

**Tasmania Special Exploration License SEL 32/2003**

**Annual Report and Application for Renewal**

**Period: July 30, 2004 to July 30, 2005**

**License Holder: OME Resources Pty Ltd**

**Report by: Focal Petroleum Engineering Pty Ltd  
With contributions by MBA Petroleum Consultants**

**Date of Report: July 15, 2005**

## **Summary**

This report is in reference to exploration activities conducted over Special Exploration License SEL 32/2003. The license applies to coalbed methane, and expires on July 30, 2005. This license was originally part of SEL13/98.

The Tasmanian Basin is a mature coal-mining production province, with significant coal resources, and hence significant potential for Coal Seam Gas. Our objective is to evaluate and demonstrate both the distribution and economic viability of CSG production in the Tasmania Basin. If drilling and pilot programs are successful, we intend to rapidly develop this resource, and establish CSG as a viable alternate energy source for the state of Tasmania.

The first step in evaluating the CSG potential is a “desk-top” study. There already exists a significant library of geological studies and core hole results accumulated from over a century of coal-mining exploration and production in Tasmania. However, this data has not yet been compiled or studied from a specifically Coal Seam Gas perspective. The interim results of this “desk-top” CSG work are presented in this report. We have now identified our preliminary tier-one drilling target areas. The final step in this “desk-top” phase will be to select specific drilling locations within the top ranked coalfields. We will then drill and test the most promising areas, and if successful, move into pilot and production.

There are four main areas that fall out in the analysis as being attractive, in order of descending importance: the Northeast coalfields (in particular, Fingal-Dalmyne), the Southern Midlands (Mt Vernon- Langloh area), the Northern Midlands (York Plains – Woodbury), and Southern Tasmania (Catamaran – Ida Bay).

By far the most attractive CSG area is in the Fingal-Dalmyne trend. Effectively, the analysis results point to Fingal-Dalmyne as warranting the bulk of the next phase of exploration / appraisal work, and the other areas ranking as moderately attractive, but requiring further work. For Fingal-Dalmyne, the coal is clearly present, and it is at or near appropriate burial depths. The next exploration / appraisal phase will aim to prove sufficient gas in place (gas content and thickness), and productivity.

Aside from proving gas content and productivity, many areas still carry basic exploration risks, such as: coal depth, total coal thickness, and vertical coal distribution (ie. total coal thickness may be near sufficient, but is distributed over several thin seams).

The Mt Vernon area, for example, has proven coal to 300 meters in one borehole, but encountered only 3 meters of coal. The York Plains – Woodbury area has proven 7 meters of coal, but only to a depth of 125 meters, while the Ida Bay – Catamaran area has proven an average of 4 meters to a depth of 290 meters.

Since much of historical coal-mining exploration drilling was aimed at proving open-cut potential, most areas have only proven coal to quite a shallow depth, and would require further geological mapping and exploratory work before drilling. However, many of these areas are faulted, and / or have coal seams dipping up to 20 degrees

(360 meters depth, for every kilometer of offset), so that the immediately adjacent areas may still have good CSG prospectivity.

The next steps in the exploration / appraisal process include:

1. Selection of specific drilling locations within the top ranked coalfields
2. Drilling of coreholes to facilitate:
  - a. field and laboratory testing of selected coal samples to establish gas desorbition characteristics
  - b. Core inspection for indications of productivity potential: cleat sizing and distribution, mineralisation, coal thickness, heterogeneities, etc.
3. Well-testing to establish gas presence, gas composition, and insitu permeability.
4. Drilling and completing pilot production wells
5. Long term pilot project to de-water, establish gas deliverability, and confirm/certify recoverable gas reserves

Our intention is to move into a pilot and production stage as quickly as possible.

In the first year of the license, to July 30, 2006, the specific plan is to drill, core, and test at least 1 well in the Fingal – Dalmayne area. The program would follow the outline in Section 5 of this report. Together with final geological and engineering preparation work for this drilling, this expenditure is anticipated to be in the order of 400 k\$.

In the second year of the license, the plan is to drill at least 2 further wells. If successful, then many wells would follow as the area moves into pilot and then phased development. The 2 wells would see a further total expenditure of circa 800 k\$, in the second year.

This is considered a minimum plan. Our objective is to move considerably faster into pilot and development.

# Table of Contents

<b>1. Introduction.....</b>	<b>6</b>
1.1. Tenement License .....	6
1.2. Areas for Renewal and Relinquishment .....	7
<b>2. Exploration / Appraisal Rationale.....</b>	<b>8</b>
2.1. Exploration / Appraisal Program .....	8
2.2. Coal Seam Gas Screening and Ranking Criteria .....	9
2.2.1. Existing Exploration / Appraisal Data .....	9
2.2.2. Total Coal Thickness .....	10
2.2.3. Coal Burial Depth .....	10
2.2.4. Potential Areal Extent .....	11
2.2.5. Coal Resource Quality .....	12
2.2.6. Development and Environmental Considerations .....	12
<b>3. Evaluation of Tasmanian CSG Prospects.....</b>	<b>14</b>
3.1. Geology - Overview .....	14
3.2. Summary of CSG Ranking .....	15
3.3. Northeastern Coalfields .....	16
3.3.1. Mount Nicholas Coalfield.....	18
3.3.2. Fingal Coalfield .....	20
3.3.3. Dalmyne Coalfield .....	21
3.4. East Coast Coalfields .....	23
3.4.1. Douglas River Coalfield .....	23
3.4.2. Denison Rivulet Coalfield.....	24
3.4.3. Seymour Coalfield .....	24
3.4.4. Llandaff Coalfield.....	25
3.4.5. Mt Paul Coalfield.....	26
3.4.6. Schouten Island Coalfield .....	27
3.4.7. Triabunna Coalfield .....	27
3.4.8. Buckland Coalfield .....	27
3.4.9. Saltwater River Coalfield.....	28
3.5. The Avoca Coalfield (Northeast).....	28
3.5.1. The Mount Christie (Stanhope) Coalfield.....	29
3.5.2. The Merrywood Coalfield.....	29
3.6. Northern Midlands Coalfields.....	30
3.6.1. York Plains.....	30
3.6.2. The Woodbury Coalfield .....	31
3.6.3. The Mike Howes Marsh Coalfield.....	32
3.7. Southern Midlands Coalfields.....	32
3.7.1. The Colebrook (Jerusalem) Coalfield.....	32
3.7.2. The Bagdad – Kempton Coalfield (Mt Vernon area) .....	33
3.7.3. The Richmond Coalfield.....	34
3.8. Southern Tasmania Coalfields .....	34
3.8.1. The New Town Coalfield.....	34
3.8.2. The Kaoota (Sandfly) Coalfield.....	34
3.8.3. Cygnet Coalfield .....	35
3.8.4. Strathblane Coalfield .....	36
3.8.5. Hastings Coalfield.....	37
3.8.6. Ida Bay Coalfield .....	37
3.8.7. The Catamaran - Moss Glen Coalfields.....	38

3.8.8.	Adventure Bay Coalfield .....	39
3.9.	Northern Tasmania Coalfields .....	39
3.9.1.	The Longford Coalfield .....	39
3.9.2.	The George Town Coalfield .....	40
3.10.	Northwest Coalfields .....	41
3.10.1.	Mersey-Don Coalfield .....	41
3.10.2.	Preolenna Coalfield.....	41
3.11.	Derwent Valley Coalfields.....	41
3.11.1.	The Langloh (Lawrenny) Coalfield .....	42
3.11.2.	The Mt Lloyd Coalfield .....	42
<b>4.</b>	<b>Further Analysis of the Fingal – Dalmayne Area .....</b>	<b>44</b>
<b>5.</b>	<b>Proposed Exploration / Appraisal Drilling Process.....</b>	<b>46</b>
5.1.	Exploration Wells Requiring Core.....	46
5.1.1.	Core, logging and sample .....	46
5.1.2.	Injectivity fall-off.....	46
5.1.3.	Back-ream and long-term production test.....	46
5.2.	Exploration / Appraisal Wells not requiring core .....	47
<b>6.</b>	<b>Pilot and Conceptual Development Plan .....</b>	<b>48</b>
6.1.	Pilot Model on 25 km <sup>2</sup> area within the Fingal Field.....	48
6.1.1.	Production Profiles.....	49
6.2.	Notional Development Plan.....	51
<b>7.</b>	<b>Exploration / Appraisal Plans and Expenditures .....</b>	<b>52</b>
7.1.	Expenditure in the year July, 2004 to July, 2005.....	52
7.2.	Exploration / Appraisal Program in Year 1 .....	52
7.3.	Exploration / Appraisal Program in Year 2 .....	52
<b>8.</b>	<b>References .....</b>	<b>53</b>

## List of Figures

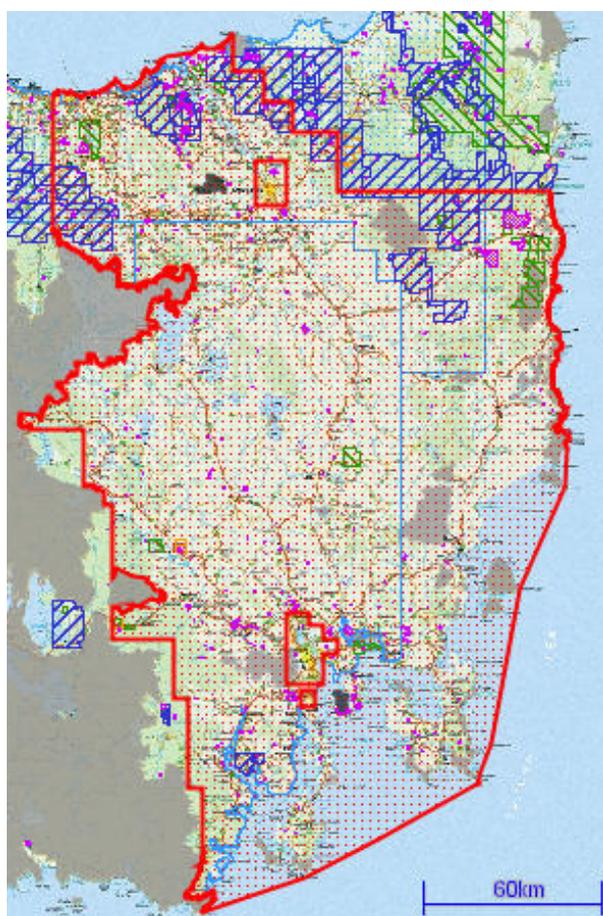
Figure 1:	Special Exploration License 32/2003 .....	6
Figure 2:	Areas Applied for Renewal, outlined in black .....	7
Figure 3:	CSG Potential in Tasmania – Best Estimate of Total Coal Thickness.....	15
Figure 4:	CSG Potential in Tasmania - Deepest Proven Coal .....	16
Figure 5:	Mt Nicholas - Fingal Mining Leases.....	18
Figure 6:	Boreholes in the Mt Nicholas - Fingal - Dalmayne Trend .....	20
Figure 7:	Borehole Locations with the Fingal-Dalmayne Area.....	44
Figure 8:	Total Coal Thickness of DOM Holes in Prime Drilling Area.....	45
Figure 9:	Production Profile for 3 pilot wells, and Phase 1 development of 3 mmscf/d .....	49
Figure 10:	Gathering system for Phase 1 Development of Fingal Area .....	50

# 1. Introduction

## 1.1. Tenement License

This report is in reference to exploration activities conducted over Special Exploration License SEL 32/2003. The license applies to coalbed methane, and expires on July 30, 2005. This license was originally part of SEL13/98.

The SEL32/2003 license area covers approximately 30,000 km<sup>2</sup>, and is shown in Figure 1.



**Figure 1: Special Exploration License 32/2003**

## 1.2. Areas for Renewal and Relinquishment

The areas being applied for renewal are shown in Figure 2, as outlined in black. The areas that are being relinquished are addressed in a separate Final Report.

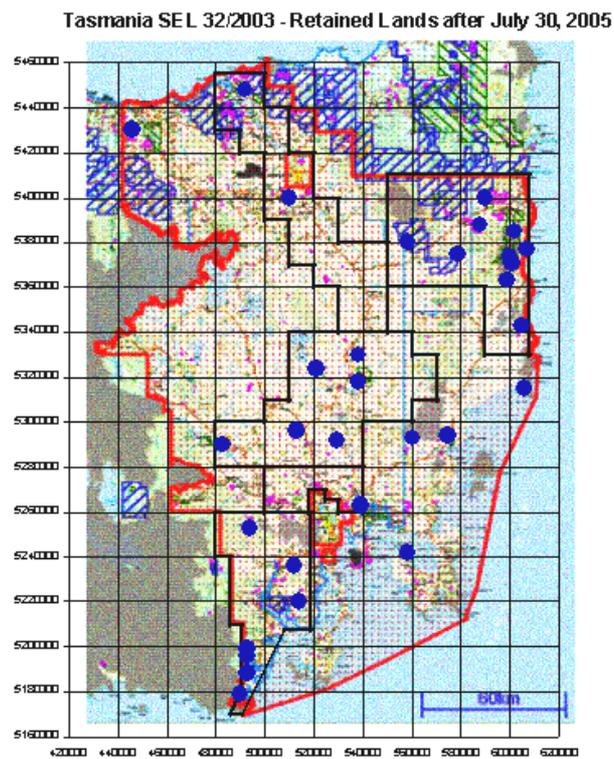


Figure 2: Areas Applied for Renewal, outlined in black

## **2. Exploration / Appraisal Rationale**

Coal Seam Gas (CSG) is a green energy source that will play a major role in future energy supply world-wide.

The Tasmania Basin is a mature coal-mining production province, with significant coal resources, and hence significant potential for Coal Seam Gas. Our objective is to evaluate and demonstrate both the distribution and economic viability of CSG production in the Tasmania Basin. If our drilling and pilot programs are successful, we plan to rapidly develop this resource, and establish CSG as a viable alternate energy source for the state of Tasmania.

Our exploration / appraisal philosophy is to leverage the extensive existing coal-mining knowledge base to identify areas of greatest potential for Coal Seam Gas. Once this “desk-top” phase is complete, we will then drill and test the most promising areas, and if successful, move quickly into pilot and production.

### **2.1. Exploration / Appraisal Program**

The first step in evaluating the CSG potential is a “desk-top” literature study. There already exists a significant library of geological studies and core hole results accumulated from over a century’s worth of coal-mining exploration and production in Tasmania. However, this data has not yet been compiled or studied from a specifically Coal Seam Gas perspective. The interim results of this CSG work are presented in this report. We have now selected our preliminary tier-one drilling target areas.

The work commitment in the original exploration license application included well sampling and geochemical analysis. These were not conducted in the first year, since it was deemed to be a higher priority to evaluate and rank all the prospective areas prior to embarking on a drilling campaign. However, the sampling and analyses are planned in next year’s program.

The next steps include:

- 1 Selection of specific drilling locations within the top ranked coalfields
- 2 Drilling of core holes to facilitate:
  - a. field and laboratory testing of selected coal samples to establish gas desorbition characteristics
  - b. Core inspection for indications of productivity potential: cleat sizing and distribution, mineralisation, coal thickness, heterogeneities, etc.
3. Well-testing to establish gas presence, gas composition, and insitu permeability.
4. Drill, case and complete pilot production wells
5. Long term pilot project to de-water, establish gas deliverability, and confirm/certify recoverable gas reserves

Our intention is to move into a pilot and production stage as quickly as possible.

