Power down under

Annual Report 2009

SEL 26/2005 (Third Annual Report)
& SEL 45/2007 (First Annual Report)
8th July 2008 to the 7th July 2009

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Abstract

KUTh Exploration Pty Ltd (KUTh) holds three Special Exploration Licences in Tasmania for Category 6 minerals (geothermal substances). The principle target of KUTh's work on these tenements is the location of high-temperature Hot Rock geothermal resources suitable for development as Enhanced Geothermal System (EGS) power generators. This combined annual report covers work completed in the year 8/7/2008 – 7/7/2009 on tenements SEL 26/2005 and SEL 45/2007. This is the third Annual Report lodged for SEL 26/2005, which was granted on 7/8/2006 and the first for SEL 45/2007 which was granted on 19/12/2007. Both tenements are located in the eastern half of Tasmania and cover a combined area of 14,171 km^2.

Work commenced and/or completed on the tenements in this period includes:

- *A shallow heat flow drill program comprising 42 holes and 10,019.65m drilling (4058.06m RC; 5961.6m DDH). Commenced in October 2007 and completed in December 2008 these holes were drilled to ~250m depth on a 20 x 20 km grid across the tenement area. A complimentary program of geothermometry and sampling for thermal conductivity was completed in these holes in April 2009 and estimated heat flow values were returned for all successful holes by May 2009.*

- *An initial magnetotelluric (MT) survey, comprising 96 stations along two east-west profiles across the Tamar Valley in the north and along the Lake Leake Highway from Swansea to Campbell Town in the south, was completed in October 2008. Modelling of data derived from this survey confirmed the existence of the Tamar Conductivity Zone (TCZ) in this area. A second, more detailed MT survey designed to build upon the results of this work commenced in the Midlands area in May 2009 and remains ongoing.*

- *Acquisition of 4084.4 line km of aeromagnetic data across the central midlands area in March 2009. Designed to infill an area of otherwise poor data coverage, the interpretation of these results will include a spectral model of estimated depth to base dolerite as well as a refinement of the depth to top granite model previously derived from gravity data.*

- *Re-interpretation of open-file seismic reflection data previously generated by Great South Land Minerals Pty Ltd in 2001, and which partly cross the boundaries of SEL 26/2005 by Hot Dry Rocks Pty Ltd.*

- *A trial of ambient seismic tomographic techniques in the Tunbridge area by Dr Anya Reading of the University of Tasmania (UTAS).*

- *3D geothermal modelling of the central tenement area to produce an Inferred Geothermal Resource (contained heat) estimation.*

Work completed across both tenements has exceeded the respective forecast yearly expenditures.

The combined results of work completed to date indicate the presence of several significant thermal anomalies (where heat flow is >90mWm^{-2}) that correspond closely with the predicted location of buried granite. The largest anomaly extends ~4000km^2 across the central portion of SEL 26/2005 and includes two zones of very high heat flow (>100mWm^{-2}), the most significant of which has an area of ~620km^2. Open along strike from the north of this anomaly is the Tamar Conductivity Zone which may indicate the presence of fracture permeability extending into the area of very high heat flow. A separate and smaller heat flow anomaly is observed at Rheban in the north of SEL 45/2007.

3D geothermal modelling of the central Midlands area in SEL 26/2005 infers a contained heat resource of around 260,000PJ within a 1019km^3 reservoir located between 3 – 5km depth in the Charlton – Lemont area. Geothermal Plays identified within this resource area include a granite-related Hot Dry Rock target in the east and a less well defined but slightly hotter target in the west. Significant uncertainty exists regarding the geology of the western play at depth and intersection with a southern extension of the TCZ is possible. Current and future work on the tenements is aimed towards better definition of this and other identified target plays.

Future work planned for SEL 26/2005 and 45/2007 includes:

- *Completion of the detailed 3D magnetotelluric survey currently underway across the Midlands to better define the location and extent of the southern TCZ*

- *Extension of the 3D geothermal model to cover the northern portion of SEL 26/2005 to quantify the resource present in this area.*

- *Installation of a temporary seismic array to monitor and record local, ambient and teleseismic data as part of ARC-linkage project '3D Seismic Velocity Structure for Geothermal Exploration' in collaboration with Dr Anya Reading and the UTAS.*

- *Drilling of an 'intermediate' depth bore hole (2-3km) to validate the resource target and 3D model and to investigate the geology at depth in the Charlton Lemont resource area.*

- *Data compilation and geological assessment of the Rheban area.*

Planning for production-style drilling on SEL 26/2005 remains ongoing. At present it is anticipated that, at earliest, production drilling of this tenement will commence in the second half of 2010.

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1 Introduction

KUTh Exploration Pty Ltd (KUTh) is a geothermal explorer based in Hobart, Tasmania and is the holder of three current geothermal exploration licences in that State. The principle target of KUTh's work is the location of high-temperature Hot Rock geothermal resources suitable for development as Enhanced Geothermal Systems (EGS) power generators. Whilst the primary goal of this work is to produce electrical energy, the company also maintains an interest in both cascading and direct-use applications for geothermal energy.

This combined annual report covers work completed in the period 8/7/2008 – 7/7/2009 on KUTh's tenements SEL 26/2005 and SEL 45/2007. This is the third Annual Report lodged for SEL 26/2005, and the first for SEL 45/2007.

1.1 Tenement Status

KUTh Exploration Pty Ltd (KUTh) is a subsidiary of KUTh Energy Ltd and is the sole holder and operator of SEL 26/2005, SEL 45/2007 and SEL 57/2008 (Figure 1). All three tenements were granted for periods of five years to search for geothermal substances (Category Type 6). Tenure details of SEL 26/2005 and SEL 45/2007 are provided in Table 1. SEL 57/2008 was granted in May 2009 and will be reported independently of the older tenements.

Tenement Type	SEL	SEL
Number	26/2005	45/2007
Commodity	Geothermal	Geothermal
Licensee	KUTh Exploration P/L	KUTh Exploration P/L
Operator	KUTh Exploration P/L	KUTh Exploration P/L
Area	12,360km^2	1,811km^2
Date Granted	7/08/2006	19/12/2007
Renewal	07/08/2011	19/12/2012

Table 1: Tenure details for SEL 26/2005 and SEL 45/2007.

1.2 Location and access

SEL 26/2005 and SEL 45/2007 combined include much of Eastern Tasmania, extending from the mouth of the Tamar River in the north, south to Hobart and north-east to St Marys (Figure 1). The SEL 26/2005 includes metropolitan Hobart and Launceston. A number of highways traverse the area and provide access along with minor roads, farm and forestry tracks. Numerous areas are excluded from both

SEL 26/2005 and 45/2007, including National Parks, Commonwealth land, a gas pipeline easement and various small historic and other features.

1.3 Topography and vegetation

Topography varies significantly across the tenement area and ranges from flat to undulating coastal and inland plains, to steep granite and dolerite ranges and tors. The maximum elevation range across the tenement area is greater than 1km, rising from sea level at the coast to peaks including Ben Lomond (1573m) in the north and Mt Wellington (1271m) in the south. Vegetation is dominated by dry eucalypt forest and developed pasture although considerable variation is present across the topographic range. Pockets of alpine moorland, wet eucalypt forest, native grassland and scrub, wetland and coastal scrub may be found at various locations across the tenements.

1.4 Geological setting

Tasmania is divided into two basement terrains located in the west and east of the State (Figure 2). Distinguished by age, lithology and deformation these two regions are 'believed to have been juxtaposed at a NNW trending dislocation' inferred to coincide with the Tamar Valley region in central Tasmania (Burrett & Martin, 1989). The Western Terrain comprises variably deformed and metamorphosed Pre-Cambrian basement, the now-deformed Cambrian volcanics and sediments of the Dundas Trough and Mt Read Volcanic Belt and the Ordovician-Silurian shelf sediments of the Wurrawina Supergroup. In the East, deformed low-grade meta-sediments of the Ordovician – Devonian Mathinna Supergroup comprise deep water turbidite deposits that are analogous to the ubiquitous Tasminide flysch of mainland eastern Australia. Similarities in the deformation and depositional style of the Mathinna Supergroup and mainland Tasminide units has led to numerous attempts to correlate the two, the Mathinna being compared variably to the Melbourne Trough and the Tabberabbera Zone of central and eastern Victoria (Powell & Baillie, 1992; Reed, 2001).

Across much of the state, basement is concealed by up to 1km of flat-lying Permian-Triassic sediments of the Tasmania Basin and the extensive thick (>300m) Jurassic dolerite sills which intruded these during Gondwana break-up. Mesozoic and Tertiary cover, including extensive dolerite, shale, silt and some coal formations, totally obscure the contact between the Pre-Cambrian Western and Palaeozoic Eastern terrains, which is inferred to underlie the tenement area.

Both Western and Eastern Terrains host Devonian granite, the most extensive intrusions being the slightly older batholiths in the East (Burrett & Martin, 1989). Exposures of Devonian-aged granite in the far north-east of the state are known to include highly-fractionated high-heat-producing (HHP) granites as part of three major suites (Figure 2; Burrett & Martin 1989). To the south and west of this area, the exposed granite plunges beneath cover which potentially provides the insulation necessary for a classic Hot Dry Rock or Enhanced Geothermal System (EGS) target. Complicating this picture is the presence of a known electrical conductivity anomaly observed in the northern Tamar Valley area and referred to as the Tamar Conductivity Zone (TCZ) (Figure 2; Hermanto, 1992). Coinciding broadly with the boundary of the East and West terrains, the TCZ has been interpreted an indicator of fluid in fractured permeable zones (Hermanto, 1992). Intersection between the TCZ and buried HHP granites may thus imply the presence of an existing fracture-permeable geothermal system in Eastern Tasmania.

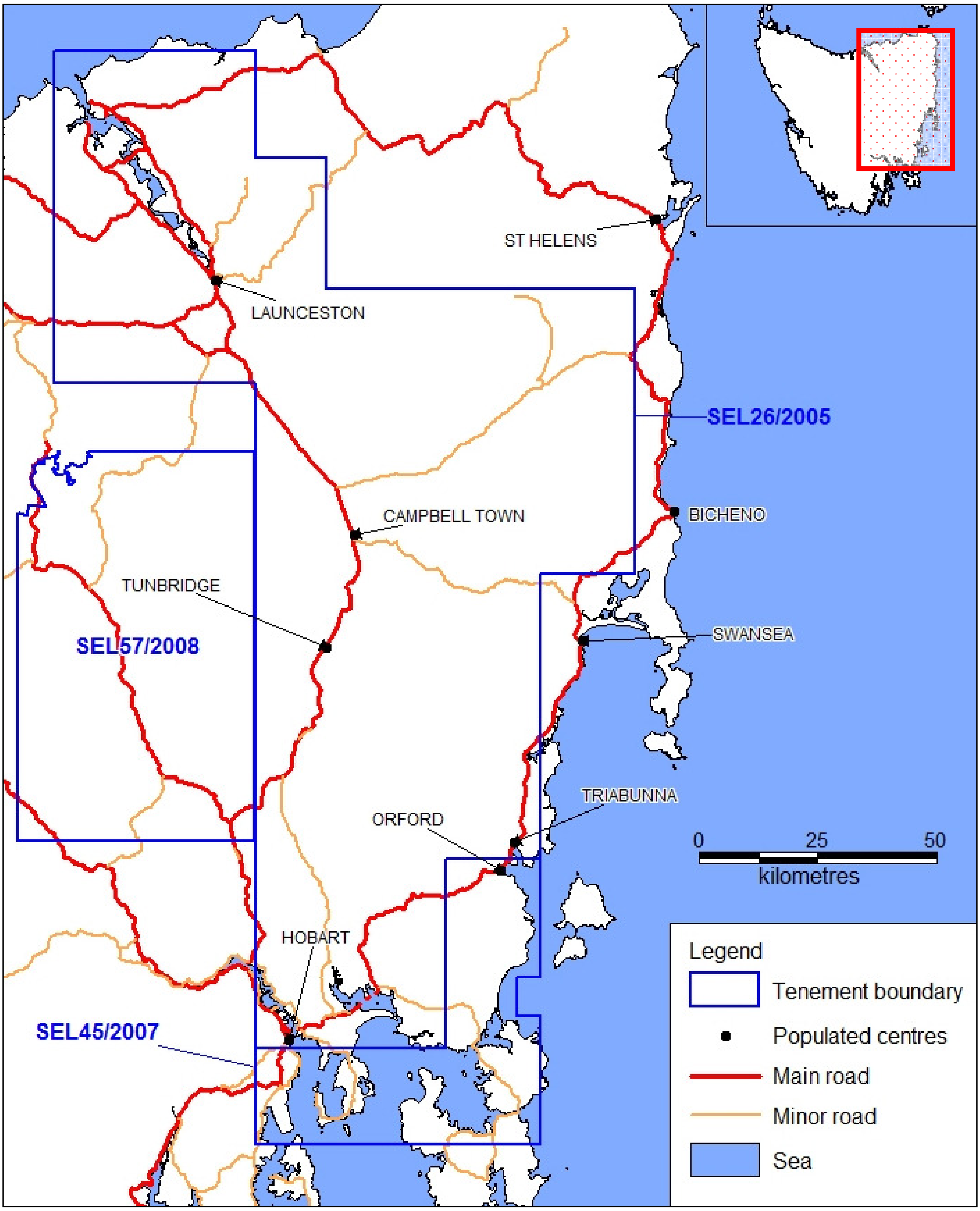

Figure 1: KUTh Energy tenement boundaries, this does not show internally excluded areas. SEL 57/2008 was granted on the 13th May 2009. Total combined tenement area is 18 151km^2.

