summing Up

Advisian Summary

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Conventional natural gas has been operating across Australia since the 1960s and signalled the end of town gas production

Natural gas transmission has evolved into an integrated East Coast gas market

Unconventionals:

- Coal seam gas is proven and mature, operating since 2000
- Early days for shale gas and tight gas

Later seminars will talk about the expansion into LNG markets

Later seminars will talk about the gas markets and gas retailing

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