For details on our proposed drilling, testing and pilot programs, see Sections 5 and 6.

For details on the exploration expenditures of the past year, and those planned over the next two years, see section 7.

## **2.2. Coal Seam Gas Screening and Ranking Criteria**

Currently we are in the “desk-top” phase of prospect evaluation. There are six key components to our CSG Screening and Ranking process:

1. Existing Coal Exploration / Appraisal Data
2. Total Coal Thickness
3. Coal Depth
4. Potential Areal Extent
5. Coal Resource Quality
  - a. Gas Content
  - b. Productivity Potential
6. Development and Environmental Considerations

Some of these criteria cannot yet be evaluated in detail, and will require drilling, sampling, and testing.

The first four criteria are dominant in the desk-top phase, since there is no hard data on gas content and productivity potential. The two criteria with the most hard data were Total Coal Thickness, and Coal Depth.

### **2.2.1. Existing Exploration / Appraisal Data**

Our philosophy is to leverage the extensive exploration and development work already done by both industry and government over the past century and a half. We have therefore concentrated on areas of established coal discoveries, and thus have used as our starting point the landmark publication, Geological Survey Bulletin 64, The Coal Resources of Tasmania, 1991, by C. A. Bacon.

The danger in this approach is that much of the coal-mining exploration has been focused on discovering shallow, more easily accessible coal seams, while Coal Seam Gas production usually originates from depths between 300 and 800 meters. In addition, our focus has been on already defined coalfields. Some attempt has been made to evaluate some of the more “wildcat” exploration boreholes, where no explicit coal-“field” has yet been identified, but this process has been limited by a lack of comprehensive data. From a pragmatic point of view, using the existing data is the obvious starting point.

From the Bulletin 64 document, and its comprehensive bibliography, we have usually been able to trace back to the individual borehole data, which have formed the basis of a number of subdatabases used to perform the screening outlined below. These databases, however, are somewhat sporadic, since the task of compiling a complete digital database of the boreholes was simply not practical.

Numerous previous reports also included cross-sections and correlation panels showing the distribution and continuity of individual coal seams. Some gravity survey data has also been used in a qualitative manner (for example, the Gravity Survey of the East Coast Coalfields, GSB60, of 1981).

### **2.2.2. Total Coal Thickness**

The next three criteria (Total Coal Thickness, Areal Extent, and to some degree, Coal Depth) are aimed mainly at establishing sufficient Gas In Place volumes to warrant potential commercial development.

The first criterion is simple: is coal proven to exist in the area, and what is the total coal thickness?

Unlike coal-mining operations, Coal Seam Gas production does not require that individual seams be thick (greater than some “working thickness” cut-off), but that the total thickness establishes sufficient Gas In Place volume, and permeability-thickness for commercial flow rates. A common rule of thumb is that the total coal thickness should be greater than 10 feet, or 3 meters. It can, however, make a CSG development more attractive if the producing coal seams are concentrated in one or a few dominant coal seams, as this can make some development optimizations easier, such as horizontal wells and fracture stimulation.

### **2.2.3. Coal Burial Depth**

As a qualitative rule of thumb, coal seams in the range of 300 to 800m depth are more attractive. Sufficient burial depth helps ensure:

1. gas content (coal maturity and adsorption)
2. reservoir pressure

These points are aimed at achieving commercial gas flow rates and increased reserves. Reservoir pressure greater than the desorption pressure will ensure methane remains adsorbed to the coal. Shallower coals will have lower confining pressure and are more likely to have surface conduits, and thus are at more risk of being gas depleted.

Although burial depth helps ensure sufficient gas content, in the Tasmania Basin, dolerite intrusions have been proven to raise the maturity of nearby coals (for example, the Langloh coalfield, where coals have only been proven to a depth of 150 meters, but have vitrinite reflectance values in the range of 1 to 3% (Bacon et al,

GSB71)). Whether or not this would improve the Coal Seam Gas prospectivity is questionable, since the effect of rapid heating by dolerite intrusion may not result in the storage of adsorbed methane similar to that achieved by coalification by burial. Of course, the dolerite intrusions could also take the coal maturity outside of the CSG prospective range, in localized areas.

Shallower coals may still be prospective in the Tasmania Basin. The Powder River and Raton Basins in the United States produce Coal Seam Gas from depths as shallow as 60 and 120 meters, respectively. Several of these low-rank shallower coals contain mainly late-stage biogenic methane.

#### **2.2.4. Potential Areal Extent**

For a given coal thickness and gas content, a minimum areal extent is required to establish sufficient gas reserves for commercial development. This minimum extent varies with the development context (location, distance to infrastructure, type of development, etc), as well as the nature of the CSG resource (thickness, permeability, gas content, etc).

However, to estimate a range of minimums, one can consider modular development of a power generation concept. Assuming a unit-size of a 12 MW generator, a plateau production rate of about 3 mmcf/d is required. With a well deliverability of 300 mcf/d, this would translate to a minimum of 10 to 15 wells. For an 80 acre well-spacing (roughly 3 wells/km<sup>2</sup>), this would mean a minimum CSG reservoir area of 3 to 5 km<sup>2</sup>. To achieve any longevity in the plateau production, and to account for reservoir heterogeneities, disappointing step-outs, etc, one might assume 10 km<sup>2</sup> as a minimum area for such a development. Conventional thinking usually puts the minimum area in the 10's of square km's; however, modular developments of "embedded" power generation are becoming more common.

For a straight gas sales development, the minimum reserve base, and hence areal extent, is obviously higher, given that a pipeline would have to be built from the Alinta pipeline running through the heart of Tasmania, approximately 50 kilometers from the Fingal – Dalmayne coalfields.

As an aside, lateral continuity of the coal seam(s) (as opposed to lateral extent) is not as large a factor in CSG development as in conventional gas development, since a typical CSG development will be drilled on 80 acre spacing, or about 3 wells per square kilometer. Some developments are as dense as 9 wells per square kilometer. Thus, a fault-segmented CSG reservoir is not necessarily a deterrent; in some cases, it can be an advantage, as compartmentalization can limit the negative impact of a strong aquifer.

### **2.2.5. Coal Resource Quality**

Resource quality here is defined as the two “umbrella” criteria: gas content, and productivity. These were briefly discussed under “Coal Burial Depth”. Coal burial depth is really just an indirect indicator of potential resource quality.

As a rule of thumb, coal gas content should be greater than about 8 m<sup>3</sup>/tonne. However, this is also a function of the gross volume of coal in place. The Powder River Basin in the United States, for example, is a commercial development with only 1 to 2 m<sup>3</sup>/tonne gas content (but this is compensated by the average total coal thickness being over 20 meters, and by high domestic gas prices). Put another way, what’s really required is a certain gas volume in place, per unit area. The Powder River Basin works out to be about 2 bcf/km<sup>2</sup>; a typical value in a Queensland development is 8 m<sup>3</sup>/tonne, with 5 meters of net coal, which also gives about 2 bcf/km<sup>2</sup> Gas In Place.

At this phase of CSG exploration, in the absence of direct gas adsorption data, then one must rely on indirect indicators of gas content, such as thermal maturity (vitrinite reflectance), ash content, and depth of burial. As a general guide, vitrinite reflectance should be between 0.7 and 2.0% (peak maturity for gas generation at about 1.2%), ash content below 40%, and depth of burial greater than 300 meters.

Later, in the CSG evaluation stage, once core and gas samples have been acquired, parameters such as Langmuir isotherms and gas composition (low acid gas) will dominate the coal quality evaluation.

From a productivity point of view, for an economic development, stabilized well gas rates should be greater than about 200,000 scf/day (depending on development setting, distance to infrastructure, gas quality, water disposal issues, etc). Gas production rates are a function of a number of factors, including effective permeability (cleat development, and matrix diffusivity), reservoir pressure, continuity, water influx, and stress environment. Generally, effective permeability should be greater than 1 to 5 mD, and reservoir pressure should be greater than about 400 psi (circa 300 meter depth, at hydrostatic gradient).

### **2.2.6. Development and Environmental Considerations**

Although the license is still in the exploration phase of Coal Seam Gas, development and environmental issues are obviously important considerations in the screening process. From a development point of view, operational issues such as land access (topography, roads, marsh, seasonal access) and lease availability (proximity to mining leases or exclusion areas), as well as commercial considerations such as proximity to potential markets and / or pipelines, can play a large role in assessing the most prospective areas.

From an environmental point of view, issues such as proximity to parks, sanctuaries, and reserves will become important. In addition, once a potential development phase is reached, the potential impact of operations such as produced water handling and

drilling and development “footprint”, will be carefully addressed. While it is anticipated that most of the CSG potential will be in areas where mining activities and infrastructure are already established, operations need to be designed to minimize the environmental impact.

## **3. Evaluation of Tasmanian CSG Prospects**

### **3.1. Geology - Overview**

The Tasmania Basin contains a sequence (up to 2km thick) of flat lying rocks ranging in age from Late Carboniferous to Late Triassic. The total section is called the Parmeener Supergroup, which is divided into the Lower Parmeener and the Upper Parmeener.

The Lower Parmeener is Late Carboniferous to Permian in age and predominantly marine, but includes a Lower Permian non-marine section towards its middle. The Upper Parmeener is Late Permian to Late Triassic in age and wholly non-marine. The boundary between the Upper and Lower is mostly conformable, but in the northeast is slightly disconformable.

The Parmeener Supergroup is extensively intruded by Mid Jurassic dolerite. The dolerite occurs most commonly as discordant sheets or sills up to 500m thick, and occasionally as dykes. The intrusions have thermally altered the sediments in a zone about half the thickness of the sill above and below, and in places have raised the rank of nearby coal seams. The dolerite is resistant to erosion and tends to dominate the landscape of the eastern part of Tasmania, capping all of the high mountains and underlying the Central Plateau.

Coal seams occur within the non-marine section of the Lower Parmeener, and within the Late Permian and the Late Triassic of the Upper Parmeener. While coals have historically been mined from each of the three coal measures, only the coal seams within the Late Triassic are currently considered economic for mining, and probably represent the better prospects for coal seam gas production.

The Early Permian coal measures are called the Preolenna and Mersey Coal Measures and their equivalents. They occur as a thin sheet 6 to 50m thick within about the middle of the Lower Parmeener, and are spread over most of the Tasmania Basin area and some of the other minor basins. The individual seams are thin (less than 1m thick), have a low ash (8 to 12%) and a high sulphur (up to 5%) content.

The Late Permian Cygnet and Adventure Bay Coal Measures comprise the lowest member of the Upper Parmeener Supergroup. They occur in the southeastern, the western and the northern peripheries of the Basin, but are absent in the northeastern corner. The coal measures generally contain two seams less than 1m thick, with ash contents of 25 to 30%.

The Late Triassic coal measures are, except for the northern edge, present over the bulk of the Tasmania Basin. Their best development is in the northeast of Tasmania, and in this region is contained the bulk of the State's coal reserves. The coal measures are about 300 to 400m thick and contain some 8 seams, up to 2m or more thick, totalling up to 10m net coal. A dolerite sheet intrudes throughout much of the coal

measures and, because it is resistant to erosion, forms high topography over most of the coalfields.

Tertiary basins are widespread across Tasmania; most are extremely small and localised and are of no economic importance, particularly for coal seam methane.

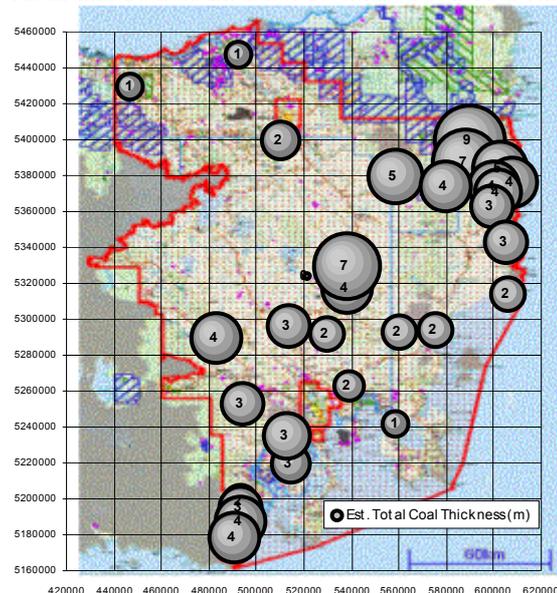
### 3.2. Summary of CSG Ranking

The two key quantitative criteria used in the screening of CSG prospects were: total coal thickness, and deepest proven coal (Figure 3 and Figure 4).

There are four main areas that fall out in the analysis as being attractive. These are, in order of descending importance: the Northeast coalfields (in particular, Fingal-Dalmaine), the Southern Midlands (Mt Vernon- Langloh area), the Northern Midlands (York Plains – Woodbury), and Southern Tasmania (Catamaran – Ida Bay).

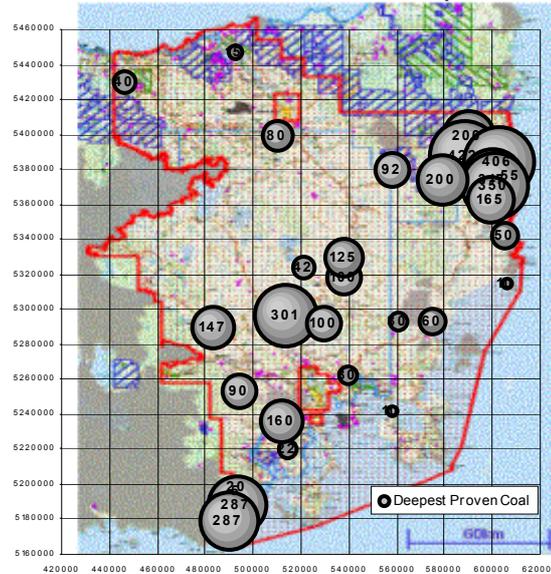
By far the most attractive CSG area is in the Fingal-Dalmaine trend. Effectively, the analysis results point to Fingal-Dalmaine as warranting the bulk of the next phase of exploration / appraisal work, with the other areas ranking as being moderately attractive, but requiring further work. For Fingal-Dalmaine, the coal is clearly present, and it is at or near appropriate burial depths. The next exploration / appraisal phase will aim to prove sufficient gas in place (gas content and thickness), and productivity.

**Tasmania Coal Seam Gas Potential - Total Coal Thickness**



**Figure 3: CSG Potential in Tasmania – Best Estimate of Total Coal Thickness**

**Tasmania Coal Seam Gas Potential - Deepest Proven Coal**



**Figure 4: CSG Potential in Tasmania - Deepest Proven Coal**

Aside from proving gas content and productivity, many areas still carry basic exploration risks, such as: coal depth, total coal thickness, and vertical coal distribution (ie. Total coal thickness may be sufficient, but is distributed over several thin seams). It is possible, however, that dolerite intrusions may have helped mature the shallower coals.