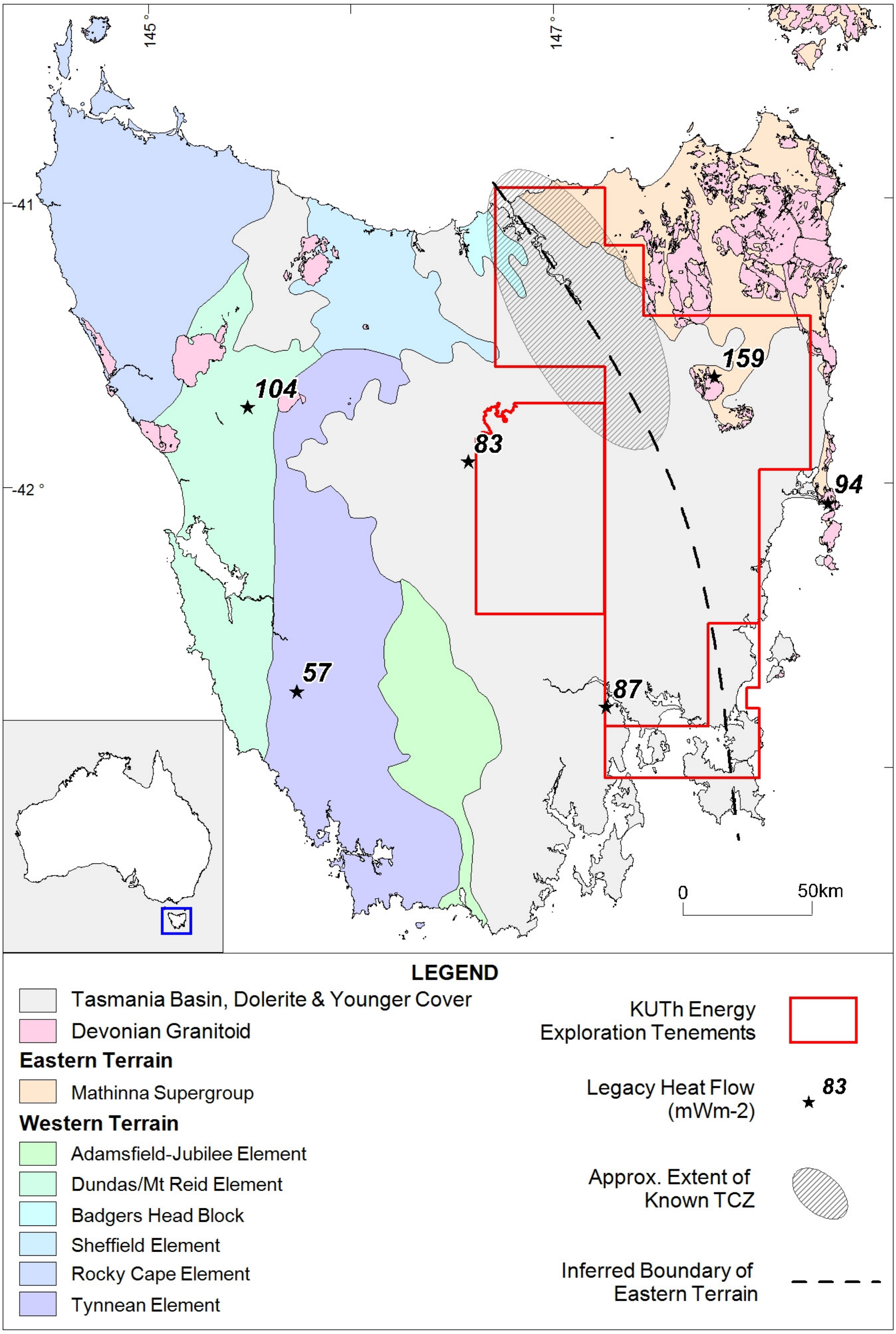

Figure 2: Regional geology of Tasmania showing the major crustal elements. Legacy heat flow data are as summarised by Cull (1991). Also shown is the approximate extent of the known TCZ prior to recent MT survey work.

2 Previous Exploration

KUTh Exploration is the first operator to undertake commercial geothermal exploration work in Tasmania. Legacy geothermal data available in this area are limited to a few early heat flow measurements recorded across the state in the 1950 – 1960s and early 1980s (Figure 2; Cull 1991). Although sparse and of variable quality, these data indicate the presence of high heat flows associated with Devonian granite in the north-east of the state. Heat production data from these granites are available from Collins et al, 1981, and include values of up to 60 $\mu W/m^3$ for granites at the Royal George Mine.

The presence of the Jurassic dolerite across much of the tenement area has limited exploration for most commodities in this region. With the exception of small areas around Storey's Creek and Fingal in the north-east of the tenements, relatively few drill holes have been cut. Stratigraphical holes at Tunbridge, Ross and Glenorchy provide the deepest information from the central tenement area but are all <1km deep. Attempts by KUTh in 2006 – 2007 to undertake a surface heat flow measurement program in existing core holes failed due to a lack of suitable open holes.

Available geophysical data includes aeromagnetic and gravity coverage. Data quality is patchy leading to an early decision by KUTh to undertake infill gravity survey work across the south-east of the tenement area (Ward *et al*., 2008). Data derived from this work, which was completed in March 2007, was provided to Dr David Leaman who used it to update the Tasmanian mantle source model of Leaman and Richardson (2003). This updated model was then used to refine predicted depth to top granite (Figure 3).

Studies of magnetotelluric field data identifying a possible conductive anomaly in Northern Tasmania date back to the mid-1970's and are summarised in Hermanto (1992). This work consistently indicated the presence of a broad zone of anomalously high electrical conductivity, approximately parallel to the NW trending axis of the northern Tamar Valley, and extending for some distance to the south (Figure 2). The anomaly appeared at depth, beneath Mesozoic cover, but no direct information was available regarding the nature or detailed structure of the geology associated with it. However, it was concluded that 'the most likely cause of the high conductivity anomaly is a combination of the presence of high conducting fluids and graphite in pores, cracks, and or fractured rocks' implying the potential for fracture permeability associated with this feature (Hermanto, 1992).

In 2007 – 2008 KUTh energy commenced a program of shallow drilling to enable systematic estimation of surface heat flow across the tenement area. Accompanying this was the acquisition of new magnetotelluric data along two east – west profiles (Ward *et al*., 2008). In both cases this work was ongoing throughout 2008 – 2009 and results are provided in the subsequent section.

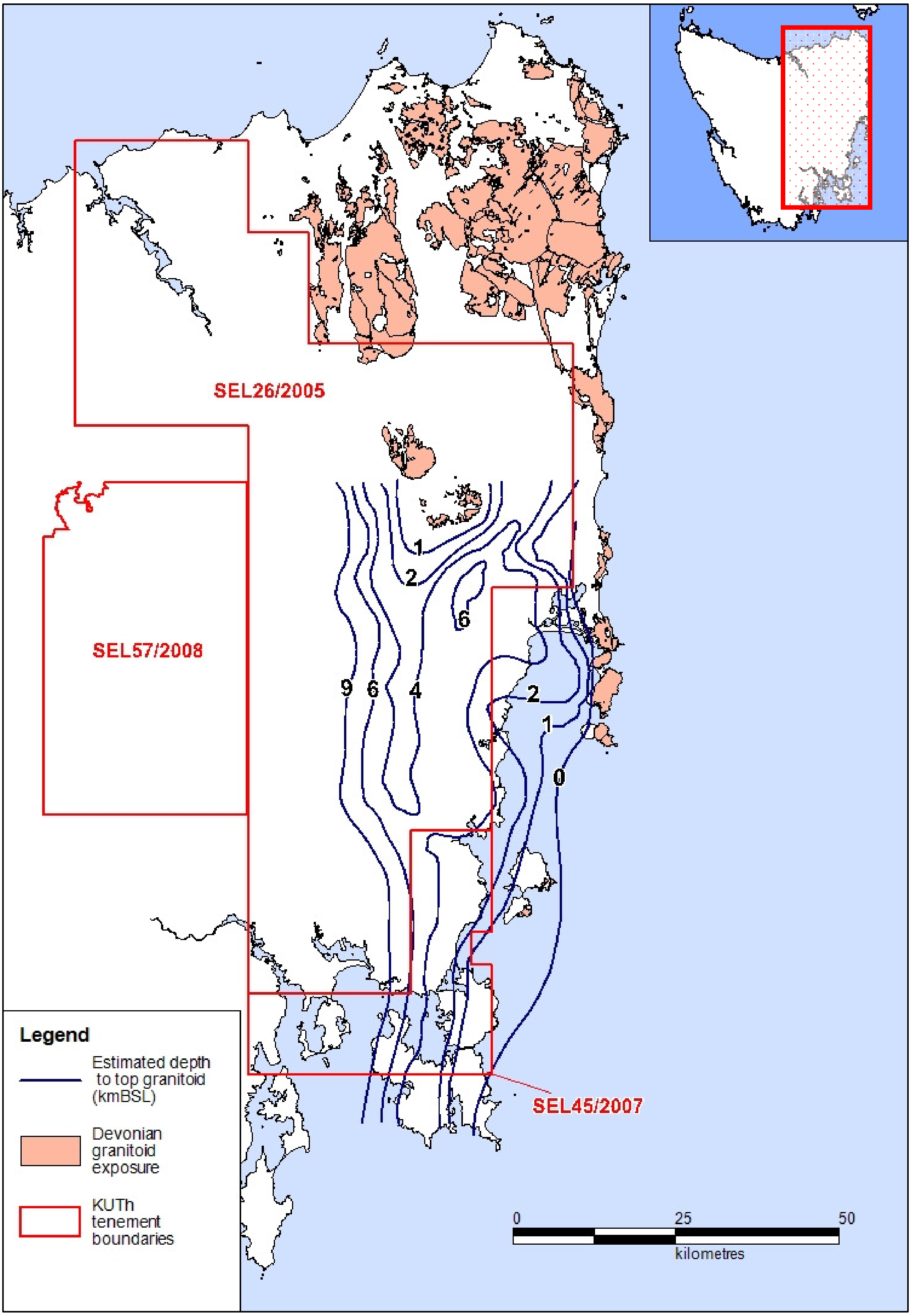

Figure 3: Predicted depth (below sea level) to top granitoid as interpreted by D. Leaman in Ward et al (2008).

3 Work Completed

Work detailed in this report took place between July 2008 and July 2009 and is outlined in Figure 4. Geophysical work, including MT and aeromagnetic data acquisition, were performed in conjunction with shallow drilling and heat flow measurement. Legacy data, including drill and seismic data, were compiled and re-interpreted to input into a 3D geothermal model. This model was used as a basis for the estimation of an Inferred Geothermal Resource for the Charlton-Lemont area.

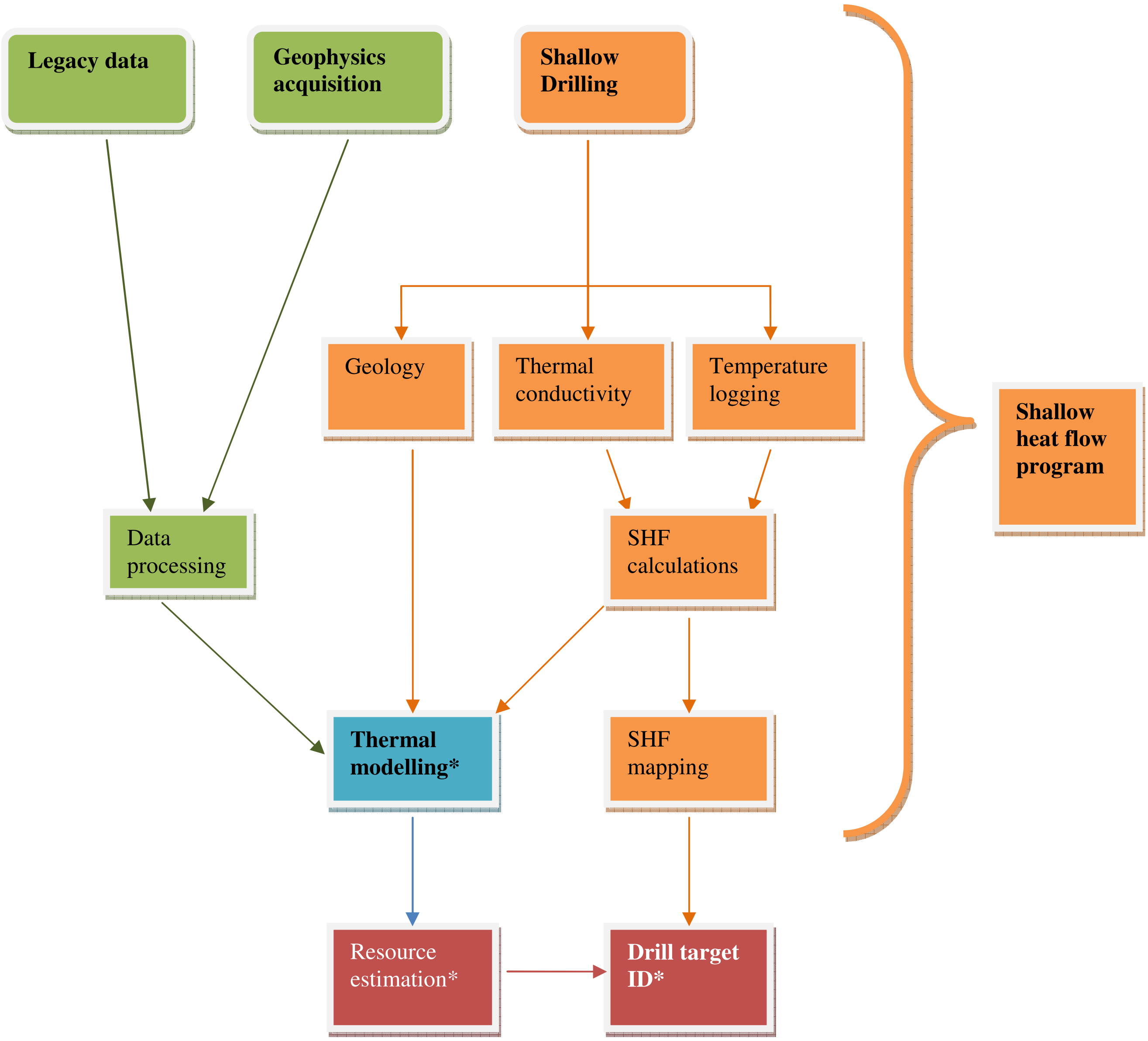

Figure 4: Work completed between July 2008 – July 2009. This chart is not indicative of when the activity took place or the time taken to complete it. ****indicates ongoing modifications as new data is acquired***

3.1 Surface Heat Flow Drilling

A program of shallow drilling for heat flow determination comprising 42 holes and 10,019.65m drilling (4058.06m RC; 5961.6m DDH) was commenced in October 2007 and continued to completion in December 2008. Collar information for these holes are summarised in Table 2 with full details provided in Appendix 2. Holes were drilled vertically to ~250m depth at 36 sites on a ~20 x 20 km grid across the tenement area (Figure 5). In all cases RC pre-collars were drilled to between 100 - 150m with diamond tails completed to total depth. A complimentary program of geothermometry and sampling for thermal conductivity was completed by contractors Hot Dry Rocks Pty Ltd in these holes in April 2009 and estimated heat flow values were returned for all successful holes by May 2009.

3.1.1 Drilling

Drilling was undertaken by Gerald Spaulding Drillers Pty Ltd of Devonport. Two rig types were used, a TH 62 percussion drill rig for pre-collar and a G & K 1000 diamond drill rig for diamond tails. Initial pre-collar depths of ~150m were shortened to ~100m during the program. Pre-collars were cased with 125mm Class 12 PVC which was grouted to prevent aquifer damage. On completion of diamond drilling 40mm Class 9 PVC was emplaced from surface to total depth to act as a guide for the thermal probe and was dummy probed to ensure that it was open and clear. A capped, lockable lid was fixed onto HWT casing at the top of the hole which was then left for approximately 2 to 3 months to equilibrate before final temperature logging was undertaken.

Chips from the percussion rig were collected every 3m and logged, photographed and archived. HQ core was placed in trays with up to 1m from each tray wrapped in "Gladwrap" to retain moisture for thermal conductivity measurements. The core was then transported to the MRT core shed where it was logged, photographed and archived. Drilling encountered a range of lithologies from black shales and turbidites of the Ordovician-Devonian Mathinna Group to Jurassic Dolerite and Permo-Triassic and Tertiary sediments (Table 3). Geological logging codes are provided in Appendix 1, detailed geological logs of all holes in Appendix 2 and chip and core photographs in Appendix 3.

Site preparation required for drilling was minimal due to the policy of selecting sites which were already available wherever possible although sumps were required for the diamond drilling. On completion of drilling, the sites were rehabilitated, taking care to ensure that rock, clay and soil were put back in the approximate order to which they had been excavated. Topsoil containing seed-bank was then placed on top.

Hole Name	Datum - GDA94 Easting	Northing	RL (m)	Drilling finish date	Depth (m)
Bangor	508572	5440427	204	09/06/08	252.2
Beaconsfield	489244	5439884	90	13/11/08	249.6
Ben Lomond	546613	5402059	694	17/01/08	276.1
Bluestone Tier	571901	5300093	353	17/06/08	252.2
Cambridge#	534378	5261742	43	28/09/08	249.6
Charlton2	545174	5339821	242	02/04/08	250.6
Elizabeth	549501	5356701	439	13/12/07	297.7
Epping	533251	5382606	215	04/02/08	288.0
Fingal3	590381	5381540	613	18/02/08	249.8
Frankford	490171	5416602	289	11/05/08	251.9
Kingston	547791	5383093	287	12/03/08	235.4
Lake Leake	568510	5338586	475	04/12/07	300.4
Lemont	547437	5322898	333	17/03/08	246.2
Lisle	528218	5437495	307	28/11/08	250.0
Macquarie	526048	5359621	295	21/04/08	223.7
Marion Bay	568645	5260030	81	16/07/08	252.1
Mt Nicholas	587962	5401440	398	05/05/08	249.7
Murdunna	573413	5242021	139	26/07/08	252.1
Native Hut	530061	5284634	378	16/10/08	249.6
Nunamara	528262	5415737	727	02/06/08	249.7
Perth	513500	5399080	200	26/05/08	252.7
Rheban	572790	5279433	79	01/07/08	252.7
Rocherlea	509171	5420496	49	05/11/08	252.5
Runnymede	546175	5280238	247	07/10/08	249.5
Snow Hill	572873	5358389	749	07/12/07	279.3
Sorell	550181	5260122	50	06/08/08	251.2
Swan2^	588108	5359271	126	18/12/07	200.0
Temple Bar	530426	5403592	353	25/01/08	298.7
Tiberias	531690	5301300	437	03/04/08	253.6
Tooms	567354	5319894	414	27/11/07	261.5
Tower Hill	573964	5399699	584	21/02/08	264.0
Tunbridge	529875	5339428	252	13/04/08	252.6
Westbury	485940	5396730	233	20/05/08	252.0
Weymouth	508409	5457196	102	21/11/08	251.6
Woodsdale	552007	5296499	365	28/03/08	252.7
Oatlands2*	531347	5319896	526	09/12/08	250.1
Fingal1*	590084	5380114	563	13/12/2007	36.0
Fingal2*	589312	5380292	577	16/12/2007	66.0
Swan1*	586856	5362471	444	8/11/2007	15.0
Charlton1*	545174	5339821	242	20/03/08	133.7
Oatlands1*	530498	5320450	559	27/10/08	249.6
Sloping Main*	552365	5236613	156	16/06/08	102.0

Table 2: Collar information for all holes in the shallow heat flow drilling program. All holes are vertical. ^ Swan 2 collapsed, redrilled and called Swan 3, * abandoned; # also known as University Farm.

Hole name	From (m)	To (m)	Geological unit
Bangor	0.0	252.2	SDs
Beaconsfield	0.0	244.3	Jdl
	244.3	249.6	Ru
Ben Lomond	0.0	276.1	SDs
Bluestone Tier	0.0	252.2	Jdl
Cambridge #	0.0	6.0	Qu
	6.0	249.6	Tb
Charlton2	0.0	3.6	Tb/Ts
	3.6	13.2	Ru
	13.2	250.7	Jdl
Elizabeth	0.0	297.7	Jdl
Epping	0.0	288.0	Jdl
Fingal3	0.0	81.9	Jdl
	81.9	249.8	Ru
Frankford	0.0	190.1	Jdl
	190.1	195.0	Jdl/Ru
	195.0	251.9	Ru
Kingston	0.0	235.4	Jdl
Lake Leake	0.0	300.4	Jdl
Lemont	0.0	64.0	Jdl
	64.0	84.0	Ru
	84.0	246.2	Jdl
Lisle	0.0	250.0	SDs
Macquarie	0.0	90.0	Jdl
	90.0	223.8	Ru
Marion Bay	0.0	15.0	Tb/Ts
	15.0	51.0	Jdl
	51.0	60.0	? Contamination of chips
	60.0	125.5	Ru
	125.5	126.8	Jdl
	126.8	142.3	Ru
	142.3	252.1	Jdl
Mt Nicholas	0.0	166.4	Pu
	166.4	249.7	SDs
Murdunna	0.0	252.1	Jdl
Native Hut	0.0	214.7	Ps
	214.7	249.6	Jdl
Nunamara	0.0	223.9	Jdl
	223.9	249.7	Pu
Perth	0.0	252.7	Jdl
Rheban	0.0	252.7	Jdl
Rocherlea	0.0	252.5	Jdl
Runnymede	0.0	15.0	Ru
	15.0	249.5	Jdl

Hole name	From (m)	To (m)	Geological unit
Snow Hill	0.0	279.3	Jdl
Sorell	0.0	172.0	Pu
	172.0	251.2	Jdl
Swan2	0.0	300.7	Jdl
Temple Bar	0.0	298.7	Jdl
Tiberias	0.0	253.6	Ru
Tooms	0.0	261.5	Jdl
Tower Hill	0.0	264.1	SDs
Tunbridge	0.0	27.0	Jdl
	27.0	132.6	Ru
	132.6	252.6	Jdl
Westbury	0.0	252.0	Jdl
Weymouth	0.0	251.6	SDs
Woodsdale	0.0	138.1	Ru
	138.1	252.7	Jdl
Oatlands2	0.0	250.1	Jdl
Fingal 1	0.0	36.0	Jdl
Fingal 2	0.0	66.0	Jdl
Swan 1	0.0	15.0	Jdl?
Charlton 1	0.0	12.0	Tb
	12.0	133.8	Jdl
Oatlands 1	0.0	84.0	no samples
	84.0	249.6	Jdl
Sloping Main	0.0	6.0	Jdl
	6.0	9.0	Ru
	9.0	21.0	Jdl
	21.0	102.0	Ru

Figure 3: Geological summaries of all holes in the drilling program including those that were abandoned. Majority of holes begin and end in Jurassic dolerite. See Appendix 1 for logging codes.

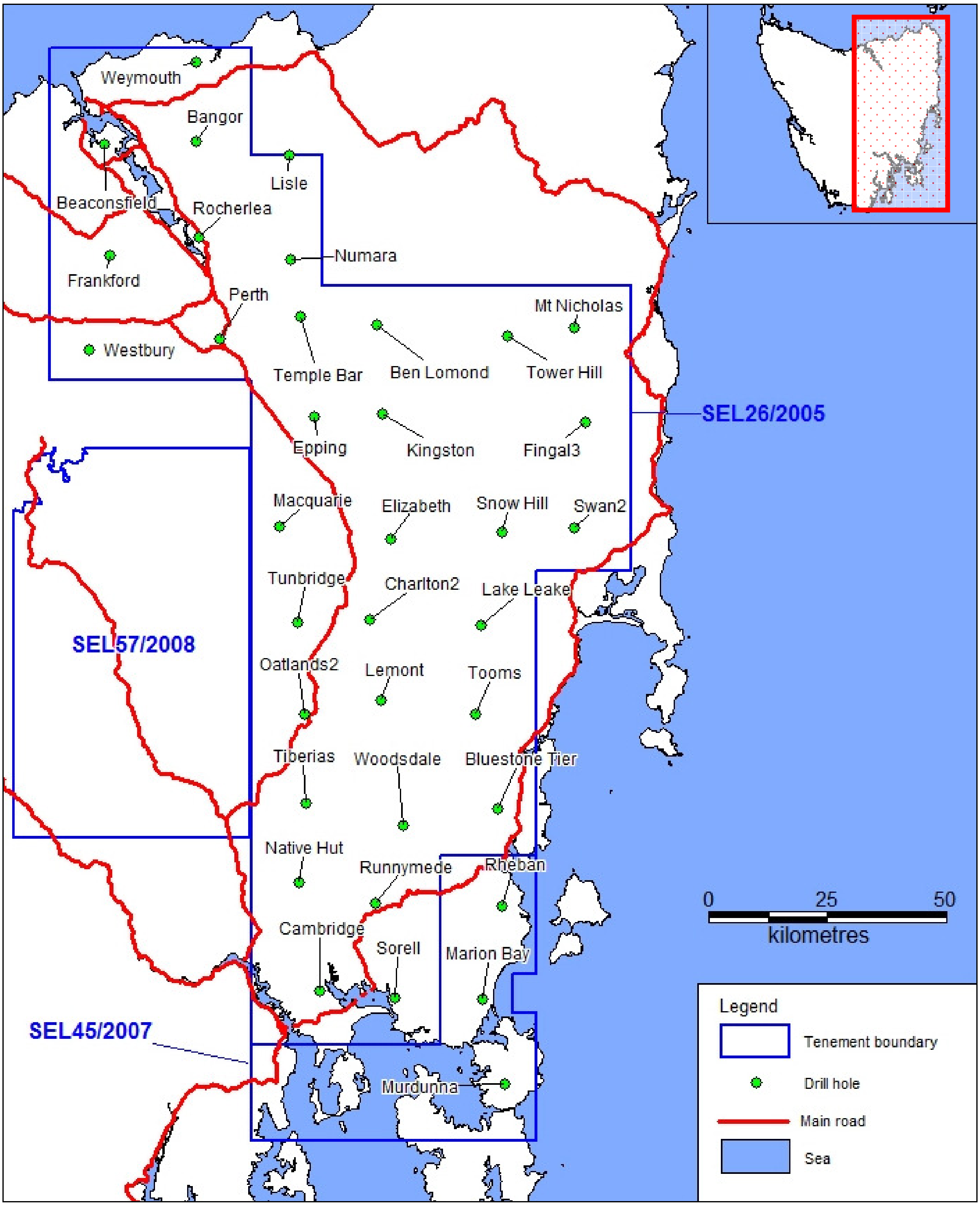

Figure 5: Location of successfully drilled holes from which surface heat flow values were calculated, except Oatlands 2. All drill holes are vertical.