The Mt Vernon area, for example, has proven coal to 300 meters in one borehole, but encountered 3 meters of coal. The York Plains – Woodbury area has proven 7 meters of coal, but only to a depth of 125 meters, while the Ida Bay – Catamaran area has proven an average of 4 meters to a depth of 290 meters.

Most other areas have only proven coal to quite a shallow depth, and would require further geological mapping and exploratory work before drilling. However, many of these areas are faulted, and /or have coal seams dipping up to 20 degrees (360 meters depth, for every kilometer of offset), so that the immediate areas may still have good CSG prospectivity.

### **3.3. Northeastern Coalfields**

The northeastern coalfields contain the Late Triassic coals of the Upper Parmeener Sub Group, and the bulk of the coal reserves in the Tasmania Basin.

The coal measures are 300 to 400m thick, and contain eight coal seams up to 2m thick or more. They occur within a sequence of dominantly lithic sandstone with minor mudstone, claystone, siltstone, and rare tuff. Total seam thickness within the coal measures ranges up to 10m, with 10 of the boreholes in Fingal having total coal thickness of over 20 meters. The seams split and lens out, and are often banded with

mudstone and claystone. In the Fingal Tier the seams are named, from the top to bottom, the A, B, C, D, E, Duncan, East Fingal, and the H. They are correlated with nearby coalfields to a greater or lesser reliability.

The coal is described as a high ash, low sulphur, dull steaming coal with ash contents of 20 to 30%. The main component of the coal is inertinite, with no more than 10% vitrinite and 5 to 10% exinite. Mineral matter is mainly locked in the contained cell structure of the constituent plant remains. Rank of the coal is relatively low except where the seams have been heated by intruded dolerite.

In large parts of the area the coal measure subcrop is overlain by the topographically prominent Jurassic dolerite sheets, and coal mine entry is through the scarp below the dolerite. The area also contains a scattering of dolerite dykes, some of which were feeders to the dolerite sheets. Gravity surveying has been effective in mapping thicknesses of the dolerite cap, and locating feeder pipes and dykes.

This issue of coal maturity is considered a risk, although probably a low-level risk. Maturation data on the Fingal, Mt. Nicholas, Dalmayne and Douglas River trend (Bacon et al, 2000; MRT GSB71; Table 5), shows thermal maturity (vitrinite reflectance,  $R_o$ ) ranging from 0.5 to 0.7%, with a high of 0.9%. These samples were selected as “likely to be not significantly affected by proximity to dolerite intrusion”. Much of the coal in place could be of higher maturity, depending on proximity to dolerite intrusions; of course there is also a risk of localized over-maturity, with values close to the dolerite being as high as 3.6% (Bacon, 1989). Ideally, for CSG generation, the range should be between 0.7 and 2.0% for coal peak generation around 1.2, (Brown et al, 1996).

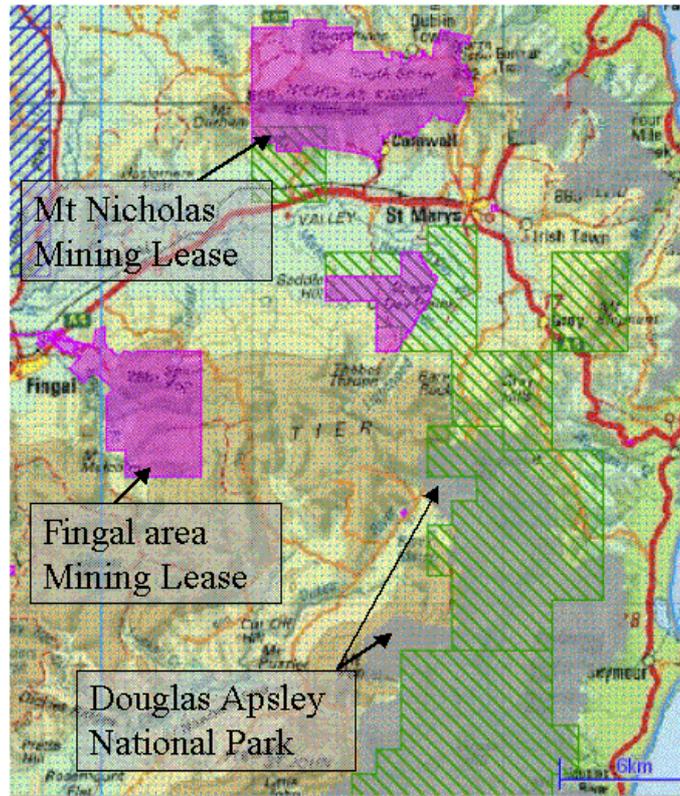


Figure 5: Mt Nicholas - Fingal Mining Leases

### 3.3.1. Mount Nicholas Coalfield

Summary: The Mt Nicholas coalfield area is considered to have moderate prospectivity for CSG exploration. While the area is proven to contain good total coal thickness and continuity within the mining lease, the deepest coal proven in the main seams within the mining lease is in the order of 275 meters. Only 5 holes have been drilled outside of the mining lease, with the deepest proven coal being at 165 meters, and of uncertain extent. However, given the faulting in the area, the variable topography, and the dolerite capping the coal measures, there is still some potential for CSG.

The Mt. Nicholas Range is located about 10 kilometers northwest of St Mary's in north eastern Tasmania, and is about 12 kilometers north of the Fingal coalfield. Much of the Mt Nicholas coalfield is covered by Mining Lease 1653P/M, held by Cornwall Coal Company (Figure 5).

Coal mining operations began in 1886, and have continued almost continuously since. Several mines have been active, including the Mt. Nicholas, Cornwall, Jubilee, Cardiff, Silkstone, and Blackwood mines. Only the Silkstone mine is outside of the currently held mining lease. Of note, a fire in the Cornwall Mine in 1955 caused closure of one section of the mine. Both the Jubilee and Silkstone mines were hampered by dewatering problems.

Total in-situ coal reserves (measured + indicated) are in the order of 100 million tonnes. From a coal-mining exploration point of view, the Mt Nicholas coalfield is considered “the most promising area in the state for future coal mining operations” (Bacon, 1991).

Several drilling campaigns have been conducted in the Mt Nicholas area. The DOM drilled a total of 11 holes (3 holes in 1957-1959, 8 holes between 1969-1978; Bacon, 1983). Shell drilled 52 holes in the early 1980’s (Patterson 1982). Cornwall Coal Company has also drilled 28 holes since 1978. The DOM boreholes are shown in Figure 6.

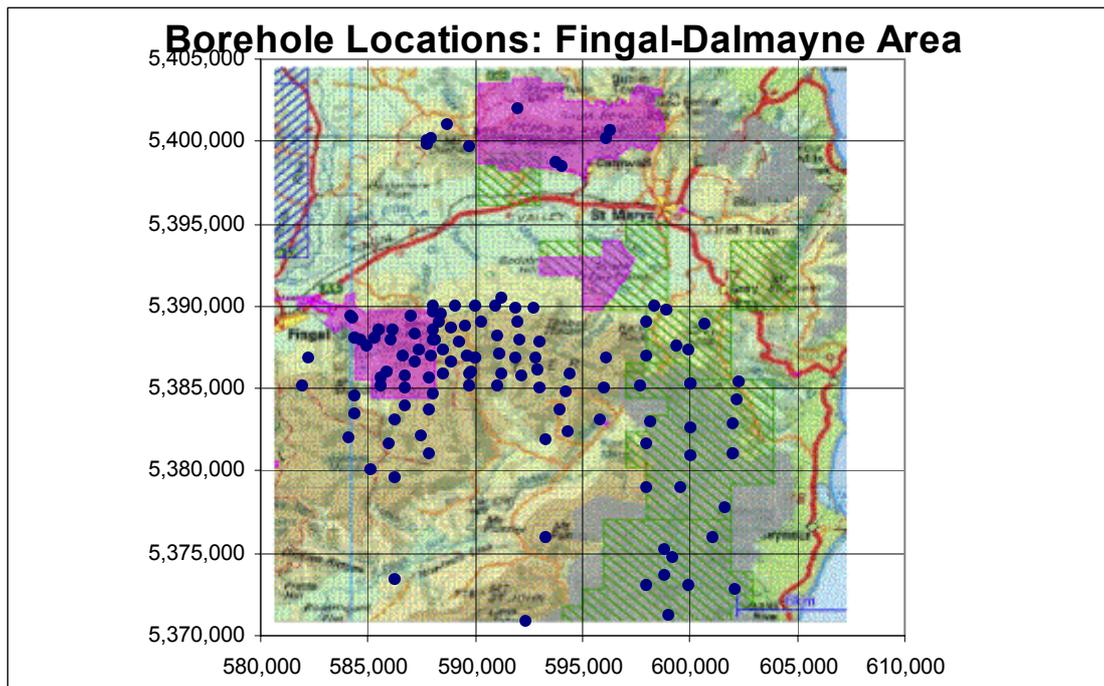
The vast majority of these holes were drilled within the current mining lease area. Only a handful of boreholes were drilled outside the lease, to the west at Mt Durham, just north of the Silkstone mine (also outside of the mining lease): DOM holes 8, 9, 10, 11, and 12.

Of these DOM holes, DOM 8 was drilled the deepest, to 251 meters, and encountered coal down to 163 meters. The four major seams, M1, M2, L1, and L2, were encountered between 23 and 130 meters depth, with a total thickness of 4.8 meters. Another 3 meters of thin, high-ash coal was also encountered. (Bacon, 1983; Appendix 2). DOM-8 intersected the greatest cumulative coal thickness at the greatest depth, outside the mining lease. DOM-12 is the second best hole outside of the mining lease, with 4.5 meters of total coal, between 55 and 150 meters depth. No ash content was measured. The average total coal thickness of these 4 holes outside the mining lease is about 4 meters.

Average total coal thickness over the entire Mt Nicholas area is in the range of 5 to 10 meters. Ash content is generally in the range of 20 to 30%.

The coal within the mining lease is also somewhat shallow. Only 12 of the 52 Shell holes were drilled deeper than 200 meters. The deepest main seam depth is 275 meters (seam L1 in hole GY132). The Shell structure maps (Patterson, 1982) interpret the main seams continuing west of the lease area, toward the DOM holes outlined above. There is also a large fault, with circa 50 to 80 meter throw, interpreted just east of the DOM-8 hole.

Faulting, topography, plus the dolerite capping the coal measures, may still make this area prospective, if somewhat risky, from a CSG point of view.



**Figure 6: Boreholes in the Mt Nicholas - Fingal - Dalmayne Trend**

### 3.3.2. Fingal Coalfield

Summary: The Fingal coalfield represents the best prospect for CSG development at this stage. There are over 70 existing boreholes in the immediate area, with a central CSG prospective area of 25 km<sup>2</sup>, with 25 existing holes. Total coal thickness averages 5 to 10 meters. Risks include depth (average coal depth 300 to 400 meters), coal quality (ash content 20 to 40%, vitrinite reflectance 0.5 to 0.7%), and of course permeability.

The Fingal coalfield is located about 15 kilometers southwest of St Mary's in northeastern Tasmania, and about 12 kilometers south of the Mt Nicholas coalfield. Several mines have operated in the coalfield, beginning in 1920 with the Fingal Mine. Only the Duncan Colliery, operated by Cornwall Coal Company, still operates. Part of the Fingal coalfield is covered by Mining Lease 1653P/M, held by Cornwall Coal Company. However, a significant prospective area exists east of the mining lease (at approximately easting 590000, and northing 5387000, in Figure 6).

Total in-situ coal reserves (measured + indicated) are in the order of 250 million tonnes, distributed between the Duncan, D, and Upper and Lower East Fingal seams. From a coal-mining exploration point of view, the Fingal coalfield has "considerable potential" (Bacon, 1991). In particular, the southern area toward St Pauls River is not well delineated by drilling.

The Fingal coalfield has been extensively drilled by the Department of Mines. In the 1970's, the DOM drilled about 70 boreholes, with much of the coalfield covered on a

roughly 1 kilometer grid. In addition, the Mt Nicholas, Dalmayne and Douglas River areas are also covered, although less intensively. The results are discussed in detail in Threader and Bacon, 1983. The data from this report has been used to generate the analyses presented here. For a more detailed analysis of the Fingal area, see the later section in this report on Fingal – Dalmayne CSG appraisal potential.

Total coal thickness averages in the range of 5 to 10 meters: 2-3 meters for the main Duncan Seam (F), 1 – 2 meters for each of the Upper and Lower East Fingal Seam (Seam G); with approximately 5 more meters for other thinner seams.

Based on the boreholes in the Fingal area, coal depths are in order of 250 meters (average top coal seam) to 425 meters (average bottom coal seam).

Coal quality is moderate: medium rank, with ash content 20 to 30% (sometimes 40% or higher). The mean maximum vitrinite reflectance of the Fingal coal is in the order of 0.5 to 0.6% (Morrison and Bacon, 1986), which is on the low side for potential CSG, and represents a risk on potential gas content. However, the samples in this dataset were intentionally selected to be unaffected by dolerite (nearby dolerite would raise the reflectance).

Of particular interest is the 5 by 5 kilometer area directly east of the Fingal coalfield mining lease (Figure 6: approximately defined by easting 588000 to 593000, northing 5385000 to 5390000). This is an area of approximately 25 km<sup>2</sup>, with 25 existing boreholes. The average depth to the top of coal from these boreholes is approximately 300 meters, with the average base of coal at approximately 400 meters. The average total coal thickness is 10 meters. Average total coal-mining “working thickness” (cutoff > 1.5 meters for an individual seam) is in the order of 2 to 4 meters.

While the area still requires more detailed assessment, at this screening stage it appears there are numerous holes that could be potentially “twinned”, in the early stage of exploration / appraisal drilling. Road access may already be in place (from the existing drilling program), but requires site inspection.

### **3.3.3. Dalmayne Coalfield**

Summary: The Dalmayne coalfield represents the second best prospect for CSG development at this stage, next to the Fingal coalfield. The main CSG prospectivity of Dalmayne is as a possible extension to any successful tests of Fingal, or as the second target exploration area after Fingal. There are over 25 existing boreholes in the immediate area. Part of the Dalmayne coalfield lies beneath Douglas Apsley National Park; however there is an immediately prospective area of roughly 10 km<sup>2</sup>, with 15 existing core holes, just to the east and north of the park. Total coal thickness averages 5 meters (up to 10 meters). Risks include depth (average coal depth 200 to 400 meters), coal quality, areal extent, and of course permeability.

The Dalmayne coalfield is located about 11 kilometers south of St Mary’s in northeastern Tasmania, and about 5 kilometers west of the coast, at Piccaninny Point.

Access is via 4-wheel drive only. Mining began at the Dalmayne Colliery in 1915, and ceased in 1955. Part of the coalfield lies beneath Douglas Apsley National Park (grey area in Figure 5) and is excluded from the license. However, a prospective CSG area exists east and north of the park, adjoining the Fingal Tier prospective areas, as shown in Figure 6. The Dalmayne coalfield is considered an easterly extension of the Fingal Coalfield (Bacon, 1991; Threader and Bacon, 1983)

Total in-situ coal reserves (measured + indicated) are in the order of 160 million tonnes, 128 of which is indicated in the DD seam. From a coal-mining exploration point of view, the Dalmayne coalfield potential is “very good” (Bacon, 1991).