3.1.2 Down-hole temperature logging

All successful drill holes were logged by Hot Dry Rocks Pty Ltd using a wireline thermistor probe, a thermometer that relies on changes in electrical resistance to measure temperature changes. Down-hole temperatures were recorded at 1 metre increments to a resolution of 0.001℃. In most cases, holes were logged twice with a preliminary run at 4 – 6 weeks after drilling followed by a final run 2 - 3 months after drilling. A summary of final and stable temperatures recorded at depth is provided in Table 4. Full results are presented as tables of temperature recorded per metre down-hole and as graphs of geothermal gradients in Appendix 4.

Hole Name	Bottom hole temperature (Deg C)	Depth (m)
Bangor	13.0	225
Beaconsfield	22.0	240
Ben Lomond	14.7	262
Bluestone Tier	14.6	246
Cambridge#	20.2	200
Charlton2	19.6	240
Elizabeth	24.6	295
Epping	22.7	270
Fingal3	18.2	230
Frankford	15.8	245
Kingston	21.4	232
Lake Leake	22.7	275
Lemont	22.1	240
Lisle	14.6	230
Macquarie	17.0	205
Marion Bay	18.3	225
Mt Nicholas	16.6	230
Murdunna	20.5	240
Native Hut	16.0	230
Nunamara	13.3	225
Perth	18.0	240
Rheban	21.8	225
Rocherlea	20.6	245
Runnymede	18.9	244
Snow Hill	20.6	275
Sorell	19.1	212
Swan2/Swan3	15.3	150
Temple Bar	19.5	225
Tiberias	12.2	200
Tooms	22.9	260
Tower Hill	13.5	250
Tunbridge	19.6	235
Westbury	16.8	235
Weymouth	18.5	230
Woodsdale	14.4	225
Oatlands2	13.9	180

Figure 4: Temperatures displayed here are for the most thermally stable and deepest part of the well.

3.1.3 Thermal conductivity measurements

Measurements of thermal conductivity were undertaken on core samples from all successful holes by Hot Dry Rocks Pty Ltd. Sampling patterns were designed on a hole-by-hole basis using the interim temperature log and a visual assessment of the downhole geology. Each sample comprised a segment of core ~10cm long from which three disks between 1 – 3cm were cut. Cut disks were polished, evacuated via vacuum pump and submerged in water prior to measurement in a divided bar instrument. Values of wet thermal conductivity were recorded in W/mK at a standard temperature of 30℃ to a precision of +/- 2℃. The uncertainty for each sample was derived from the uncertainty of the individual disk measurements.

A summary of thermal conductivity measurements from the shallow heat flow program is given in Table 5 and full results are presented in Appendix 5. These results confirm the relatively good insulating properties of both the Jurassic Dolerite and the Tasmania Basin sediments. Predictably, the turbidite sequences of the Mathinna Supergroup display variable thermal conductivities, depending upon rock type and grainsize. Of particular interest in these units, however, was the observation of a strong anisotropy associated with the development of fold axial cleavage (Figure 6). This effect, which was observed most strongly in fine-grained mudstone and shale, serves to significantly reduce the insulating advantage of the fine-grained lithologies wherever heat flow is directed along the cleavage plane.

Hole Name	Dominant lithology	Thermal conductivity (W/mK)
Bangor	SDs	**2.06-3.77**
Beaconsfield	Jdl	**2.28-2.34**
Ben Lomond	SDs	**3.87-4.41**
Bluestone Tier	Jdl	**2.07-2.20**
Cambridge#	Tb	**1.93-2.22**
Charlton2	Jdl	**2.23-2.28**
Elizabeth	Jdl	**1.99-2.27**
Epping	Jdl	**1.87-2.18**
Fingal3	Ru	**0.68-2.53**
Frankford	Jdl	**2.17-2.35**
Kingston	Jdl	**1.88-1.97**
Lake Leake	Jdl	**1.96-2.18**
Lemont	Jdl	**2.09-2.31**
Lisle	SDs	**3.18-4.80**
Macquarie	Ps	**2.44-4.96**
Marion Bay	Jdl	**2.02-2.26**
Mt Nicholas	Pu	**1.85-4.80**
Murdunna	Jdl	**2.13-2.42**
Native Hut	Ru	**2.19-4.48**
Nunamara	Jdl	**2.26-2.47**
Perth	Jdl	**2.07-2.41**
Rheban	Jdl	**2.05-2.23**
Rocherlea	Jdl	**1.97-2.25**

Runnymede	Jdl	**2.17-2.63**
Snow Hill	Jdl	**1.99-2.25**
Sorell	Pu	**2.91-3.76**
Swan2/Swan3	Jdl	**1.98-2.13**
Temple Bar	Jdl	**2.28-2.49**
Tiberias	Ru	**1.70-4.50**
Tooms	Jdl	**1.80-2.07**
Tower Hill	SDs	**4.06-5.23**
Tunbridge	Jdl	**1.83-2.39**
Westbury	Jdl	**2.07-2.21**
Weymouth	SDs	**2.95-4.02**
Woodsdale	Ru	**2.95-4.54**
Oatlands2	Jdl	**1.96-2.10**

Table 5: Thermal conductivity ranges given for the dominant lithology of each hole. Dolerite has a smaller range than the sediments. See Appendix 1 for logging codes.

3.1.4 Surface heat flow estimation

Heat flow is determined as a product of temperature gradient and thermal conductivity. Estimations of surface heat flow (mWm^{-2}) from shallow drill holes provide an indication of the heat flux at a given point on the surface of the Earth. Thermal data derived from the shallow drilling program were input into one-dimensional (1D) conductive heat flow modelling software by Hot Dry Rock Pty Ltd and heat flow for each bore was estimated by comparison of modelled (predicted) and observed temperature values. Results of the heat flow modelling process are summarised in Table 6 below and are presented in full in Appendix 6.
A total of 35 surface heat flow estimations were completed with only one site (Oatlands 2) failing to return a sensible value (Figure 7). In this instance, temperature log data indicate the presence of water flowing down the outside of the casing and entering a permeable formation at around 200m depth. Shallow advective influences, related to the movement of ground or meteoric water, are interpreted to affect the temperature field in a number of holes (Table 6). In all cases where shallow water movement is suspected, regional heat flow is assumed to be that value which was observed below the advective influence.

Surface heat flow determined by this program are generally of high quality with good to excellent model fit and uncertainties typically <5%. Only two holes, Rocherlea and Tiberias, failed to produce good model fit and are therefore considered to be of relatively low quality.

When mapped, the values of surface heat flow determined from the shallow drilling program are found to be spatially consistent and support interpolation of a smoothly varying thermal field (Figure 8). Values are generally high and include several that are within the top 10% of all heat flow data from Australia. Variations between heat flow estimates clearly indicate the existence of significant thermal anomalies in central Eastern Tasmania. The size, distribution and location of these are consistent with the current geological model of buried high-heat-producing granite batholiths at depth (Figure 3). Located in the centre of SEL 26/2005 the largest anomaly includes an area of ~4170km^2 where heat flow is >90mWm^{-2} and remains open to the west. Within this zone smaller areas of higher heat flow are identified, the most significant of which defines an area of ~620km^2 in the Oatlands region. A second area of elevated heat flow (>100 mWm^{-2}) is observed at Mt Nicholas in the north-east of the tenement area. A separate, small heat flow anomaly is also visible in the south, centred upon the Rheban drill hole on SEL 45/2007.

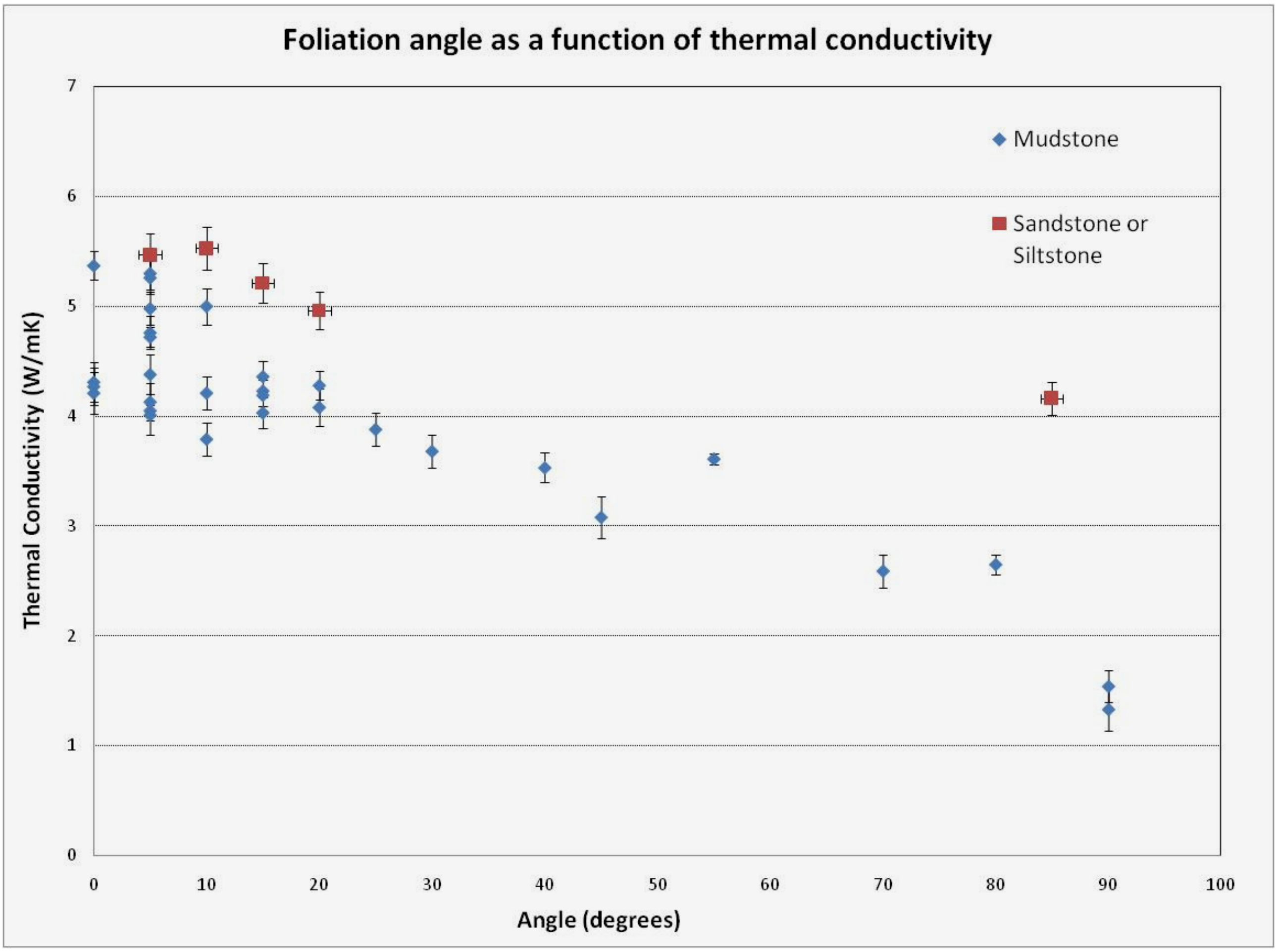

Figure 6: Zero degrees is the heat flow parallel to the foliation and 90° is the heat flow across the foliation. Thermal conductivity increases the more foliation becomes parallel to the heat flow. Finer sediments such as mudstones have lower thermal conductivities in general compared to sandstones.