The Dalmayne coalfield has had a number of drilling campaigns. The DOM drilled 9 holes between 1949 and 1952, and Industrial and Mining Investigation drilled 2 holes in 1974. These holes were generally shallow, with the IMI holes encountering 7 meters total coal (with ash < 40%, up to 15 meters total coal), at depths of 100 to 200 meters. The DOM holes encountered an average of 4.5 meters of total coal, but at depths of 10 to 100 meters. (Bacon and Calver, 1984).

In 1978, the Shell Company, in conjunction with IMI, drilled 24 coreholes in the Dalmayne area. For a more detailed analysis of the Dalmayne area, see the section later in this report on Fingal – Dalmayne CSG appraisal potential. The results are based on the data presented in Ford and Bos, 1984 (which also presents holes drilled in Douglas River, Denison Rivulet, and Llandaff coalfields). The average total coal thickness encountered in Shell’s Dalmayne coreholes was in the order of 5 meters (up to 10 meters), with 4 of the holes encountering no coal at all. For the holes that had encountered first coal deeper than 100 meters, the average top coal was 300 meters drill depth, and average bottom coal was 350 meters drill depth.

Coal quality is moderate: medium rank, with ash content 20 to 30% (average of samples, 24%).

Of particular interest is the area directly north and east of Douglas Apsley Park. 16 of the coreholes were drilled outside of the park. The average total coal thickness for these holes was 5 meters, with 3 of the holes encountering no coal. Average top coal depth was 250 meters, with average base coal at 400 meters.

From a CSG perspective, there is an issue, or risk, with the depth of the coal seams. Of the 25 core holes, only about half have coal seams deeper than 300m, so careful selection of sufficiently deep areas will be required. A logical next step is to begin mapping the coal seams for depth and thickness.

As with the Fingal coalfield, the area still requires more detailed assessment before drilling. However, at this screening stage it appears there are several potentially twin-able wells. If the Fingal Tier area proves to be productive, then the extension toward and into Dalmayne coalfield would be the next step.

### **3.4. East Coast Coalfields**

The East Coast Coalfields stretch down the coast from the area of the northeastern fields (Mt Nicholas, Fingal, and Dalmayne). The coal measures lie within the Upper Triassic Parmeener Sub Group, with extensive Jurassic dolerite capping much of the area.

Note that for practical ranking and retention purposes, the Mt Paul and Llandaff coalfields have been grouped with the northeast coalfields.

#### **3.4.1. Douglas River Coalfield**

Summary: The Douglas River coalfield is considered a southern extension of the Dalmayne coalfield, and has similar CSG potential to Dalmayne. Total coal thickness averages 4 to 5 meters. Risks include depth (average coal depth only 200 to 400 meters), coal quality, areal extent, and of course permeability. However, much of the Douglas River coalfield lies under Douglas Apsley National Park. The area is worth retaining, however, due to the CSG potential surrounding the park, in particular to the west.

The Douglas River Coalfield is south of and adjoins the Dalmayne coalfield, and comprises the land for several kilometres on either bank of the river. Dolerite caps the area away from Douglas River, and rugged topography has limited further coal exploration and mining. However, the coalfield appears to be mostly contained within Douglas Apsley National Park.

There are six coaly intervals within the coal measures, but only one seam (the DD) is of significance to mining. Seams are 2 to 3m thick and an in situ indicated coal reserve of 30 million tonnes has been quoted (Bacon, 1991, Appendix 1). The coalfield has “considerable interest for further (coal mining) exploration.”

The Shell drilling campaign of 1979 (Ford and Bos, 1984) included 7 coreholes over the Douglas River coalfield (GY22, 23, 25, 27, 103, 104, 105). The data gives similar results to the Dalmayne coalfield: average total coal thickness 4 to 5 meters, distributed over 3 to 4 main seams, each about 1 to 1.5 meters thick. The coal is distributed over an interval of about 50 to 100 meters.

As with the Dalmayne coalfield, from a CSG perspective, there is a risk with the depth of the coal seams. Of the 7 core holes, only four have coal seams deeper than 300m. For all the 7 core holes, the average depth interval is 220 to 320 meters; for the four holes with deeper coal, the average depth interval is between 300 to 400 meters.

### **3.4.2. Denison Rivulet Coalfield**

Summary: The Denison Rivulet coalfield is considered a southern extension of the Douglas River (and hence Dalmayne) coalfield. There are only two holes drilled in the coalfield, with similar results to Douglas River and Dalmayne. As with Douglas River, much of the Denison Rivulet coalfield lies under Douglas Apsley National Park. The area is worth retaining, however, due to the CSG potential surrounding the park, in particular to the west.

The Denison Rivulet Coalfield lies to the south of and adjoins the Douglas River Coalfield. It includes the land for several kilometres on both banks of the rivulet. The seams are described as thin and banded; however selected coal plies when analysed demonstrate relatively low ash content. Away from the rivulet the area is capped by dolerite and has rugged topography. Coal mining reserves within the coalfield itself are likely to be small (Bacon, 1991). Combined with the Dalmayne and Douglas River areas, it is still considered an area of coal-mining exploration interest (Bacon, 1991).

Only two documented boreholes have been drilled in the Denison Rivulet coalfield. One by the DOM (DOM Bicheno DDH5) in 1979, and one by Shell (GY29) in 1982. GY29 was drilled to a depth of 431 meters, and encountered 7 meters of total coal, over 5 seams averaging 1.5 meters each, over an interval from 200 to 337 meters drill depth. Details of Bicheno DDH5 were unavailable.

However, the areas under the dolerite, away from the rivulet, may have deeper coal seam gas potential. More data would be required to assess any deeper CSG potential.

### **3.4.3. Seymour Coalfield**

Summary: The Seymour coalfield is considered of limited near-term CSG prospectivity, given the limited drill-hole data and the shallow depth of the proven coal. However, it is proven that deeper coals exist to the west, at Dalmayne and Douglas River, although much of this area is under Douglas Apsley National Park. The area is worth retaining, however, due to the CSG potential surrounding the park, in particular to the west.

The Seymour Coalfield lies on the eastern coastal plain, about 15 kilometers north of Bicheno, and about 10 kilometers southwest of the Dalmayne coalfield. The western extension of Seymour coalfield lies under Douglas Apsley National Park.

The thickness of the Upper Triassic coal measures is approximately 100m thick, with four seams, all less than 1.5m thick and mudstone banded. Dolerite caps the sequence on the highlands to the west. Coal-mining reserves within the coalfield are described as small.

Five boreholes were drilled in 1888, and are summarized in Hills et al, 1922. One of these boreholes, Seymour 5, is closer to the Douglas River coalfield than the Seymour coalfield. Total coal thickness is in the order of 4 meters. However, the coal is

generally quite shallow, from 8 meters to 110 meters depth. The deepest coal encountered in these Seymour boreholes was 110 meters, in Seymour 4. (Seymour 5 encountered coal to 188 meters).

Two DOM boreholes were drilled in 1944-45, but were only drilled to 48 and 76 meters depth. No boreholes have been drilled since.

#### **3.4.4. Llandaff Coalfield**

Summary: The Llandaff coalfield area is considered moderately prospective for CSG exploration / appraisal, both because of its proximity to the Fingal - Dalmayne - Denison Rivulet - Douglas River trend, and because of the “Llandaff north-west” being previously identified as a prime target area for coal exploration (GSB60, 1981, Leaman and Richardson). However, coal seams have only been proven to a depth of 165 meters, although the “coal measures” have been proven to a depth of 320 meters. Further exploration / appraisal work would be required to delineate potentially deeper coals.

The Llandaff coalfield is located about 5 kilometers west of Bicheno, on the east coast of Tasmania, and about 5 kilometers southeast of the southern edge of Douglas Apsley Park. It is also about 20 to 25 kilometers south of the most CSG-prospective Fingal-Dalmayne area.

From a coal-mining perspective, the Llandaff coalfield itself (to be distinguished, presumably, from the Llandaff north-west area identified by Leaman and Richardson) is considered of minimal interest for future exploration (Bacon, Bulletin 64) because of the thinness nature of the seams and their limited or discontinuous lateral extent.

A total of 8 holes appear to have been drilled in the area: Llandaff 1, 2, and 3, by the DOM; core hole GY8 by Shell in 1978; and DOM Bicheno 3A, 4, 7, and 8 around 1980, as part of the regional gravity survey. Specific data on the individual coal seams was not always easily found in the references.

Geological Survey Bulletin 60, 1981: Gravity Survey of the East Coast Coalfields, by Leaman and Richardson, lists “Llandaff north-west” as a prime target area for further coal exploration, as it is one of the areas where “the Triassic section is thickest”. Which does not necessarily mean that the Triassic is coal-bearing, but that it is prospective.

Specific drill hole data is summarised as follows. From Leaman and Richardson appendix 3: in drillholes Llandaff 1 to 3, the “coal measures” extend to depths of 142, 218, and 221 meters respectively. Hills et al present the detailed drillhole data for Llandaff Bore numbers 1, 2, and 3, drilled to depths of 145, 218, and 229 meters respectively. Total coal thicknesses range from 1 to 2 meters, while the deepest proven coal is 166 meters in Llandaff-3.

Shell’s core-hole GY8, in 1978, was drilled and cored to a depth of 265 meters, intersecting a 2.2 meter seam at a depth of 150 meters (ref. Ford and Bos, 1984).

DOM holes Bicheno 3A and 4 were drilled to depths of 352 and 127 meters respectively. The only coal seam data found was that the “coal measures” reached 320 meters in Bicheno 3A, and only 3 meters depth in Bicheno 4. Bicheno 7 was only drilled to 47 meters. Ford and Bos also document these holes in their report, but give no individual coal seam data on these particular holes; possibly because Llandaff was outside of their area of interest (or possibly because the holes may not have intersected coal).

From a total coal thickness point of view, the most likely thickness appears to be about 3 meters, with one outcropping seam reported by Twelvetrees in 1902 to be 4 meters thick.

### **3.4.5. Mt Paul Coalfield**

Summary: The Mt Paul coalfield is considered of limited near-term CSG prospectivity, given the limited drill-hole data, poor access, and possibly limited areal extent of the coal. However, it is possible that deeper coals may exist in the Mt Peter area. This would require grass-roots exploration to assess.

The Mt Paul coalfield is located about 8 kilometers north of Coles Bay, on the east coast of Tasmania, or about 20 kilometers south of the Llandaff coalfield. Access is reportedly poor.

Only two diamond drill holes have been drilled in the area, by the DOM in 1969, but these were targeted at delineating limestone (Jennings, 1969). The holes were drilled to depths of 25 and 70 meters. No coal intersections were shown on the Lithological Sections (Figure 27, Jennings).

Ford (1982) studied the area for Shell, and on the basis of the adit driven north in the 1920's, maps the coal dipping to the north at about 4 to 5 degrees. From the schematic cross-section (Enclosure 1, Ford, 1982), “Interpretation 1” would place this main coal seam at a depth of about 150 meters below Mt Paul, and 300 to 400 meters in the Mt Peter area, although this is quite an extrapolation. Given the outcropping of the coals to the south, coal seam gas retention may require fault-sealing in the area. “Interpretation 2” does posit an east-west trending fault between Mt Paul and Mt Peter, which could make the area around Mt Peter prospective for CSG.

Total coal thickness is estimated at 3 meters, based on the data in GSB64. However, the presence of other minor coals could conceivably bring this up to the 5 to 8 meter range, as in the northeast fields.

The coal-bearing area is limited to a small graben (GSB64, Bacon, 1991), and the area is badly faulted, although from a CSG point of view, faulting is not necessarily a limiting factor.

### **3.4.6. Schouten Island Coalfield**

Schouten Island was declared a National Park in 1967, and is exempt from provisions of the Mining Act.

### **3.4.7. Triabunna Coalfield**

Summary: The Triabunna coalfield is considered of limited near-term CSG prospectivity, given the limited drill-hole data, the shallow proven depth of coal (maximum 60 to 75 meters), the intermittent presence of coal in the drillholes and shafts, and its apparently limited areal extent.

The Triabunna coalfield is located east of the town of Triabunna, on the east coast of Tasmania, about midway between Hobart and northeast coalfields.

Coal was initially discovered outcropping on a hill east of Triabunna. A total of seven shafts were sunk in the area in the late 1800's, with two of them intersecting a coal seam 1.5 meters thick.

Montgomery studied the area in 1890, and states that 130 meters thickness of "coal measures" are proven in the area. Coal had been proven to a depth of about 35 meters, in Shaft C.

Four boreholes were drilled in 1891 (proposed by Montgomery, 1891). Results are presented in Hills et al, 1922. The four bores were drilled to total depths of 53, 23, 130, and 80 meters. Bore No. 4 appears to be the only one to encounter coal, about 2 meters of banded coal at a depth of 30 meters, with thin traces of coal at depths of 60 and 75 meters.

No coal mining or exploration has occurred in the area since the 1890's. Potential for future coal mining exploration in this area is considered very limited (GSB64, Bacon).

### **3.4.8. Buckland Coalfield**

Summary: The Buckland coalfield is considered of limited near-term CSG prospectivity, given the limited drill-hole data, the shallow proven depth of coal (maximum 30 meters), the intermittent presence of coal in the drillholes and shafts, and its apparently limited areal extent.

The Buckland coalfield is located about 10 kilometers north of Buckland, and is divided into two coal discoveries. However, both of these coal deposits are contained within a small fault block, with limited areal extent, in the order of 1 to "a few" square kilometers each.

Two bores (A and B) were drilled in the Prosser's Plains area early in the century, to depths of 125 and 133 meters. Results are presented in Hills et al, 1922, and do not

show any coal being intersected. Hills explains the lack of coal: “The failure in cutting the coal beds, and the fact that the strata passed through consist of the lowest members of the Trias-Jura, clearly show that the felspathic sandstones containing the seams have been faulted, the displacement amounting to fully 450 feet.”

In Robinson’s “shaft and drive” data, presented in Hills, 1922, several coal seams were intersected, totaling 2.5 meters in thickness, and extending to a depth of 30 meters.

No significant further exploration work appears to have been done since about 1920.

Potential for future coal-mining exploration is considered very small (GSB64, Bacon).

### **3.4.9. Saltwater River Coalfield**

Summary: The Saltwater River coalfield is of limited areal extent, of questionable coal quality, and is classified as an Historic Site.

The Saltwater River coalfield is located on the outermost, northern end of the Tasman Peninsula. The mine was the first to be operated in Tasmania, and is now designated a Historic Site. In addition, the area directly to the north, where the coalfield extends, is a Nature Reserve.

The coal-bearing sediments of the Upper Parmeener Supergroup are limited to a small fault block only 500 meters wide. Also, the coal is purportedly poor quality.

There has been no exploration of the area since the mine closed in 1877. GSB64 (Bacon) classifies the coalfield as having “no potential” for further coal-mining exploration.

## **3.5. *The Avoca Coalfield (Northeast)***

The Avoca coalfield is located in the northeastern part of Tasmania, but inland from the major northeastern fields.