Hole Name	Confidence level	Surface HF mW/m²	Error mW/m²	Base HF mW/m²	Error mW/m²	Comment
Bangor	Mod-High	**70.0**	4.6	64.0	4.2	advective influence at 142-205m, resulting in higher basal heat flow
Beaconsfield	High	**86.0**	0.4			
Ben Lomond	High	**97.0**	2.3			
Bluestone Tier	High	**72.0**	0.6			
Cambridge#	High	**74.0**	1.2			
Charlton2	Mod-High	**71.0**	1.3	105.3	1.9	advective influence at 100-160m, resulting in higher basal heat flow
Elizabeth	High	**94.0**	2.4			
Epping	Mod	**62.0**	0.4	92.0	0.6	heat removal by cold water between 225-25m
Fingal3	Mod	**70.0**	2.1	97.0	2.9	cool water moving in upper section of hole, 150m
Frankford	High	**72.0**	2.2			
Kingston	High	**86.0**	3.1			
Lake Leake	High	**92.0**	2.9			
Lemont	High	**118.0**	6.4			
Lisle	High	**65.0**	0.5			
Macquarie	High	**103.0**	1.0			
Marion Bay	High	**70.0**	0.5			
Mt Nicholas	High	**106.0**	1.3			
Murdunna	High	**81.0**	1.1			
Native Hut	High	**78.0**	1.8			
Nunamara	High	**75.0**	1.1			
Perth	High	**75.0**	1.1			
Rheban	High	**94.0**	0.5			
Rocherlea	High	**48.0**	0.4			anomalously low
Runnymede	High	**84.0**	2.5			
Snow Hill	High	**92.0**	2.3			
Sorell	High	**83.0**	1.1			
Swan2/Swan3	High	**85.0**	1.2			
Temple Bar	High	**87.0**	1.9			
Tiberias	Low	**73.0**	3.9			cool water moving down hole
Tooms	Mod	**96.0**	2.5	63.3	1.3	shallow warm water entering hole at 154-204m via possible fractures
Tower Hill	High	**83.0**	1.0			
Tunbridge	High	**81.0**	1.2			
Westbury	Mod-High	**60.0**	1.3	72.0	1.3	advective influence at 140m, resulting in higher basal heat flow
Weymouth	High	**75.0**	1.3			
Woodsdale	High	**81.0**	3.2			
Oatlands2	Very Low	**43?**	0.2?			highly disturbed temperature profile, very low confidence heat flow value

Table 6: Summary of estimated surface and base heat flow values from KUTh's shallow drilling program. Majority of calculations have a high confidence. Comments are possible explanations for variations in thermal profiles. # also known as University Farm.

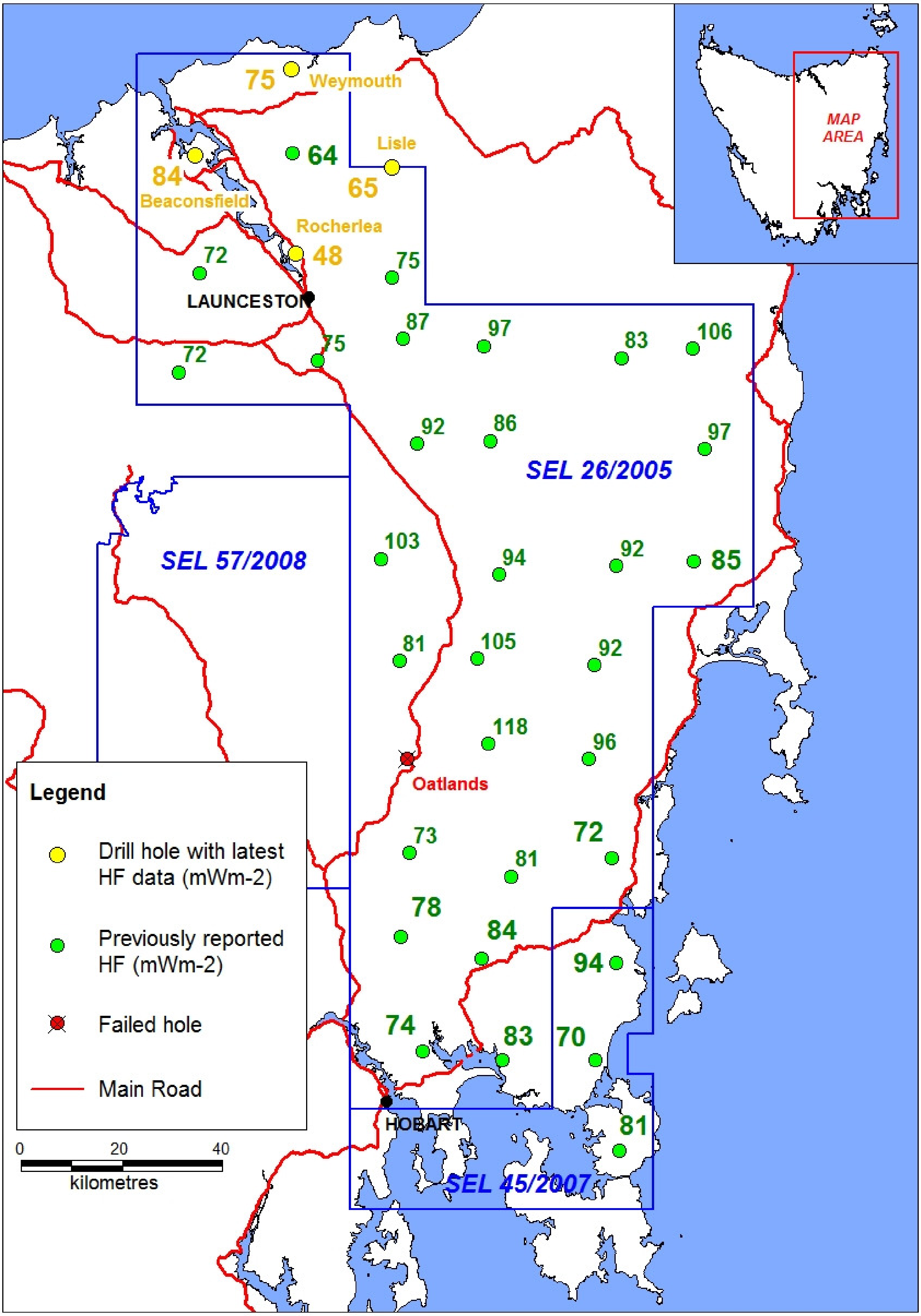

Figure 7: Surface heat flow results from the shallow drilling program. Yellow dots indicate the most recently received results.

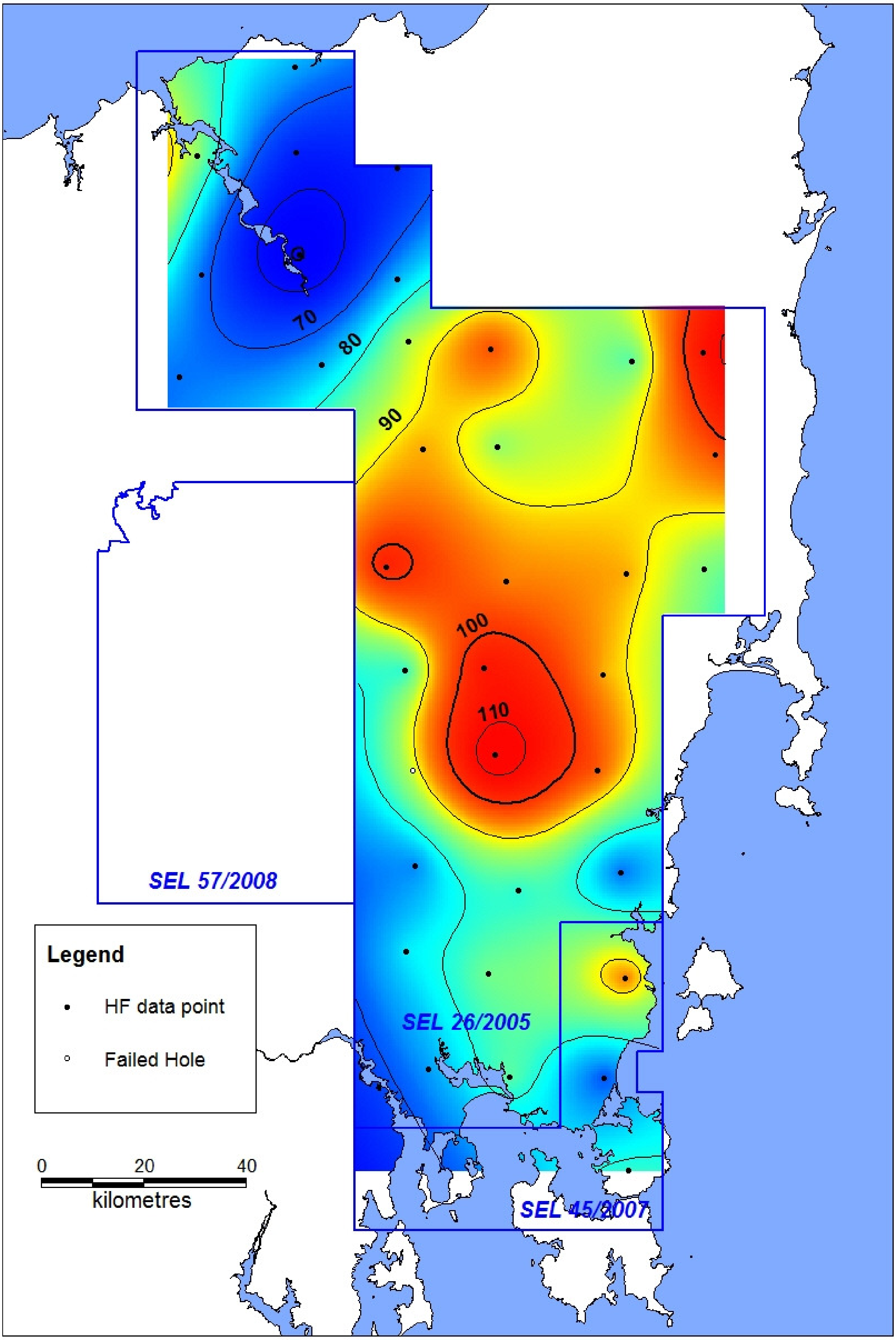

Figure 8: Interpolation of surface heat flow values from KUTh's Tasmanian shallow drilling program. Contour interval is 10mWm-2.

3.2 Magnetotelluric (MT) surveys

An initial MT survey was undertaken across SEL 26/2005 in September – October 2008. The aim of this work was twofold - to confirm the extent and detailed structure of the Tamar Conductivity Zone and to investigate the application of modern MT techniques in Tasmania. Data were recorded along two east-west line profiles in the north and centre of the tenement. Results, including 1 and 2D modelled profiles, were returned in January 2009 and confirmed both the existence of the TCZ and increased its known extent. The proximity of the newly defined TCZ to areas of extreme heat flow in the south led to the decision to augment the MT coverage in this area with the collection of ~160 new data points. Data acquisition on the expanded array, designed to enable 3D MT modelling across the central midland area, commenced in May 2009 with completion anticipated by mid-late July 2009.

3.2.1 MT 2008

Location and Planning

In order to test the applicability of natural-source MT survey techniques it was decided to undertake two east-west orientation lines across SEL 26/2005, one to the north of the tenement across the Tamar Valley and one to the south along the Lake Leake Highway between Campbell Town and Swansea. The northern line (Figure 9) was 43.9km long striking 70°ENE and started approximately 8km west of Exeter. This line commenced on Permian sediments, crossing into recent sediments and Jurassic dolerite in the Tamar River Valley. The last 20km (20 stations) on the east were over folded Ordovician - Devonian Mathinna Beds. At its eastern end, the line traversed out of SEL26/2005 into minerals exploration tenements controlled by Beaconsfield Gold NL. Permission to conduct the MT survey over this ground was granted by Beaconsfield Gold NL.

The southern MT line (Figure 9) investigated a zone where Devonian granite plutons are modelled to lie below 3-5km of sediments and are co-incident with high (>90mW/m^2) surface heat flows (Figures 3; 8). Located entirely on Jurassic dolerite this line was 53km long and trended ~110°, following the Lake Leake Highway for good access. Toward the east the line departed from the main road at the boundary of a large State Reserve, traversing to the south of the Reserve. At its eastern end, it traversed off SEL26/2005 onto a mineral exploration tenement then controlled by Mineral Ventures Pty Ltd, a subsidiary of KUTh Energy Limited. Extensions off tenement at the end of each of the lines were a technical requirement to enable modelling of deeper features in the central part of the survey. A full list of all 2008 MT stations and their locations is provided in Appendix 7.

Data Acquisition

MT data were acquired by Moombarriga Geosciences using Phoenix systems over a six week period from September to October 2008. Full tensor data collection was attempted at every site although digging difficulties in hard and rocky ground prevented collection of Hz at some locations. Stations were left in the ground for ~12 hours to ensure resolution of apparent resistivity and phase data in the range 300 – 0.01Hz.