The seams occur within a sequence of dominantly lithic sandstone interbedded with minor mudstone, siltstone and coal of the Upper Parmeener Supergroup. Total coal thickness is up to 5m thick and includes numerous mudstone bands. The coal quality is similar to that in the northeastern coalfields: high ash, low sulphur, steaming coal. The coalfield is heavily faulted and seam correlation is difficult. Only very small in situ coal reserves are quoted for the area. Jurassic dolerite extensively intrudes the sediments and caps most of the higher topography.

### **3.5.1. The Mount Christie (Stanhope) Coalfield**

Summary: Although the presence of very shallow coal seams has been proven, no significant seams have been proven to exist deeper than 100 meters. The possibility of significant and deeper coals existing appears slim.

The Mount Christie Coalfield is located about 8 kilometers north west of Avoca. Coal has been mined from this coalfield continuously since 1923. The following mines are found within this area: Fenton, Stanhope, Mt Christie, Buena Vista, with Stanhope and New Stanhope being the largest historical producers.

The coal seams occur in the Upper Parmeener Supergroup, which overlies a coal-void quartzose sandstone; meaning that the potential for CSG coals occurring deeper may be limited. However, the area is badly faulted (Hills, 1922), making correlation of coal seams difficult, but also opening the possibility for deeper coals. Seam thicknesses of up to 4m have been recorded in the mines, but not outside the central mining area.

Early drilling (1953-1972) by mine management was mostly shallow. However, one well, DDH17, did encounter a 2.1m coal seam at 92m drill depth (although the exact location of this well is unknown – Bacon, 1983; The Mount Christie – Stanhope Coalfield, Appendix 3).

In 1976, Western Mining Corporation drilled 9 chip holes (TAR-1 through 9) west of the central mining area. The maximum depth, however, was 85 meters, and only 3 of the wells intersected minor coal seams, with the other 6 holes encountering no coal. The deepest intersected coal seam was at 44m in TAR-3.

In 1980, Shell drilled two deep holes west of Stanhope (AV-12, AV-13). AV-12 was drilled to 490 meters, and encountered “minor coal”. AV-13 was drilled to 350 meters and encountered no coal.

Avoca Transport Pty Ltd drilled 8 shallow holes (maximum depth 25 meters) in the mid 1980’s (Ref: Avoca Transport Company Pty Ltd, E.L. 1/84 Final Report).

### **3.5.2. The Merrywood Coalfield**

Summary: Although only shallow coal seams appear to exist in the immediate Merrywood mine area, deeper seams have been proven to exist to a depth of about 200 meters in DOM DDH22 at Locaber (7 km east of Merrywood). The potential of encountering deeper coals than this requires further geological work.

The Merrywood coalfield is located 15 kilometers south of Fingal, and 20 kilometers east of Avoca, and is considered a southern extension of the Fingal – Mount Nicholas coalfield. Mining ceased in 1963.

The Merrywood seam is in the order of 3 to 4m thick, in the open cut section, and is tentatively correlatable to the ‘C’ coal interval in Fingal Tier. The coal is of good

quality (average 25% ash content) but the deposit was small, from a mining perspective.

Approximately 25 holes were drilled in the Merrywood area between 1974 and 1986, by various exploration companies. The vast majority of holes were shallow (<50m).

In 1978, Investigator Coal Exploration drilled 4 holes in the Merrywood area (Sangster; March, 1979). The total depth of the holes ranged from 100 to 200 meters, with coal being encountered as deep as 155m in Hole 78RG-1 and 160m in 78RG-2. These two holes are located about 10 km south of the Merrywood mine, or 5 km south of Royal George

DOM DDH22 was drilled about 12 kilometers northeast of Royal George, or 8 kilometers east of the Merrywood mine, and encountered 6 “thin coaly intervals”, totaling approximately 4.5 meters of coal, with the deepest seam being at 200 meters drill depth (Waters, 1978).

The Avoca Transport Company’s 1987 progress report (TCR report 87-2727), depicts a conceptual cross-section (Figure 3) of the Merrywood coal seam, with its intersection with DOM DDH22 at a depth of approximately 125m (as well as coals as deep as 200m). Also, under Pratts Hill, there is the potential for 200m or more of depth to the Merrywood seam, although the possibility of significant coals deeper than this in the immediate area appears questionable, based on the relatively gently dipping Merrywood Coal Seam (from the cross-section constructed by Avoca Transport in 1987).

Also note that DOM DDH18 was drilled to 452m depth, and encountered no coal.

### **3.6. Northern Midlands Coalfields**

The Northern Midlands coalfields consist of the York Plains, the Woodbury and the Mike Howes Marsh Fields. The coal measures were deposited during the Upper Triassic which was intruded by Jurassic dolerite. Coal is similar in quality to other Tasmanian Triassic coals, namely dull, high ash, steaming coal, except that in places the volatile content has been reduced by the heating effects of the intrusions. Most of the mining and exploration drilling in the area has been at shallow depth, and little has been done to explore deeper. Proven coal reserves are small.

#### **3.6.1. York Plains**

Summary: This area is considered under-explored from a CSG perspective, and has moderate CSG prospectivity. Although the presence of fairly thick (average 4 meters total), shallow coal seams has been proven, no coal seams have been proven to exist beyond 105 meters depth. The potential of deeper coals being penetrated requires further geological work.

York Plains is located about five kilometers northeast of Oatlands, with good access by road. Coal was mined at the York Plains Colliery from 1894 to 1947.

York Plains has had several drill hole programs, most of them quite shallow. The average total thickness from the CRA program of 1984 (Summons, 1984; 7 York Plains drill holes summarised) is 4 meters (range of 0.4 up to 7 meters), of good quality coal (similar to other Tasmania coals: 20-30% ash, 24-26 MJ/kg specific energy). However, none of the drill holes penetrated beyond 50 meters depth in this campaign.

The Department of Mines drill hole DOM York Plains DDH2 in 1984 (Bacon, 1985) established coal down to 105 meters, and encountered a total coal thickness of about 3.5 meters.

### **3.6.2. The Woodbury Coalfield**

Summary: This area is considered under-explored from a CSG perspective, and has moderate CSG prospectivity. Although the presence of thick, shallow coal seams has been proven, no coal beds have been proven beyond 125 meters depth. Also, the coal quality is questionable, with ash content at 40%, and specific energy only 19 MJ/kg. The potential of deeper coals being penetrated requires further geological work.

The Woodbury Coalfield is located about 12 kilometers north of the York Plains area, and 5 kilometers south east of Tunbridge. A small open-cut deposit of coal found near Woodbury, but was never mined.

Coal reserves of 25 Mt (in situ, measured and indicated), have been defined (Eshuys and Summons, 1982). However, these reserves are for open-cut mining, and are likely to be too shallow for CSG development. An additional 290 Mt of in situ inferred coal reserves are also defined, for areas adjacent to Woodbury.

A Victor Petroleum Joint Venture drilled 18 chip and core holes in the early 1980's.

The coal seams A through D constitute a total thickness of 5 to 9 meters. However, the ash content is somewhat high, averaging 40% (Eshuys, Summons, 1982), and the average specific energy is only 19 MJ/kg. An average value for total coal thickness of 7 meters is assumed, based on Eshuys and Summons, Table 1.

The maximum depth that coal reserves have been identified in the drill campaigns is Seam B at 62 meters (Drill Hole W49; Eshuys, Summons, 1982) However, the cross-sections of the Woodbury mine (Enclosures in Eshuys, Summons, 1982) show several drill holes (W1, W40, W46) encountering coal seams as deep as 80 to 125 meters drill depth. Drill holes W3 and W15 were drilled to 150 and 137 meters respectively, with both encountering deepest coal at about 100m.

### **3.6.3. The Mike Howes Marsh Coalfield**

Summary: Although this coalfield is under-explored from a CSG perspective, the two shallow drill holes (each 50 meters total depth) only encountered a total of 0.1 meters of total coal thickness. The CSG prospectivity is considered poor.

The Mike Howes Marsh Coalfield is located in central Tasmania, about 20 kilometers north-west of York Plains. No coal has been mined. The restricted lateral extent and thin nature of the seam leave this area with limited potential for coal mining and CSG exploration.

Only two drill holes have been drilled in the coalfield (O-04 in 1982, and JC-01 in 1984), both to a depth of only 50 meters. Hole O-04 encountered one thin coal seam (0.1 meters thick, at 42m drill depth), and JC-01 encountered no coal.

## **3.7. Southern Midlands Coalfields**

The Southern Midlands Coalfields are a group of small coalfields containing the Upper Triassic coal measures intruded by Jurassic dolerite. Coal seams of 2m thickness or more have been mined in the area; however most of the mining and exploration drilling has been shallow, and has proven only small reserves of coal.

### **3.7.1. The Colebrook (Jerusalem) Coalfield**

Summary: This area is considered to have low prospectivity for CSG. Only thin, shallow coal seams have been proven (average total coal about 2.5 meters; several holes intersected no coal at all). The deepest proven coal is 70 meters. No holes have been drilled deeper than 105 meters. However, the coal-bearing units are interpreted to be downthrown to the east and west (Bacon, 1991). Deeper, prospective coals would require further geological work.

The Colebrook coalfield is located near the town of Colebrook. Two minor coal mines operated north of Colebrook, and were closed down around the turn of the century (1900). Good access is likely, via sealed and unsealed roads. Dolerite caps the surrounding hills. The area is faulted, and coal-mining has been concentrated in down-thrown grabens.

Several boreholes have been drilled in the area (Summons, 1984; General Geological Services (for Capricorn Mining), 1981; and Hills et al, 1922). No holes were drilled deeper than 105 meters.

In 1891, Jerusalem-1 was drilled to a depth of 105 meters, and encountered 2.6 meters of total coal (over 4 seams), with the deepest coal being at 70 meters drill depth (Hills et al, 1922). From a CSG perspective, this is the deepest coal proven in the immediate area.

Two diamond drill holes were drilled by Capricorn Mining in 1982, with minor, shallow seams being encountered. Corehole data show 2 to 5 seams of 0.3m to 1.5 meters thick. However, these seams are shallow (the wells were only drilled to a depth of 50 and 100 meters). The potential for coals requires further geological work.

### **3.7.2. The Bagdad – Kempton Coalfield (Mt Vernon area)**

Summary: This area is considered to have moderate CSG exploration potential. A good quality seam was encountered at 200 meters in a single drill hole (Mt Vernon DDH1), with the deepest coal at 296 meters drill depth. With apparent faulting and/or steeply dipping beds, there is a possibility of deeper coals in the area. However, there is a productivity risk, with calcite on cleat faces noted in the core.

This coalfield is located between the towns of Bagdad and Kempton, approximately 40 to 50 km North of Hobart. Access is via the Midland highway. No mining has taken place in the area.

A DOM drill hole (DOM Mt Vernon DDH1; Bacon, 1983) encountered 1 seam 2.3m thick, of good quality coal at 200 meters depth (15% ash, Specific Energy 28 MJ/Kg).

Several other coal seams were encountered in the DOM drill hole, mostly shallower than the main seam at 200 meters. The hole was drilled to a total depth of 500 meters, with further thin coal seams (3 seams at 0.7 to 1.4 m thick; multiple seams < 0.5m thick) reported down to 296m depth, in what was termed “Sequence 3” (Summons, 1984, CRA Exploration). However, there were “vertical wisps of calcite” and “calcite on cleat faces” noted in the core.

Other holes were drilled by CRA Exploration in 1984. Several thin (0.5-1.0m) coal seams were encountered, at depths less than 100m. These wells were only drilled to less than 50 meters total depth.

The area is probably broken up due to faulting (Bacon, 1991). The presence of a good quality seam at 205 meters depth, and its possible presence in other seams at outcrop, suggests significant dip and/or faulting, which could result in some seams being deeper than 300m in the area.

This area is considered to have moderate CSG exploration potential.

### **3.7.3. The Richmond Coalfield**

Summary: The Richmond coalfield is considered of limited immediate interest from a CSG point of view. Little data exists. One borehole from 1888 proved 1.5 meters of total coal, to a depth of 133 meters.

The Richmond Coalfield is located southeast of Richmond. A brief, unsuccessful mine operated in the 1840's. One bore hole was drilled in 1888 by DOM, which intersected 3 thin seams, up to 0.7m thick, totaling 1.5 meters of coal. The hole was drilled to a depth of 150 meters, with the deepest coal being at 133 meters.

From a coal mining point of view, the area is considered of little interest for future exploration (Bacon, 1991).

## **3.8. Southern Tasmania Coalfields**

The Southern Tasmania Coalfields contain the Upper Permian Cygnet Coal Measures and some Upper Triassic coal seams. Jurassic dolerite covers much of the area, capping the hills. Individual seams within the Cygnet Coal Measures are generally thin (1m or less) and faulted, and inferred coal reserves are small. Prospects for CSG exploration are moderate. Coal seams in the Upper Triassic coal measures are generally thin, faulted and banded, but present moderate prospects for CSG exploration.

### **3.8.1. The New Town Coalfield**

The New Town Coalfield is a now part of a residential district on the eastern edge of Hobart and is exempt from the Mining Act.

Coal was proven to a depth of 130 meters (Hills et al, 1922). The coal was of poor quality, and mined for domestic purposes only.

### **3.8.2. The Kaoota (Sandfly) Coalfield**

Summary: The Kaoota Coalfield is considered to have moderate CSG potential. Average total coal thickness is about 3 to 4 meters, with the deepest proven coal being at 160 meters drill depth. Further exploration work would be required to find deeper coals, and ideally, thicker total coal sections.

The Kaoota coalfield is located near the town of Kaoota, about 25 kilometers southwest of Hobart. The Coalfield was mined intermittently from 1876 to 1973.

The coal seams occur in the Kaoota Coal Measures, within the Upper Parmeener Supergroup. The coal measures do not outcrop in the area, and the area is likely to be faulted. The areal extent from a CSG perspective is uncertain.

A total of 16 holes have been drilled in the area since 1895: 4 by the DOM in 1895, 7 by the DOM in the early 1970's, and 5 by Capricorn Mining Ltd in 1981. Detailed data for 14 of the 16 boreholes was found and collated (Hills et al, 1922; Threader, 1972; Threader, 1974; Capricorn Mining, 1981).

Only 6 of boreholes were drilled beyond 100 meters. From these six, the average total coal thickness is 3.3 meters, over 4 to 7 seams, with the thickest seam generally about 1 to 2 meters thick. The deepest coal was encountered in the deepest hole, DOM Bore A, in 1895: total drill depth of 205 meters, with the deepest coal encountered at 160 meters depth. All of the holes, except Capricorn's K-01, encountered coal (K-01 was drilled to only 50 meters). Some of the holes were drilled strictly to define fault locations and fault throw, and were not necessarily intended for coal delineation.

It is also important to note that all 16 boreholes were drilled within a relatively small area of 4 km<sup>2</sup>. Further exploration work would be required to find deeper coals, and ideally, thicker total coal sections.

Coal quality appears similar to other Tasmania coals (eg. 23% ash content).

From a strictly coal-mining perspective, the Kaoota coalfield is considered to have limited further exploration potential, given its thickness (circa 0.75 meters in the mined Sandfly seam), the limited areal extent of the coalfield, and the field being badly faulted in the immediate mining area (GSB64).