Data were collected at total of 54 stations along the southern line with difficult digging impacting on the ability to record Hz data. Data quality was variable with a generally low signal due to the survey timing (during the 11-year cyclical sunspot low) and the occasional presence of electrical noise from cultural or natural sources. By contrast, data quality on the northern line was significantly impacted by cultural noise, most commonly attributed to electric fences. Notably, however, the proximity to the DC BassLink interconnector appeared to have no impact on data quality. To counter the effects of noise on the northern line, a remote station was located in a quiet zone near Oatlands and allowed to record continuously until the end of the survey. Data were collected at a total of 44 sites along the northern line.

Field data processing undertaken by Moombarriga Geosciences included the conversion of time series data to apparent resistivity and phase curves using Phoenix propriety software. Full details of the data acquisition field processing and results are included in the MT Survey Report (Appendix 7).

Modelling and Interpretation

Modelling of data generated by this survey was performed by Dr Adele Manzella of the *Consiglio Nazionale delle Ricerche-Istituto di Geoscienze e Georisorse* (CNR-IGG) in Italy. The processed data were found to be of high quality with relatively few incidences of major signal noise. As part of the modelling process Dr Manzella applied a systematic process of data validation to identify, correct or remove poor or biased data. A manually derived 'static shift' correction was applied to compensate for distortion effects produced in the electromagnetic field by near-surface features.

The 2D models produced by Dr Manzella for this survey are presented in Figure 10. In both cases these models have been refined by the use of *a priori* constraints regarding the location of resistive bodies determined in 1D inversion models. No assumptions were made regarding the location, size or intensity of electrically conductive anomalies or of the nature or distribution of the existing geology. Comparisons of TE, TM and joint TE-TM inversion models for the two lines indicated a good agreement for the northern line whilst the southern line displayed significant differences indicating these data are influenced by 3D effects. Full details of Dr Manzella's interpretation are included in Appendix 8.

The models derived from the MT data show the presence of large electrically conductive bodies within the crust in the vicinity of both survey lines. In the northern profile, a strong east-dipping conductive body is observed at a depth of 2.5km and is interpreted to have a thickness of no less than 2km. This body, together with a weaker west-dipping conductor, confirms the presence of the 'Tamar Conductivity Zone' (TCZ) in this region.

An east-dipping electrically-conductive anomaly is also identified at the western end of the southern MT profile at a depth of 3.5 - 4km. This body lies directly along strike from the east-dipping feature identified in the northern profile and is interpreted to be an extension of the TCZ along the Tamar Lineament (Figure 11).

An electrically insulating anomaly is seen located to the east of the interpreted east-dipping TCZ anomaly in both the northern and southern profiles. At present the identity of the geological feature causing this anomaly remains speculative.

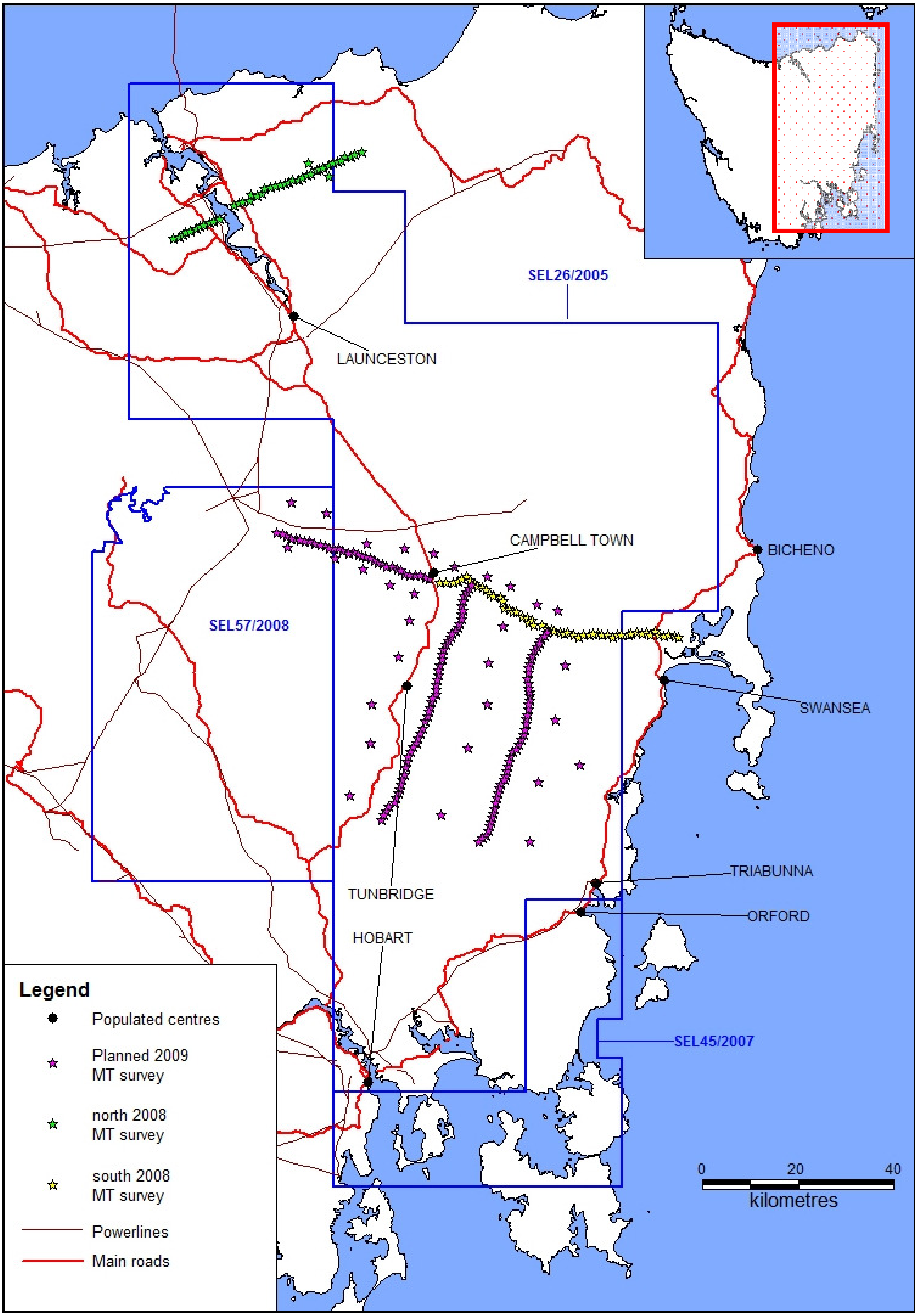

Figure 9: Actual locations of the 2008 MT survey and the planned locations of the 2009 MT across the Midlands of Tasmania.

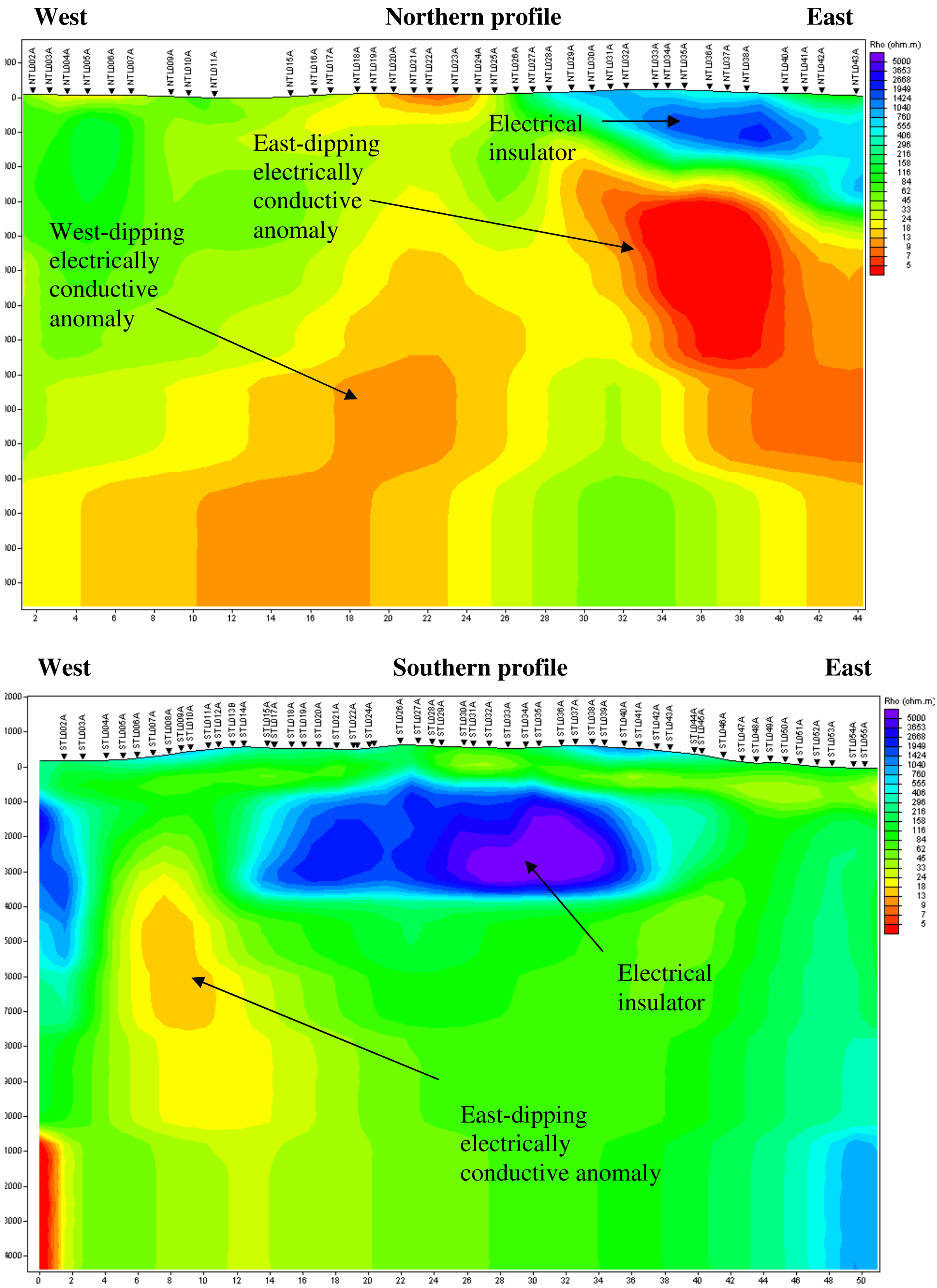

Figure 10: Northern and southern profiles of the 2008 MT survey. Both are 2D inversions of TM-TE shifted data using a priori model built on the base of the 1D inversion results. Northern RMS= 18.4, southern RMS= 19.0. See Appendix 8.

3.2.2 MT 2009

The apparent extension of the known TCZ southwards towards central Tasmania creates potential for an intersection of two significant geothermal targets. The TCZ remains open to the south where it is seen to be striking towards the area of anomalously high surface heat flow (Figure 11). Extension of the TCZ into this area may imply the existence of fracture permeability and naturally occurring fluids at depth and hence would represent a significant target for future geothermal development.

The observation of apparent 3D effects along the southern line of the 2008 MT survey indicates that to investigate this area further, and to correctly delineate the southern extension of the TCZ, a more detailed 3D MT array is required. To achieve this, a second MT survey was planned to extend the 2008 MT into the southern Midlands area.

Location and Planning

An array of stations was planned adjacent to the 2008 southern MT line with the aim of supporting a 3D MT model of the area across the central Midlands (Figure 9). Two NNE trending profiles, NSA and NSB, extend south ~50km orthogonal to the southern line. A third profile line, EWA, runs WNW extending the western end of the original southern line by around 34km. The western end of this line runs onto SEL 57/2008, the third tenement held by KUTh in Tasmania. Station spacing along the profiles is ~1km with a wider spaced array of ~5km located around the main lines and to the north of the original southern line. Geology beneath the lines varies from mainly dolerite in the east variably to dolerite, Permo-Triassic and Tertiary sediments in the west and south.

Data Acquisition

MT data acquisition was commenced by Moombarriga Geosciences using Phoenix systems in May 2009. Full tensor data collection will again be attempted at every site although digging difficulties in hard and rocky ground will again likely prevent collection of Hz at some locations. Survey parameters are identical to 2008 although stations will now be left in the ground for a minimum of 15 hours to best ensure resolution of apparent resistivity and phase data in the range 300 – 0.01Hz. MT data at each site will also be augmented by the addition of Time Domain Electro-Magnetic (TDEM) data recorded on an Alpha Geoscience TerraTEM system. These data will be used to accurately correct for static shift errors in MT modelling.

At the time of reporting data acquisition remains underway and is expected to continue into July. Completion of data acquisition is currently expected by late July with modelling results anticipated by the end of September 2009.