### **3.8.3. Cygnet Coalfield**

Summary: The Cygnet coalfield is considered of limited immediate interest from a CSG perspective. Only five boreholes have been drilled, and only two boreholes definitively encountered coal, at depths of 20 meters. The potential of deeper coals requires further geological work.

The Cygnet coalfield is located about 8 kilometers east of the town of Cygnet, about 40 kilometers south-west of Hobart. The coal seams are part of the Cygnet Coal Measures, which do not outcrop in the Cygnet area. The lack of coal-outcropping in the area may be a positive from a CSG perspective.

Five boreholes appear to have been drilled in the area. The DOM hole at Mt Cygnet (Farmer, 1979) proved 35 meters of Cygnet Coal Measures, and proved coal to a depth of 22 meters. The hole was drilled to a total depth of 54 meters.

Capricorn Mining Limited hired General Geological Services in 1981 to drill 4 holes in the Cygnet area. According to Bacon (1983), "no coal intersections were noted on the lithological logs although indications of seams are claimed on some of the

geophysical logs". Two of the holes were spudded below the coal-bearing strata. According to Capricorn Mining's Six-month Progress Report, 1981 (report TCR 82-1682, Table 23), only drillhole C-04 intersected coal, a 1.0 meter seam at a depth of 17 meters.

Total coal thickness from the mining data suggests two main seams are present in the area, totaling about 1 to 2.5 meters in thickness. The DOM borehole intersected 4 seams totaling 1.3 meters, with the thickest being 1.0 meters.

From a coal-mining exploration perspective, the area is considered to have poor potential, due to the area being faulted and having thin seams.

#### **3.8.4. Strathblane Coalfield**

Summary: This area is considered of low to moderate CSG prospectivity. No coal has been proven beyond a depth of about 10 meters, and the coal is of uncertain total thickness and areal extent. However, it is possible, or even likely, that deeper coal seams occur beneath the dolerite-capped ridge.

The Strathblane Coalfield is located about 4 kilometers west of the town of Strathblane, in southern Tasmania, or about 60 kilometers southwest of Hobart. The area is in the far southwestern corner of the exploration lease, only two kilometers from the western edge.

The coalfield has been the subject of limited coal-mining and exploration. Intermittent small-scale mining operations were conducted between 1910 and the 1960's. More recently, in 1976, Earth Resources Australia Pty Ltd explored the area, drilling a total of 19 holes. However, their objective was to find open-cut mines, and none of the drill holes went deeper than 30 meters (Bunny, 1976).

In 1983/84 Marathon Petroleum Australia explored the area (as EL40/83), but relinquished the area in 1985. No further drilling was done

The Earth Resources boreholes were only drilled to 30 meters, and only three of the holes in Line A encountered coal. Line B to the north only had one well encounter coal. In the boreholes that did encounter coal, only about 0.2 meters was found. Most of the seams worked in the mines, however, were about 0.6 to 1.6 meters thick, with high variability and abrupt lateral changes. The average working seam was about 1 meter thick.

From a CSG exploration perspective, the coal seams dip in the range of 20 to 25 degrees (1 meter in 3), the ridge is capped by dolerite (as in the northeastern coalfields), and the area is faulted. The dip of the seams (Bacon, 1991) appears to suggest that the coal seams dip under the high dolerite ridge. So it is possible that deeper, CSG-prospective, coals (>300m depth) could exist in the area (1 km at 25 degree dip = 300 meters depth), and that the seams could be "sealed" by faulting, and possibly the dolerite. The maturity of the coal could also be affected by the dolerite.

However, the downside is that there may not be enough total coal thickness to warrant further drilling, and the area appears limited to about 10 km<sup>2</sup>. More detailed analysis of total coal thickness, and geological mapping, based on the borehole and mining operation data would be required.

The coal is apparently of good quality (ash content less than 20% from the limited number of samples).

From a coal-mining perspective, the coalfield is considered of very limited potential, due to its thin, patchy seams, variable thickness, discontinuity, and apparent lack of areal extent.

### **3.8.5. Hastings Coalfield**

Summary: Very little is known about the Hasting Coalfield, except that three main seams totaling 3 meters in thickness were briefly mined. However, the area is worth keeping from a CSG perspective because of its proximity to the Ida Bay area to the south, where relatively thick coal seams have been proven to a depth of 300 meters.

The Hastings Coalfield is located in southern Tasmania, about seven kilometers north of the town of Ida Bay, or 3 kilometers south of the Strathblane Coalfield. The Hastings Coalfield was briefly mined in the early 1900's. No work has been done since 1922. No drillhole data appears to be available in the immediate area.

From a strictly coal-mining perspective, the Hastings coalfield is not considered prospective, due to its limited extent and thin, banded seams.

### **3.8.6. Ida Bay Coalfield**

Summary: The Ida Bay Coalfield, and in particular the area immediately to the south and southwest toward Catamaran Coalfield, is considered to have good prospectivity for CSG. Coal has been proven to a depth of nearly 300 meters (about 5 kilometers south of the field), and total coal thickness is encouraging, ranging from an average of 4 meters, up to 7 meters. Coal quality is uncertain, however. Also, the areal extent of any CSG development could be limited by the proximity to the lease boundary to the west.

The Ida Bay Coalfield is located about 2 kilometers south of the town of Ida Bay in southern Tasmania. The lease boundary is only about 3 to kilometers to the west. Minor coal mining operations were conducted early in the 1900's.

More recently, in 1976, Earth Resources Australia Pty Ltd explored the area, drilling a total of 15 holes. However, their objective was find open-cut mines, and none of the drill holes were deeper than 30 meters (Bunny, 1976).

In 1983/84 Marathon Petroleum Australia explored for open-cut coal, and drilled 20 boreholes between Ida Bay and Catamaran (as EL40/83). About half of the holes concentrated in the Ida Bay area (Perkins, 1982; Perkins, 1983). Borehole CA106, drilled about 2 kilometers southwest of the Ida Bay Coalfield, intersected about 4 meters of total coal, down to a depth of 212 meters. CA114, about 1 kilometer southwest of the Ida Coalfield, intersected the thickest total coal section: 7 meters of coal, to a depth of 163 meters. The deepest coal was intersected in CA109, another 4 kilometers south, which intersected coal down to 287 meters.

The coal quality is uncertain (Hills, 1922: unsuitable for steaming or domestic use); Table 23 in Bulletin 64 shows an ash content from the limited samples in the range of 23%, with a specific energy being of 18 to 25 MJ/kg.

### **3.8.7. The Catamaran - Moss Glen Coalfields**

Summary: As with Ida Bay, this area is considered to have good prospectivity for CSG. Coal has been proven to a depth of nearly 300 meters (about 4 kilometers north of the Moss Glen field), and total coal thickness is encouraging, ranging from an average of 4 meters, up to 7 meters. The areal extent of any CSG development could be limited, however, by the proximity to the lease boundary to the west.

From a CSG development perspective, the average coal depth in the existing boreholes is probably too shallow, but the area should still be considered prospective for further exploratory / appraisal work.

The Catamaran – Moss Glenn Coalfields are located in the extreme southwestern corner of the permit, near Southwest National Park. The two coalfields are about 3 kilometers from each other, with the Catamaran field being 2 kilometers west of the town of Catamaran, and the Moss Glenn coalfield being 3 kilometers north of the town.

The Moss Glen coalfield was never mined. The Catamaran coalfield was mined from 1900 to 1939 by a number of different operators. From the perspective of coal-mining exploration, the area north of Catamaran, including Moss Glen, is considered of some interest (Bacon, 1991), even though the coal seams are expected to be “thin, banded, discontinuous, and badly faulted.” In particular, the area north of Catamaran, including Moss Glenn, is “worth closer inspection.”

Marathon’s exploration program of the early 1980’s (summarised by Perkins and Dunn, 1984) drilled a total of 20 boreholes in the Ida Bay – Catamaran area, 5 of which were abandoned due to drilling problems, and two of which were chipholes. As partly discussed under the Ida Bay Coalfield section, 12 of these holes were drilled beyond 100 meters total depth, with 6 boreholes in total proving coal beyond 150 meters depth.

In the immediate area, CA109, drilled about 2.5 kilometers north of Moss Glen, intersected 4 meters of coal, with the deepest coal being at 287 meters. CA111, which

is midway between Moss Glen and Catamaran, intersected 5.3 meters of total coal (two seams 3.9 and 1.4 meters thick), with deepest coal being at 156 meters.

The average total coal thickness of the drilling program was about 4 meters. The average deepest coal was about 150 meters. The areal coverage of the program was roughly 20 km<sup>2</sup>.

The coal quality is variable, but looks prospective, with ash content ranging from as low as 3% up to 33%. Specific energy ranges from 19 to 30 MJ/kg.

From a CSG development perspective, the average coal depth in the existing boreholes is probably too shallow, but the area should still be considered prospective for further exploratory / appraisal work.

### **3.8.8. Adventure Bay Coalfield**

Summary: The economics of Coal Seam Gas development exclude this island coalfield from consideration in the short to medium term.

The Adventure Bay Coalfield is located on South Bruny Island. No detailed analysis has been done of this coalfield during this review (although according to Bulletin 64, the Adventure Bay coalfield is of “no economic importance” and has “no potential for further (coal-mining) exploration”, due to the “extremely thin nature of the seams and the small areal extent”). While the possibility that the coalfield has some CSG prospectivity cannot be excluded at this point, the economics of CSG make the development of an island coalfield extremely unlikely in the foreseeable future.

## **3.9. Northern Tasmania Coalfields**

Coal measures are of Late Triassic age in the Longford Coalfield. The sequence is of small areal extent, and faulted to the east against a dolerite sheet. It probably also overlies the dolerite sheet, which has intruded the basal sediments of the Upper Parmeener Super Group. The coal measures at the mine contain a coal seam of 1.8 to 2.0 m thickness, with thinner seams recorded in drill holes.

The coal seams in the George Town Coalfield are Late Permian in age, equivalent to the Cygnet Coal Measures in the southeast of Tasmania. Seams are thin and of limited extent.

### **3.9.1. The Longford Coalfield**

Summary: Of the 29 holes drilled over a fairly wide area by CSR in 1982, only 3 intersected coal. The best hole intersected 10 meters of coal at a depth of 50 meters.

None of the wells was drilled beyond 100 meters, with the maximum depth of proven coal being 80 meters. Although the presence of deeper coals can't be ruled out, the fact that so few of the holes intersected any coal has to relegate the area to low prospectivity for CSG.

The Longford coalfield is located 6 kilometers north of Longford, near the township of Pateena. Two small mines (Norwich and Pateena) operated from 1886 to 1919. The coalfield is considered of no further economic interest from a coal mining point of view, due to its limited areal extent and thin coal seams.

Two diamond-drill holes were drilled in 1886 south of Longford but intersected no coal seams. The Pateena mine shaft intersected a seam at a depth of 80 meters in 1886.

More recently, of the 29 drill holes sunk by CSR Coal Division in 1982, two were drilled in the Longford Coalfield area, with one of the holes encountering 3 thin coal seams, totaling 2.4 meters in thickness. Hole RO55 (drilled about 10 km northwest of Longford) encountered about 10 meters of coal to a depth of 55m drill depth. However, none of the 29 holes were drilled deeper than 100 meters. In addition, the 29 holes were drilled over a fairly wide area of the Carrick-Longford part of the Launceston basin, and only 3 of the holes encountered coal, "...significantly downgrading the economic potential" (Carr, 1984).

The coal quality appears good, with an ash content of only 13%, although this data is from 1888. Seam thicknesses were reported in the order of 2 meters at the Norwich mine, and 0.6m at Pateena, although these are "working thicknesses" of the mined seams, not total coal thickness.

### **3.9.2. The George Town Coalfield**

Summary: Little of the George Town area is within the license SEL32/2003. Also, there is little data deeper than 15 meters, and the coal that has been encountered is thin.

The George Town coalfield is located on south east side of Mt George, 3 kilometers east of George Town. Only thin coal seams were found (generally <0.3m). A limited number of shafts were sunk during prospecting but no mining operations were conducted. The coalfield has very limited potential from a coal mining perspective.

Six holes were drilled in 1935, with no coal being encountered.

More recently, Avoca Transport sunk several auger holes and costeans in 1981, with no significant coal seams being encountered, although these holes were only to a maximum of 9 meters, and were of "limited value" (Miedecke, 1983).

Coal quality appears good, but the limited data is from "hand-picked" samples in 1904. Ash content averages less than 10%.

### **3.10. Northwest Coalfields**

#### **3.10.1. Mersey-Don Coalfield**

Summary: This area is considered low prospectivity for Coal Seam Gas. Coal has only been proven to a depth of 40 meters, and the few wells that were drilled to find deeper seams (although only to a maximum depth of 100m), found no further coal.

The Mersey-Don coalfield is located between the Mersey and Don Rivers in Northwest Tasmania, extending from Tugra in the northwest to Dulverton in the southeast. Several small collieries worked the coalfield in the period between 1850 and 1961. These are described in some detail by Burns (1975).

The coalfield is comprised of thin, faulted seams in the order of 0.5m thick. Data on total coal thickness is difficult to find, although from the Burns data there appears to be 1 to 3 seams in the boreholes, totaling about 1 meter thickness.

Coal quality data is all pre-1943, with average ash content low (circa 5%), and sulphur content up to 5%. The sulphur content is not necessarily a problem with CSG development, unless the associated water becomes difficult to dispose of. Some interest has been shown on the oil shale potential of the area, but at a deeper interval than the Mersey Coal Measures.

Burns (1978) described ten smaller areas within the Mersey Coalfield that have been worked, all of them shallow (less than 40 meters). Depth-to-proven-coal is as follows (from Burns): Mersey Colliery (proven coal to 40 meters; 1 seam), Dennys Colliery (6 meters), Don Colliery (30 meters), Alfred Colliery (25 meters; borehole No. 4 was deepened in 1861 to 100 meters, without further coal), Rileys Coal Mine (15 meters), Coventry (12 meters), Compton's bore at Dawson's Pit (30 meters, 3 seams (1861)).

#### **3.10.2. Preolenna Coalfield**

The Preolenna Coalfield is outside of Exploration License SEL32/2003.

### **3.11. Derwent Valley Coalfields**

The Derwent Valley Coalfields are situated in the Derwent River Valley. They contain the Upper Triassic coal measures. The seams are similar in quality and lithotype to other Triassic Tasmanian coals. Seams are thin and coal reserves are small.

### **3.11.1. The Langloh (Lawrenny) Coalfield**

Summary: The Langloh Coalfield is considered to have moderate to good prospectivity for CSG. Coal has been proven to a depth of 150 meters, and total coal thickness is encouraging, ranging from an average of 4 meters, up to 7 meters. Thermal maturity has been increased by the dolerite intrusion, into the range of 1 to 3% vitrinite reflectance. The areal extent of any CSG development could be limited, however; the coal bearing area is possibly limited to a graben of roughly 10 km<sup>2</sup>, although this requires further study.