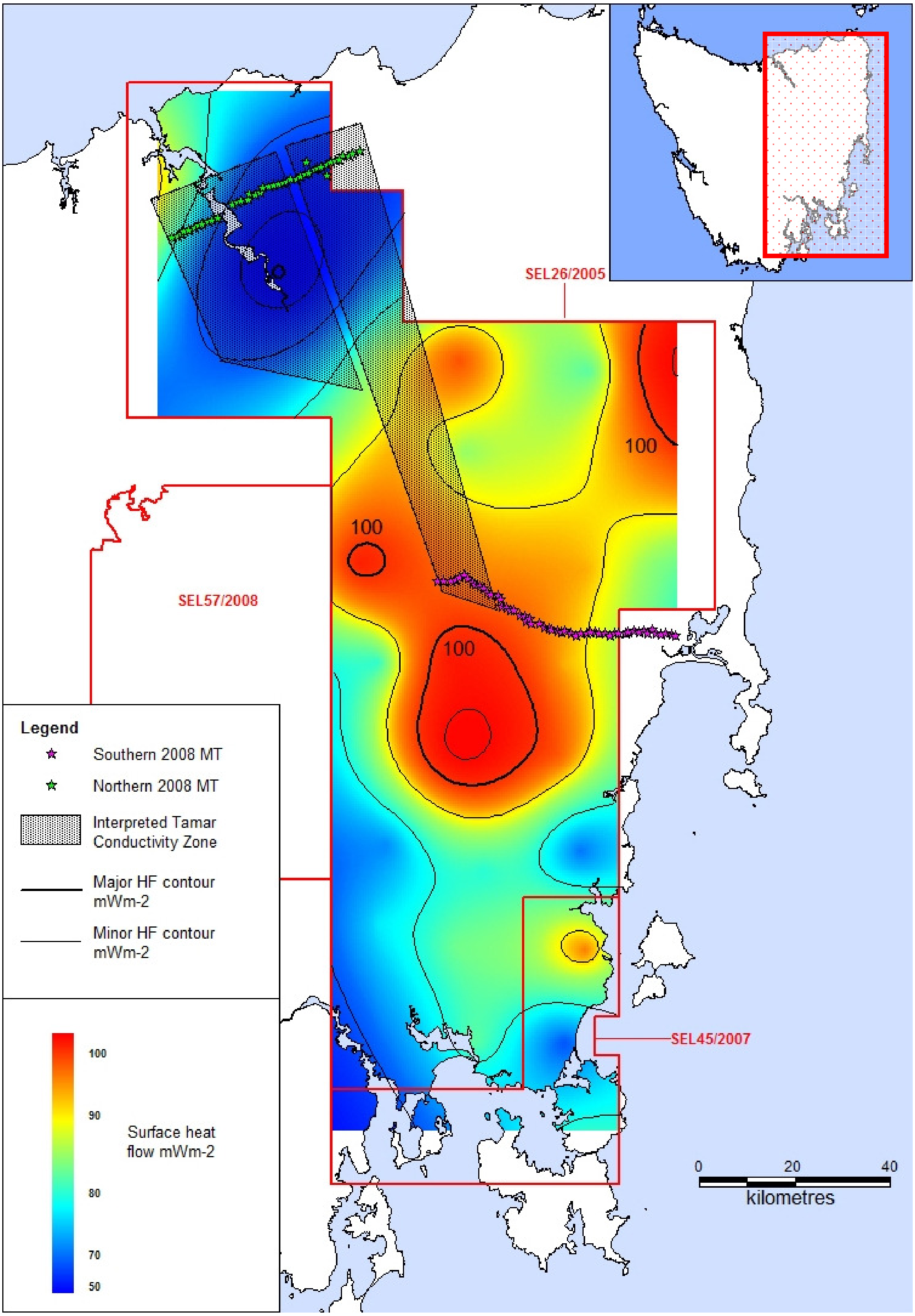

Figure 11: Interpreted extent of electrically conductive anomaly from the 2008 MT survey.

3.3 Aeromagnetic survey 2009

Infill aeromagnetic data acquisition was undertaken to provide information on the depth of the Jurassic Dolerite layer which lies at surface across the central midlands area. The dolerite is an excellent thermal insulator and is therefore a potentially important component required for 3D modelling and resource estimation. Results of the aeromagnetic data acquisition will be subject to a spectral analysis to estimate depth to base dolerite. Data from this survey will also be used to further refine the predicted depth to top granite from D.Leamans report *(Ward et al 2008*).

Data acquisition

Aeromagnetic data acquisition was undertaken on behalf of KUTh Energy by Thomson Aviation Pty Ltd in March 2009. The survey was designed to infill an area of poor data coverage around the edge of the AGSO 1999 Southern Midlands survey (Figure 12). Survey specifications are as outlined in Table 7. During the execution of the survey an issue arose regarding the impact of the aircraft on breeding pheasants at the Currawong Lakes private game reserve, 9km south of Lake Leake in the central Midlands area. Following discussion with Currawong Lakes' management (Peacebrook Pty Ltd) an agreement was made to excise an area from the survey to minimise disturbance of the breeding fowl.

Full details of the aeromagnetic data acquisition, including raw data results are provided in Appendix 9.

Data Processing

Processing of magnetic and elevation data acquired during the survey was undertaken by Baigent Geosciences. Full details of the processing applied are included in Appendix 9 along with the resultant data grids.

Data Interpretation

A spectral interpretation of the combined KUTh and AGSO southern Midland aeromagnetic data is underway at the time of reporting. This work, which is experimental, aims to utilise spectral magnetics to map depth-to-base dolerite across the survey area. It is being undertaken by Kate Godber of Mitre Geophysics in collaboration with Dr Roger Lewis of Liddington Technology Pty Ltd. Results of this work are anticipated in the second half of 2009.

Flight line direction	East- West	Boundary Lines used (GDA94 Zone 55)	
Flight line spacing	200 m	518000	5364000
Tie line direction	North- South	582000	5364000
Tie line spacing	2000 m	582000	5300000
Sensor mean terrain clearance	90 m	557000	5300000
Time base- for magnetics	0.05 sec (<4 m)	549000	5340000
Total line km	4084.4	518000	5340000
Aircraft	Cessna 210L, VH-JHF & VH-AQS		
Magnetometer	Geometrics G822A		
Magnetometer resolution	0.01nT		
Magnetometer compensation	Pico Envirotec MMS-4 processor		
Magnetometer sample interval	not stated		
Data acquisition	GeOZ_DAS		
Spectrometer	not stated		
Crystal size	not stated		
Spectrometer sample interval	not stated		
GPS Navigation system	Novatel OEMV-1 VBS Receiver		

Table 7: Aeromagnetic survey specifications and equipment.

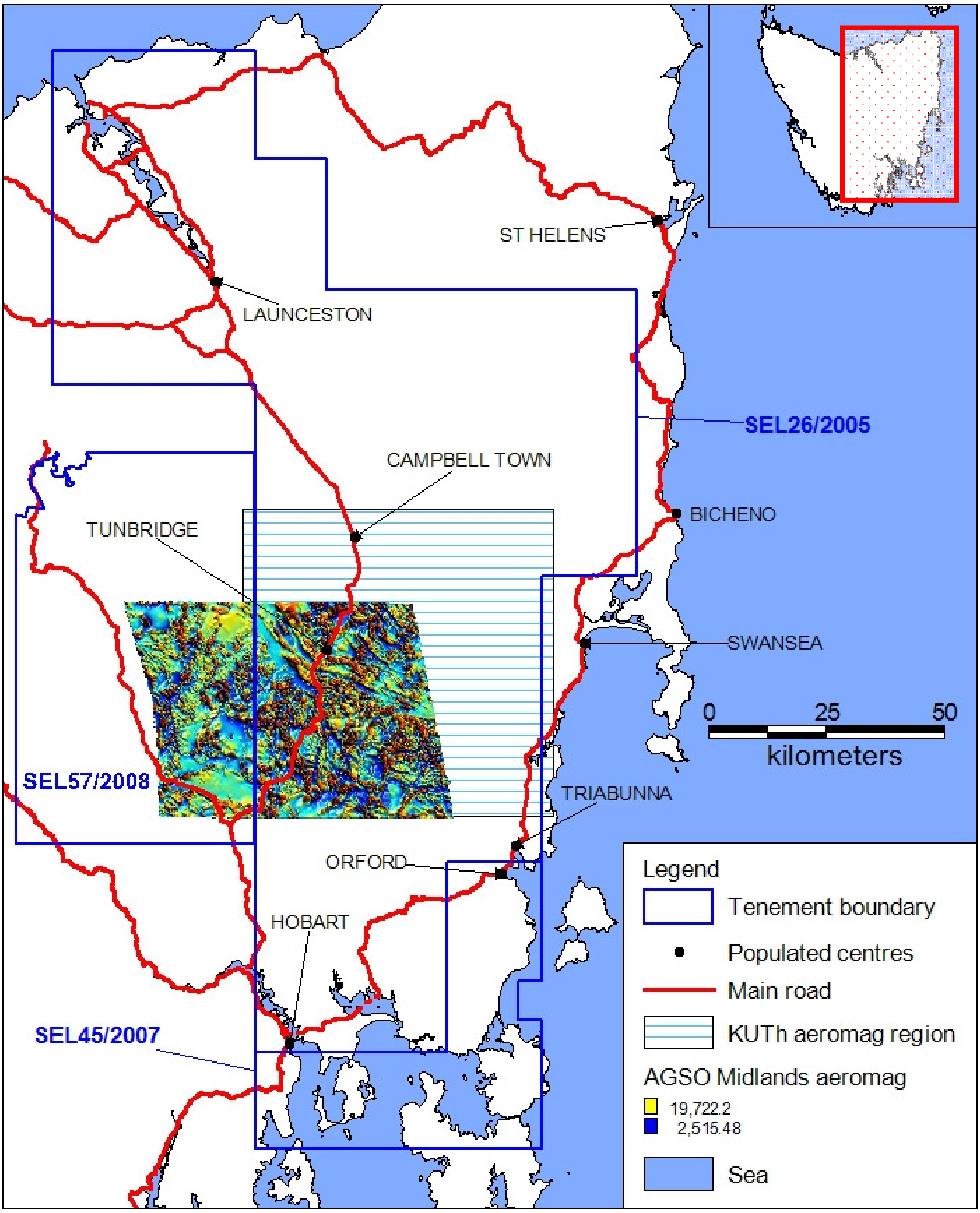

Figure 12: Location diagram of KUTh Aeromagnetic data acquisition relevant to tenement and adjacent AGSO 1999 Southern Midlands survey. Refer to Appendix 9 for full flight line diagrams.

3.4 Seismic re-interpretation

As part of a program of legacy data assessment KUTh commissioned Hot Dry Rocks PL to undertake a reinterpretation of selected open-file 2D reflection seismic data previously acquired over Central Tasmania by Great South Land Minerals PL (GSLM) and by Geoscience Australia (GA). The GSLM lines, which were acquired in 2001 as part of a petroleum exploration program, are generally located to the west of SEL 26/2005 although a small number of profiles extend across the western portion of the tenement (Figure 13). Two further onshore lines, which were shot by GA in 1995 as part of a broader investigation into the Tasmanian crust, are located within the tenement area near Tunbridge in the west and Mathinna in the north-east. In all, four GSLM lines (TB01-PF, TB01-PG, TB01-PT and TB01-ST) and two GA lines (95AGST4 and 95AGST3) were reinterpreted. The goal of this work was to gain an understanding of the regional structural style and to provide information constraining the layer geometry of a 3D geo-model of the central Midlands area.

When viewed by HDR PL the GSLM seismic data were found to be adequate for interpretation, although they were of relatively poor quality due to noise attenuation and line curvature. Issues were also encountered with the GSLM header file data which were incomplete, requiring assumptions to be made regarding the datum for depth conversion. Data from the GA survey lines were generally of poor quality although stacking velocities derived from these lines were used to interpret the GSLM data.

Results of the re-interpretation, provided in detail in Appendix 10, indicate a regional structural style that is dominated by NE-dipping, NNW-trending faults which sole into a major detachment interpreted between 7 - 8km depth. A major bounding fault in the west, visible on line TB01-ST, marks the western extent of interpreted Mathinna-equivalent units (Figure 14 – see if we can insert a small picture of ST here?). Evidence suggests the reactivation of faults over time, with inversion of the tectonic regime from early extension to later compression marked by thrust-faulting. Younger Permian-aged faults commonly sole into older structures and are observed to display similar NNW trends.

Thicknesses of Mathinna and/or Mathinna-equivalent sediments were interpreted to range between 4 – 5km along the eastern margin of the GSLM lines. The Parmeener Supergroup appeared to thin to <1km toward the east from a maximum of 2 - 3km beneath Tertiary sub-basins along the Tamar Valley axis. Jurassic Dolerite is interpreted as a blanket layer between 200 – 320m thick and is observed to be offset by minor Tertiary and ?Cretaceous faulting. No evidence of Devonian granitoid was observed which is consistent with interpretations which place these rocks further to the east (Leaman, 2008).