The Langloh Coalfield is located in the Derwent Valley between the towns of Hamilton and Ouse, approximately 80 kilometers northwest of Hobart. The Langloh coalfield was mined between 1938 and 1963. A Measured + Indicated coal reserve of 10 million tonnes in situ is estimated (Bacon, 1991, Appendix 1). The coalfield has “considerable potential for further (coal-mining) development.” (Bacon, 1991)

Five drilling campaigns were waged in the search for coal: 1893, 1939, 1944-46, 1956, and 1982 (all by the DOM, except the last campaign, by Capricorn Mining Ltd, 1982, Report TCR82-1682). A total of over 30 holes was drilled, although only 8 holes were drilled deeper than 100 meters, with the deepest being 185 meters (Borehole E in 1893).

The deepest coal seams encountered were in Capricorn’s H-06, at a depth of 147 meters. DOM Borehole B (1893) encountered coal as deep as 97 meters.

Total coal thickness during mining operations was in the range of 3 to 4.5 meters total “workable” coal thickness (based on 3 seams, each 1 to 1.5 meters thick). From the borehole data, total coal thickness from the Capricorn drilling campaign in 1981, and the DOM campaign in 1893, is in the range of 2 to 7 meters, with an average of about 4 meters.

Coal quality is similar to other Triassic coals, with an average ash content of 20%, and an average specific energy of 25 MJ/kg. However, vitrinite reflectance of the coal has been raised by the dolerite intrusion, to a mean maximum reflectance of 1.0 to 3.3%. This is higher, and possibly more prospective from a CSG point of view, than the Fingal-Dalmaine-Mt Nicholas samples, which range from 0.5 to 0.7%. The ideal range for coal seam gas generation is in the order of 0.7 to 2.0%.

### **3.11.2. The Mt Lloyd Coalfield**

Summary: The Mt Lloyd coalfield is considered of low to moderate CSG prospectivity. There is little data, and coal has been proven to a depth of 90 meters. Total coal thickness is likely between 2 and 4 meters.

The Mt Lloyd coalfield is located about 12 kilometers south-west of New Norfolk, and about 30 kilometers west of Hobart. No real mining has occurred at Mt Lloyd, only a few minor Teakle workings.

Four relatively thin (< 1.0 meter) coal seams have been reported in the area. From a coal-mining exploration point of view, the most promising areas appear to be on the flats, south of Mt Lloyd (Bacon, 1991).

The coal-bearing sequence dips due west, beneath a dolerite sill capping Mt Lloyd, possibly suggesting further CSG prospectivity to the west.

Three boreholes were drilled in the area of Mt Lloyd Coalfield: 2 in 1958 by DOM, and 3 in 1985 by Australian Newsprint Mills (ANM). Two of the ANM holes were abandoned due to drilling problems; no data could be found on the successful ANM hole, although it appears to have been drilled within 500 meters of DOM-1.

Of the DOM holes in 1958, DOM-2 was drilled to a depth of 82 meters, but did not intersect any significant coal; DOM-1 was drilled to 98 meters, and intersected a total of 2 meters coal, with the deepest coal being at 90 meters.

Total coal thickness is in the order of 2 to 3 meters.

Coal quality is “fair”, with average ash content of 27% and specific energy ranging from 21 to 25 MJ/kg.

## 4. Further Analysis of the Fingal – Dalmayne Area

Of particular interest is the 5 by 5 kilometer area (dashed outline, Figure 7) directly east of the Fingal coalfield mining lease. This is an area of approximately 25 km<sup>2</sup>, with 25 existing boreholes. Each of the grid squares in Figure 7 is 25 km<sup>2</sup>.

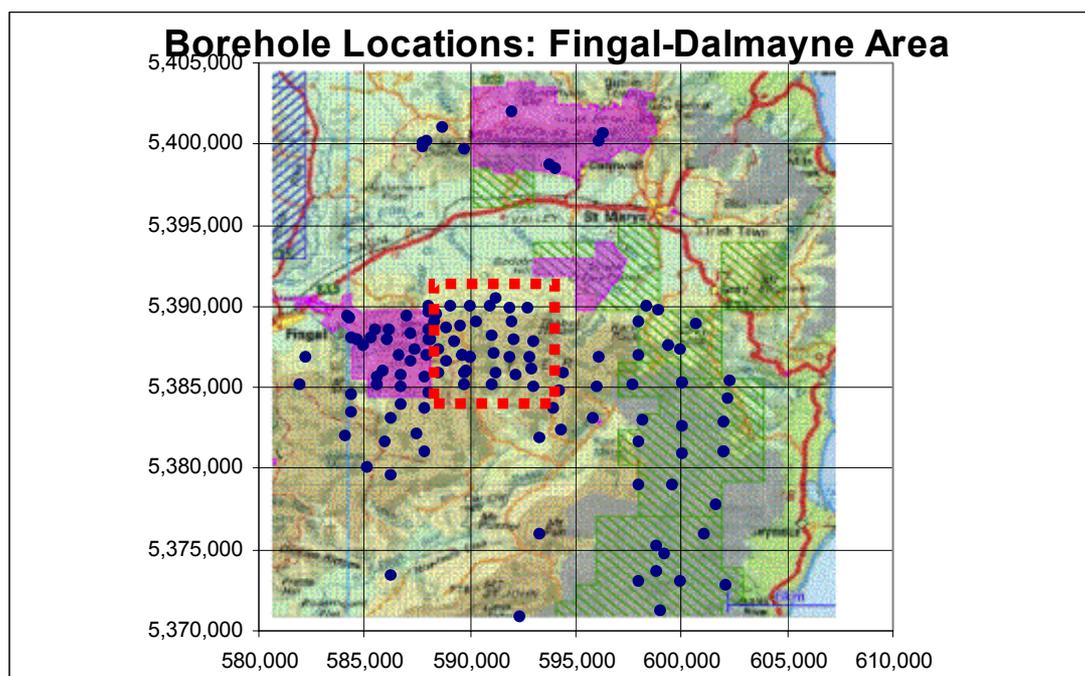


Figure 7: Borehole Locations with the Fingal-Dalmayne Area

As mentioned earlier in the report, the average top coal from these boreholes is at approximately 300 meters depth, with the average base coal at approximately 400 meters.

Figure 8 shows the total coal thickness encountered in the DOM drillholes within this prospective area. The average total coal thickness is 10 meters, while several holes encountered considerably thicker sections. Average total coal-mining “working thickness” (cutoff > 1.5 meters for an individual seam) is in the order of 2 to 4 meters. One of the boreholes did not encounter any coal.

To estimate the potential Original Gas In Place (OGIP) for this area:

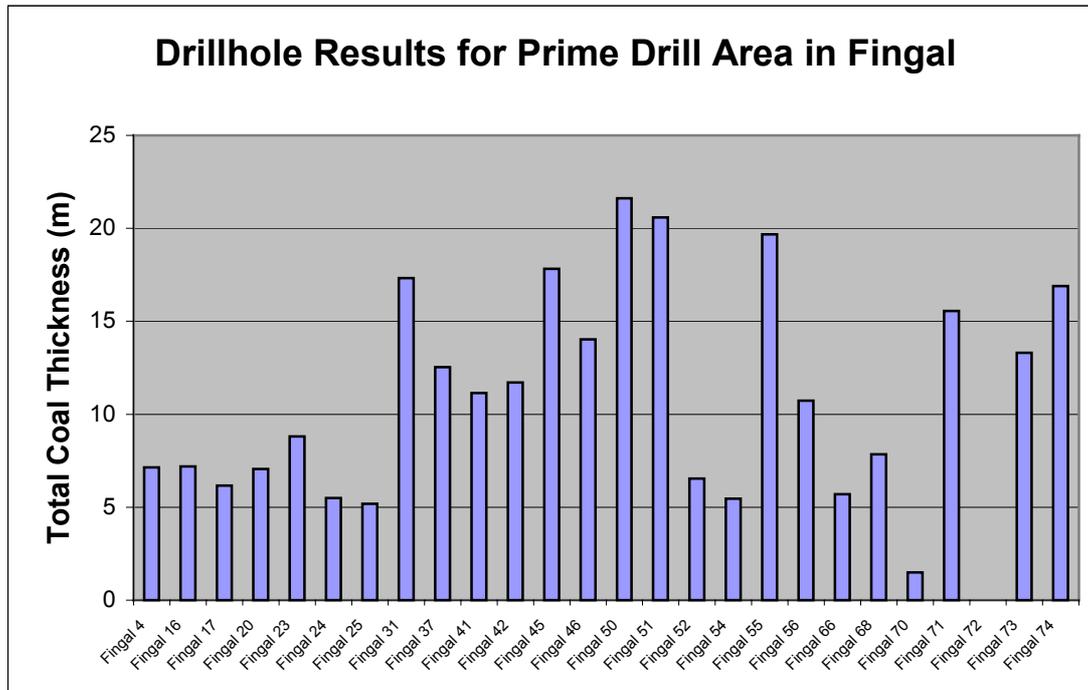
$$\text{OGIP per km}^2 = \text{Total Net Coal} * \text{Gas Content} * \text{Coal Density}$$

Using the 10 meters average from the DOM boreholes, and assuming an average value for Gas Content (8 m<sup>3</sup>/tonne) and Coal Density (1500 tonnes/m<sup>3</sup>), yields:

$$\text{OGIP per km}^2 = 10\text{m} * 8 \text{ m}^3/\text{tonne} * 1500 \text{ tonnes}/\text{m}^3 * 37 \text{ PJ}/\text{m}^3 = 4.5 \text{ PJ}/\text{km}^2$$

Assuming a recovery factor of 50 to 75% would yield recoverable gas volumes of approximately 2 to 3.5 PJ/km<sup>2</sup>.

Thus, for this 25 km<sup>2</sup> area, the potential OGIP is in the order of 100 PJ. If exploration / appraisal drilling is successful in proving gas content and productivity, then the potential 2P reserves in this area are in the order of 50 to 80 PJ.



**Figure 8: Total Coal Thickness of DOM Holes in Prime Drilling Area**

If this central “core” area of 25 km<sup>2</sup> proves to be successful, then there is a further 300 km<sup>2</sup> that becomes immediately prospective, with the potential OGIP over 1350 PJ, half of which is already drilled. Potential recoverable gas volumes are then in the order of 700 to 1000 PJ.

## **5. Proposed Exploration / Appraisal Drilling Process**

Given the presence of the extensive DOM holes in the immediate area, further drilling could be deemed as much an appraisal campaign as an exploration campaign. The key uncertainties of the presence of coal, and coal thickness and depth, have already been largely eliminated. The two remaining risks are gas content and productivity.

The exploration / appraisal process will involve several staged steps.

1. Selection of specific drilling locations, based on further study of existing data
2. Drilling of coreholes
3. Injectivity fall-off testing of coreholes
4. Back-reaming and production testing
5. Drilling, casing and completing pilot production wells
6. Long term pilot project to de-water, establish gas deliverability, and confirm/certify recoverable gas reserves

Steps 2, 3, and 4 are outlined below, as applied to the first exploration wells. If these results are promising, then we would proceed to Steps 5 and 6, outlined in the subsequent section on Pilot and Conceptual Development Plan.

### **5.1. Exploration Wells Requiring Core**

#### **5.1.1. Core, logging and sample**

The key objectives of the coring and logging program are to establish net coal and gas content, as well as qualitative indications of production potential. Specifically, the core will help define:

1. coal distribution (seam thicknesses and depths)
2. gas desorbtion characteristics, through field and laboratory testing
3. cleat sizing and distribution, mineralisation, heterogeneities, etc.

#### **5.1.2. Injectivity fall-off**

While on-site desorbtion tests are being run, slim-hole injectivity fall-offs can be conducted on intervals selected from core. The objective of the injectivity fall-off is to establish absolute permeability (to water in this case) and reservoir pressure.

#### **5.1.3. Back-ream and long-term production test**

If the well is a suitable candidate for further evaluation (based on net coal, gas content and injectivity fall-off results), it will be back-reamed and then completed for de-

watering and long-term testing. Completion options include open-hole, slotted liners / screens, perforated casing and fracture stimulation (if needed). The best completion option will be chosen after an on-site evaluation is carried out on the hole condition and stability.

A long-term production test will then be conducted to de-water the coals and establish long-term production characteristics: gas rates and composition, water rates and composition, and pressure decline (indications of reservoir size and continuity).

De-watering of the well will be done by the use of a bottom hole pump. The type of pump used will be dictated by the wells de-watering needs. The common types used are PCP's (Progressive Cavity Pump), Rod Insert Pumps (Plunger Pump), ESP's (Electric Submersible Pump) and Jet Pumps.

During the production test, facilities will be required for water-handling. The method of produced water disposal will be dependant on surface location, water composition, produced water rates and environmental considerations. For the initial pilot program, the base plan will be to transport produced water off-site for disposal. If water composition and other factors allow, then alternative plans and approvals will be pursued.

## **5.2. *Exploration / Appraisal Wells not requiring core***

Exploration and appraisal wells not requiring core will be drilled with a conventional 8.5" hole size. Logs will be run, and the well evaluated by conducting drill-stem tests over selected intervals of interest. If the well is a suitable candidate for further evaluation it will be completed for de-watering and testing, as outlined above.

## 6. Pilot and Conceptual Development Plan

Once a prospect has proven the potential of economic coal seam gas production, through the exploration / appraisal program outlined above, a Pilot and Development Plan will be initiated. This will involve the drilling and completion of a number of additional wells for de-watering and gas production. These wells will be positioned to best prove up both production and reserves.

It is envisaged that the gas produced during the first development stage may be used to drive on-site gas-fired power generating plants, which would supply electricity into the local grid. The conceptual development involves using modularized Plant, Compression and Power Generation facilities, to allow greater flexibility during development. The modular size may be 6 or 12 MW; a 12 MW power generator, for example, requires about 3 mmcf/d of gas.

### **6.1. Pilot Model on 25 km<sup>2</sup> area within the Fingal Field**

As outlined earlier, we have notionally identified a 25 sq km area within the Fingal coalfield as a potential initial development area. Here is presented a notional pilot and development plan for this area.

- i. Drill and core the first 3 wells during which time on-site gas desorbtion can be carried out on the core, and DST's conducted on seams of interest
- ii. Complete wells for de-watering
- iii. De-water wells monitoring water rates and quality, and gas rates and quality
- iv. Review data and formulate an in-field pilot development plan:
  - a. Well types and design (horizontal, verticals, fracture stimulation, etc)
  - b. Number of wells, locations, patterns
  - c. Facilities
- v. Drill and complete the required number of wells to deliver 3 mmscfd (circa 12 wells in total)
- vi. Whilst the wells are going through the de-watering stage, carry out the construction of the gathering system, processing plant, water-handling facilities, and installation of the power generating plants.

Effectively, the last two steps are the first phases of a staged development.

To illustrate the conceptual development, a multi-well production and gathering system model was constructed using the Fekete Software, Piper.

The scenario assumes a first stage consisting of the 3 well pilot, followed by ramping up to a plateau production level of 3 mmscfd to fire a 12 MW generator. Additional wells would be drilled in phases to maintain the plateau production. Assuming initial

well deliverability of 300 mscf/d per well, and approximately 3 PJ of reserves per square kilometer (as calculated in Section 4), this would require approximately 22 wells in total, phased over a period of 4 years.

These 22 wells would be drilled at a spacing of 1 well per square kilometer, to delineate the full area for development purposes, and reserves certification.

### 6.1.1. Production Profiles

Figure 9 below depicts a notional production profile resulting from the assumptions outlined above. Figure 10 shows the layout of the gathering system and producing wells from the model, at a snapshot of 2010. The wells are spaced approximately 1 kilometer apart.

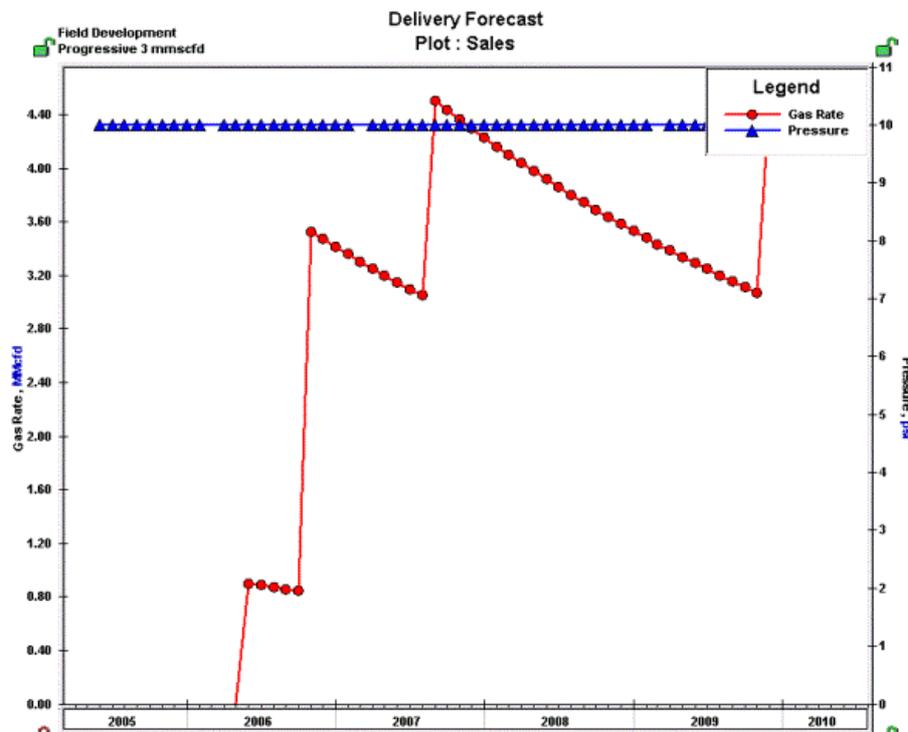


Figure 9: Production Profile for 3 pilot wells, and Phase 1 development of 3 mmscf/d

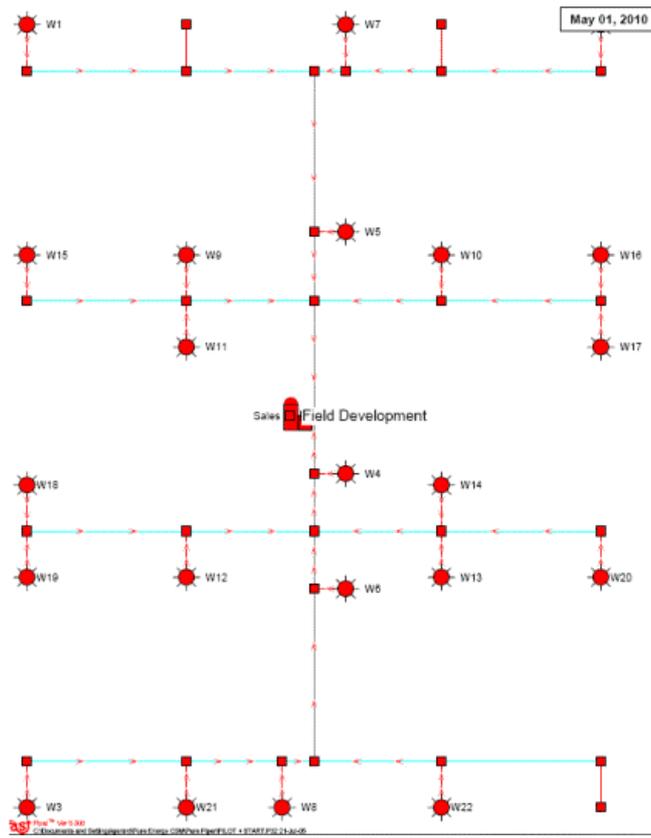


Figure 10: Gathering system for Phase 1 Development of Fingal Area

## **6.2. Notional Development Plan**

If the pilot and first phase of development prove to be commercial, then a much larger potential development exists, first targeting infill drilling of the 25 sq km “core” area, and then expanding out to the larger Fingal-Dalmayne-Douglas River trend, which covers a highly prospective area in excess of 300 sq km.

In CSG developments, typical well spacings are in the order of 3 wells per square kilometer. Thus, the immediately prospective area of 25 sq km in Fingal could be developed with about 75 wells, and would recover approximately 75 PJ of reserves. With a 75 well development, at circa 300,000 scf/d per well, the plateau rate would be in the order of 10 mmscf/d, which would translate into approximately 40 MW of potential power generation. The expansion of the development would likely be modularized, using 6 or 12 MW generators, or possibly larger generators, if economies of scale warranted.

If this central “core” area proves to be successful, then the immediately surrounding area also becomes highly prospective. From Figure 7, this surrounding area is in the order of 250 to 300 km<sup>2</sup>, or roughly 10 times the size of the notional development outlined above. For this area, then, the 3P OGIP is well over 1000 PJ, which could translate to a plateau production of over 100 mmscf/d, from 100’s of wells, potentially generating 100’s of MW of power.

## 7. Exploration / Appraisal Plans and Expenditures

### 7.1. Expenditure in the year July, 2004 to July, 2005

The exploration expenditure in the past year totaled \$178,500. As outlined in Section 2.1, the first step in evaluating the CSG potential of the license area is a “desk-top” study, including literature review, data compilation, geological review, CSG prospect screening and analysis, pilot and development modeling, and exploration drilling, evaluation, and testing design. The interim results are presented in this report.

The expenditure is itemized as follows:

Activity	Cost (\$)
Literature Review	38,250
Data Compilation	18,750
Geological Review	19,500
CSG Prospect Screening and Ranking	45,500
Pilot and Development Modeling	31,250
Exploration Drilling, Evaluation and Testing Programs	25,250
<b>Total</b>	<b>\$178,500</b>

### 7.2. Exploration / Appraisal Program in Year 1

In the first year of the license, to July 30, 2006, the plan is to drill, core, log, and test at least 1 well in the Fingal – Dalmayne area. The program would follow the outline in Section 5 of this report. Together with final geological and engineering preparation work for this drilling, this expenditure is anticipated to be in the order of 400 k\$.

### 7.3. Exploration / Appraisal Program in Year 2

In the second year of the license, the plan is to drill at least a further 2 wells, along with supporting geological and engineering work. If successful, then many wells would follow as the area moves into pilot and then phased development. The 2 further wells would see a further total expenditure of circa 800 k\$, in the second year.

This is considered a minimum plan. Our objective is to move considerably faster into pilot and development.

## 8. References

1. AVOCA TRANSPORT. 1987b .EL 21/82, Merrywood area. Exploration Licence report. Period October 1985 – October 1986. *Avoca Transport Co Pty Ltd*. [TCR 87 2645]
2. AVOCA TRANSPORT. 1987c. EL 21/82, Merrywood area. Exploration Licence report. Period October 1986 – October 1987. *Avoca Transport Co Pty Ltd* [TCR 87-2727]
3. AVOCA TRANSPORT. 1987a. EL1/84, Stanhope area. Final report. *Avoca Transport Co Pty Ltd*. [TCR 87-2657]
4. PERKINS, N.T.; DUNN, D.J. 4984. *Geological evaluation of EL 6/79, Catamaran*. Marathon Petroleum Australia Ltd. Report 1983/03. [TCR 84-2110]
5. BACON, C.A. The Cygnet Coalfield; UR1983-04.
6. FARMER, N. 1979b. A diamond drill hole at Mt Cygnet.; *Unpubl. Rep. Dep Mines Tasm. 1979.29*
7. GENERAL GEOLOGICAL SERVICES 1981b. *Final Report of south-eastern Tasmanian coal prospects for Capricorn Mining Ltd*. General Geological Services [TCR 81-1513]
8. GENERAL GEOLOGICAL SERVICES 1981a. *Tasmanian coal prospects. Six monthly progress report, 17 April to 16 October 1981, for Capricorn Mining Ltd*. General Geological Services CAP 704/20. [TCR 81-1682]
9. BACON, C.A., Calver, C.R.; The Dalmayne Coalfield; UR 1984-10.
10. FORD, R.M.D.; BOS, F. 1984. *Geology and coal resources of the Dalmayne, Douglas River and Apsley River areas, Eastern Tasmania, EL5161*. Shell Company of Australia Ltd and Industrial and Mining Investigations Pty Ltd. CEPR 10/84. [TCR 85-24446]
11. LEAMAN, D.E.; RICHARDSON, R.G. 1981. Gravity survey of the East Coast coalfields. *Bull. Geol. Surv. Tasm.* 60
12. THREADER, V.M.; BACON, C.A. 1983. The Department of Mines coal exploration programme, Fingal Tier. *Unpubl. Rep. Dep. Mines Tasm.* 1983/46.
13. MIEDECKE, J. 1983. *Exploration Licence 16/79. Relinquishment report, 1982*. Avoca Transport Company Pty Ltd [TCR 84-2128]

14. BACON, C.A., *The Coal Resources of Tasmania*; Geological Survey Bulletin 64 (GSB64), 1991. Tasmania Department of Resources and Energy; Division of Mines and Mineral Resources.
15. BACON, C.A., CALVER, C.R., BOREHAM, C.J., LEAMAN, D.E., MORRISON, K.C., REVILL, A.T., VOLKMAN, J.K; Geological Survey Bulletin 71 (GBS71). The Petroleum Potential of Onshore Tasmanian, a review; 2000.
16. HILLS, C.L.; REID, A.M.; NYE, P.B.; KEID, H.G.W.; REID, W.D. 1922. The coal resources of Tasmania. *Miner. Resour. geol. Surv. Tasm.* 7
17. PERKINS, N.T.; Six-monthly report on Catamaran License 6/79, June 1982. Marathon Petroleum; 1982-1769.
18. PERKINS, N.T.; Six-monthly report on Catamaran License 6/79, March, 1983. Marathon Petroleum; 1983-1965.
19. BACON, C.A.; The Kaoota (Sandfly) Coalfield; UR1983-05
20. THREADER, V.M. 1973. Diamond drilling at the Sandfly coal mine, Kaoota. *Tech. Rep. Dep. Mines Tasm*, 15:40-43
21. THREADER, V.M. 1974. Further investigations at the Sandfly coal mine, Kaoota. *Tech. Rep. Dep. Mines Tasm.* 17:27-33
22. BACON, C.A. 1983c. The Mount Christie-Stanhope coalfield. *Unpubl. Rep. Dep. Mines Tasm.* 1983/22
23. BACON, C.A., The Langloh (Lawrenny) Coalfield. UR1985-31.
24. CARR, M.J. 1984. *Exploration Licence 20/80 ston, Final Report on area relinquished, 22 August 1984.* CSR Ltd Coal Division. [TCR 84-2206].
25. SANGSTER, J.W. 1979. *investigator Coal Pty Ltd. Exploration Licence 16/77, Royal George. Report for 6 months, 23 June 1978 to 23 December 1978.* Investigator Coal Pty Ltd 1032. [TCR 79-1324]
26. WATERS, D.D. 1978. *Investigator Coal Pty Ltd. Exploration Licence 16/77, Royal George. Report for 6 months, 23 December 1977 to 23 June 1978.* Investigator Coal Pty Ltd 985. [TCR 78-1278]
27. BURNS, K. Report of the Mersey Coalfield, 1978. Report 03-4892.
28. BACON, C.A. 1983c. The Mount Christie-Stanhope coalfield. *Unpubl. Rep. Dep. Mines Tasm.* 1983/22
29. BURNS, K.L. 1957a. The distribution of coal at Mt Lloyd. *Tech Rep. Dep. Mines Tasm.* 1:33-35

30. BACON, C.A.; The Mt Lloyd coalfield. UR1983-06
31. BACON, C.A., The Mt Nicholas Coalfield. UR1983-41
32. PATTERSON, C.L. 1982. *Mount Nicholas geological report*. Shell Company of Australia Ltd and Industrial and Mining Investigations Pty Ltd. CEPR 31/82. [TCR 83-1896]
33. BAILLIE, P.W.; CALVER, C.A. 1980. The geology of the Mt Nicholas, Fingal Valley and Mt St John areas. *Unpubl. Rep. Dep. Mines Tasm. 1980-13*
34. BACON, C.A., The Mt Paul Coalfield. UR1984-17.
35. JENNINGS D.J. 1969. Limestone at Saltwater Lagoon: Friendly Beaches, Coles Bay Peninsula. *Tech. Rep. Dep. Mines Tasm. 13:11-19*
36. FORD, R.M.D. 1982. *Geology and coal resource of Mount Peter and Mount Paul, Freycinet Peninsula, Tasmania*. Shell Company of Australia Ltd and Industrial and Mining Investigations Pty Ltd. CEPR 25/82. [TCR 82-1869]
37. BURRETT, C.; Comments on Prospects for Coal Bed Methane (CBM) in Tasmania, 2001.
38. BACON, C.A.; The New Town Coalfield. UR1986-07.
39. Exploration Licence 30/80, Southeast Tasmania, Final Report, October, 1984. UR 1984-2289.
40. BACON, C.A.; The Strathblane, Hastings, Ida Bay, Moss Glen, and Catamaran Coalfields. UR1983-08
41. BUNNY, M.R. 1976. *Summary report on coal drilling operations at Ida Bay and Strathblane Plains, southeastern Tasmania*. Earth resources Australia Pty Ltd. [TCR 76-1166]
42. BACON, C.A., LATINOVIC, M; A review of groundwater in Tasmania, 2003. Tasmanian Geological Survey, Record 2003-01.
43. WAKEFIELD, L.L; The Exploration Prospectivity of the Onshore Tasmania Basin, Independent Geologist's Report for Great Southland Minerals Ltd; 2000.
44. THREADER, V.M.; Coal Seams in Tasmania, 1969. UR 1969-25
45. MONTGOMERY, A. 1891. Report on the proposal to bore for coal in the township of Triabunna, Spring Bay, and its neighbourhood. *Rep. Secr. Mines Tasm. 1890-91:15-22*

46. ESHUYS, E.; SUMMONS, T.G. 1982. *The Woodbury coal deposit (revised report), Exploration Licence 31/80. Victor Petroleum and Resources Ltd and North West Bay Company Pty Ltd. [TCR 83-1914]*
47. BACON, C.A. 1985 Petrographic and proximate analyses of coal from the York Plains coalfield/ *Unpubl. Rep. Dep. Mines Tasm.* 1985/09.
48. FORSYTH, S.M., BACON, C.A.; The York Plains Coalfield. UR1985-14
49. SUMMONS, T.G. 1984. Exploration Report for the Year Ending 30<sup>th</sup> September 1984, EL18/82, EL 19/82, EL 20/82. *C.R.A. Exploration Pty Ltd*