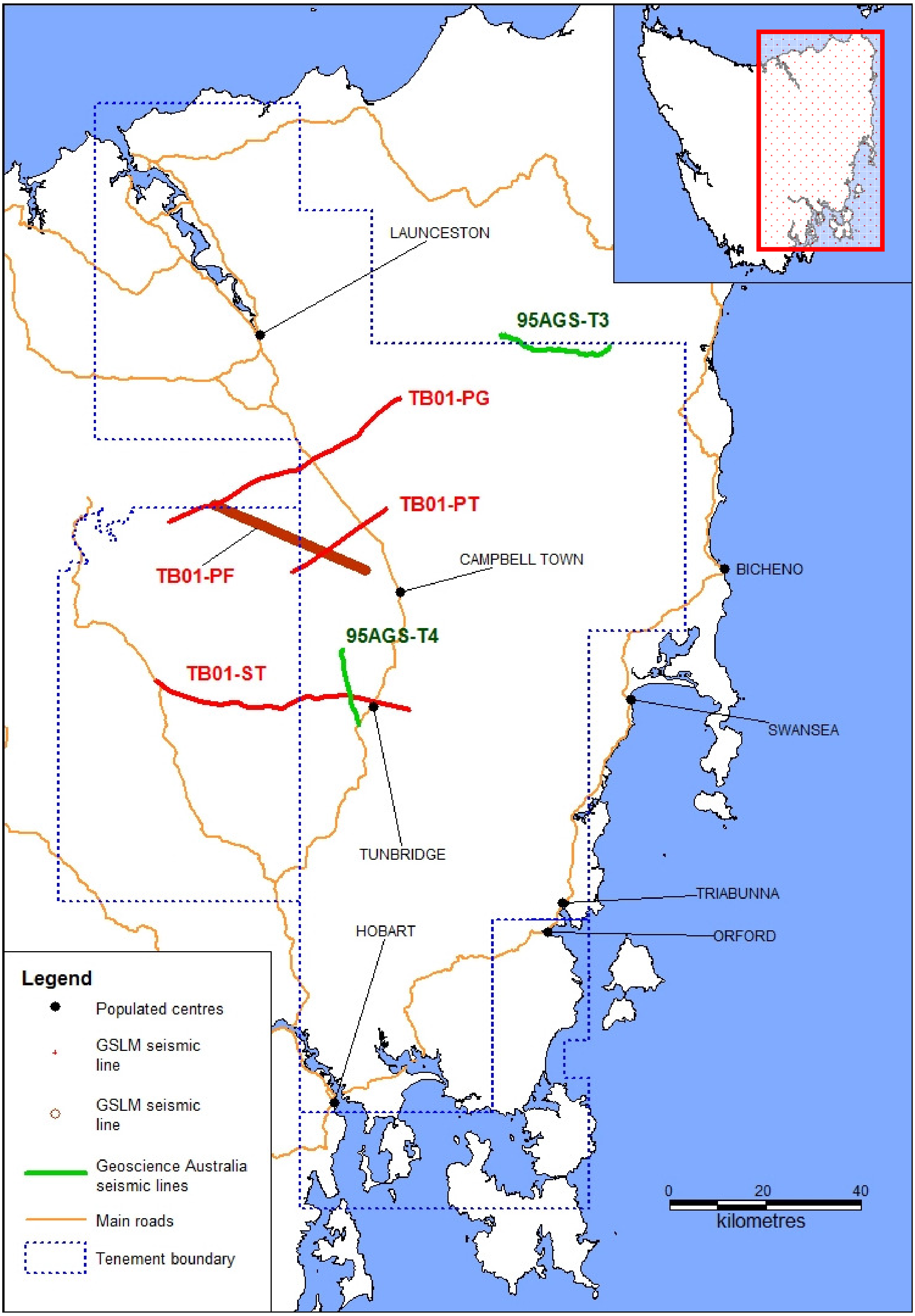

Figure 13: Red lines/points are seismic lines sourced from GSLM and green lines/points are sourced from Geoscience Australia.

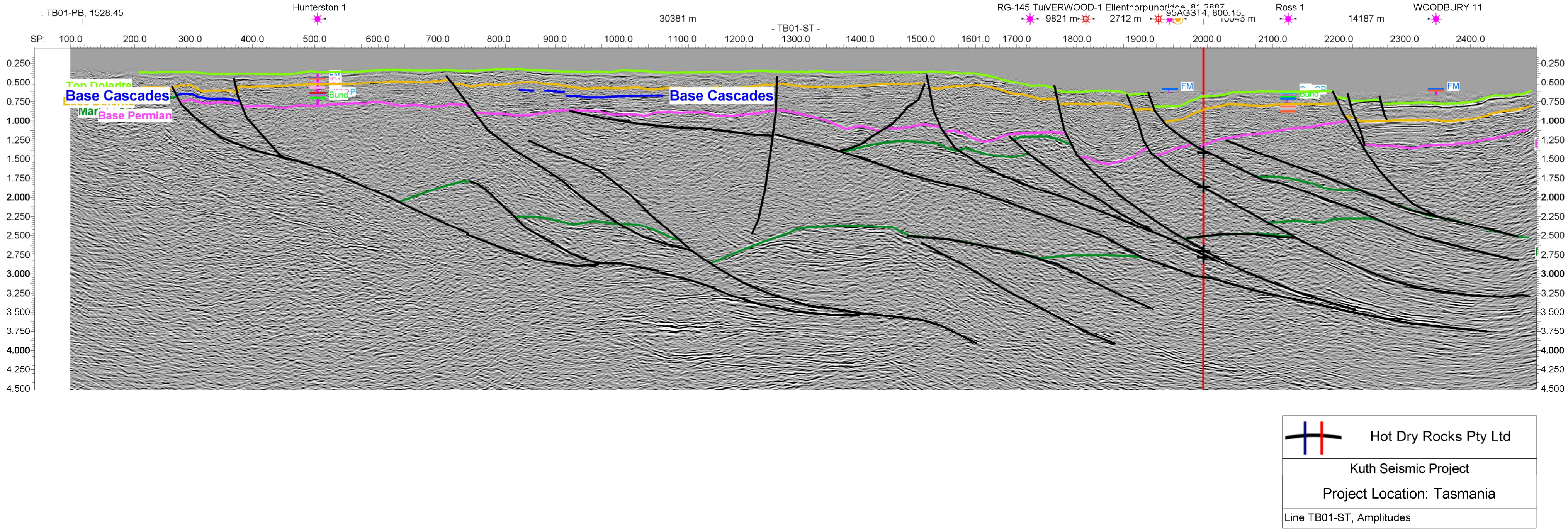

Figure 14: Great South Land Mineral seismic line TB01-ST reinterpreted by HDR PL. Major bounding fault is on the left of this image.

3.5 Thermal modelling and resource estimation

Following the success of the surface heat flow mapping program, work commenced upon the collation of available data and the production of a 3D geomodel for application in thermal modelling and estimation of a 'contained' or 'stored-heat' geothermal resource. The area chosen for initial modelling work was that surrounding the very high heat flows observed in the Charlton ($103mWm^{-2}$) and Lemont ($118mWm^{-2}$) drill holes in central SEL 26/2005. A 3D earth model was constructed by Hot Dry Rocks PL covering an area of $4140km^2$ in the Central Midlands (521,000 - 581,000mE; 5,290,000 – 5,359,000mN; AMG94, Zone 55) and to a depth of 7km. The model was initially constructed using a simplified stratigraphy comprising six layers: Jurassic Dolerite, Upper Parmeener, Lower Parmeener, Mathinna, Devonian Granite and Undifferentiated Pre-Cambrian basement (Figure 15). Layer geometries of these units were constrained using data derived from various sources, including drilling, seismic and gravity interpretations (Table 8).

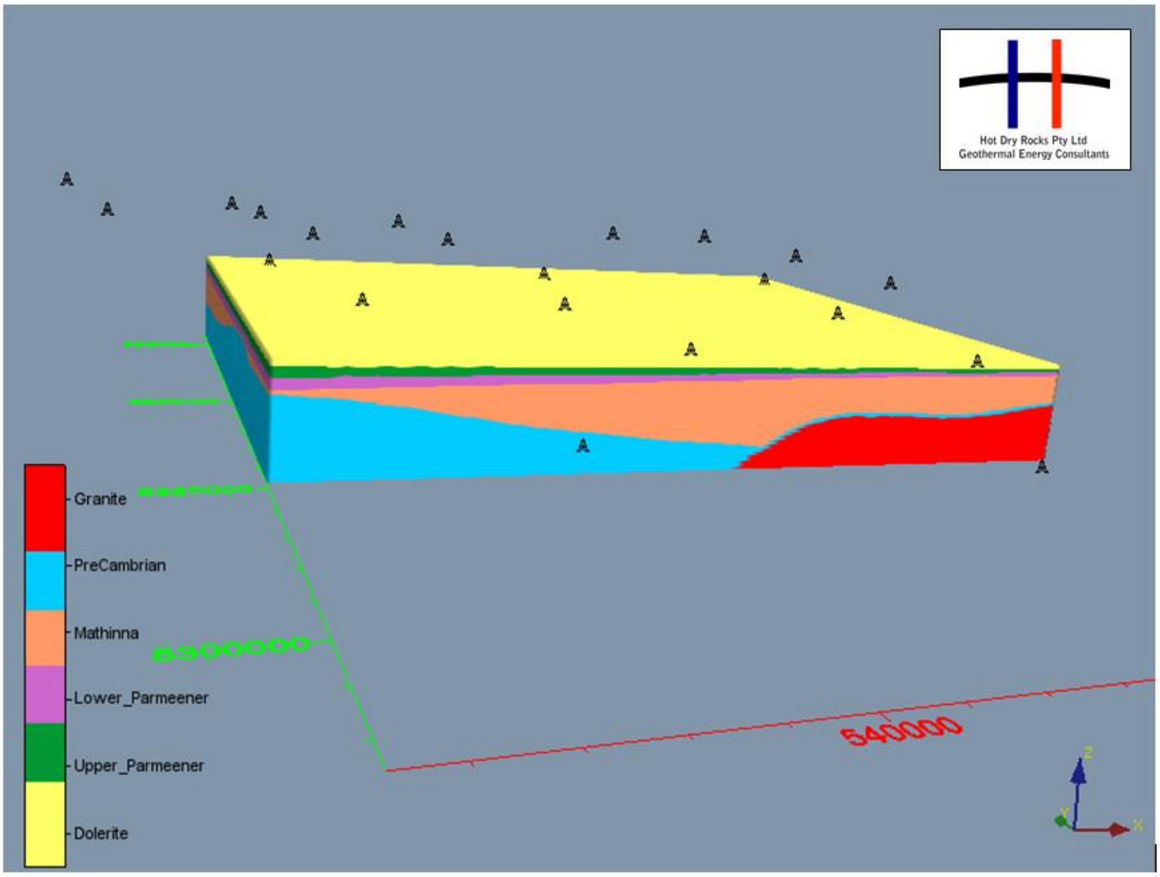

Figure 15: Earth model of the Charlton- Lemont area with simplified geology, produced by HDR PL. Input values are described in Table 8.

The layer model was 'voxelated' (cell size 500m x 500m x 70 m (xyz)) and thermal properties (thermal conductivity and heat production) were assigned to each voxel on the basis of stratigraphy (Table 9). Rock property data used were derived from a range of sources as described in Table 8. For Mathinna Units, which are known to

Model Input	Jurassic Dolerite	Upper Parmeener	Lower Parmeener	Mathinna	Devonian Granite	PreCambrian
Layer Geometry	Flat lying 320m-thick layer assumed from drill data, seismic interpretation	Combined data from seismic re-interpretation, drill data and isopachs in Burrett and Martin (1989).	Combined data from seismic re-interpretation, drill data and isopachs in Reid (2002).	Data from seismic re-interpretation	Depth to top-granite from Leaman (2008)	Data from seismic re-interpretation
Thermal Conductivity	KUTh SHFP	KUTh Measurements combined with bulk estimates derived from Glenorchy & Tunbridge drill holes	KUTh Measurements combined with bulk estimates derived from Glenorchy & Tunbridge drill holes	KUTh SHFP & Goh (2008)	Goh (2008)	Assumed. Equivalent to Mathinna.
Heat Production	Assumed (nil)	Assumed (nil)	Assumed (nil)	Goh (2008)	Goh (2008)	Assumed. Equivalent to Mathinna.
Density	n/a	n/a	n/a	Goh (2008)	Goh (2008)	Assumed. Equivalent to Mathinna.
Specific Heat	n/a	n/a	n/a	Goh (2008)	Goh (2008)	Assumed from literature.

Table 8: Source of data for the various parameters of the 3D model.

be anisotropic with respect to thermal conductivity, high, low and median cases were identified for trial in the model.

A 3D conductive heat flow inversion model was applied to predict temperature at depth. This inversion was constrained by measured values of surface heat flow and temperature gradient in ten holes from KUTh's shallow heat flow drill program. Initial modelled results indicated that the input geology model was unable to account for the extreme heat flow recorded beneath the Charlton and Lemont area. In order to explain these anomalies it was necessary to assume the presence of a previously unrecognised geological unit aligned north-south along the western margin of the interpreted Devonian Granite (Figure 16). This body, referred to as 'Unit A', has no known surface projection and is not detected by available geophysics. Possible options for this body include a granodiorite ridge, characterised by moderate heat production and high thermal conductivity, or a body of sediment characterised by high to very high thermal conductivity. A third option, that of a previously unrecognised high-heat-producing granite, is discounted due to the absence of any evidence in gravity data for additional low-density bodies in this area.

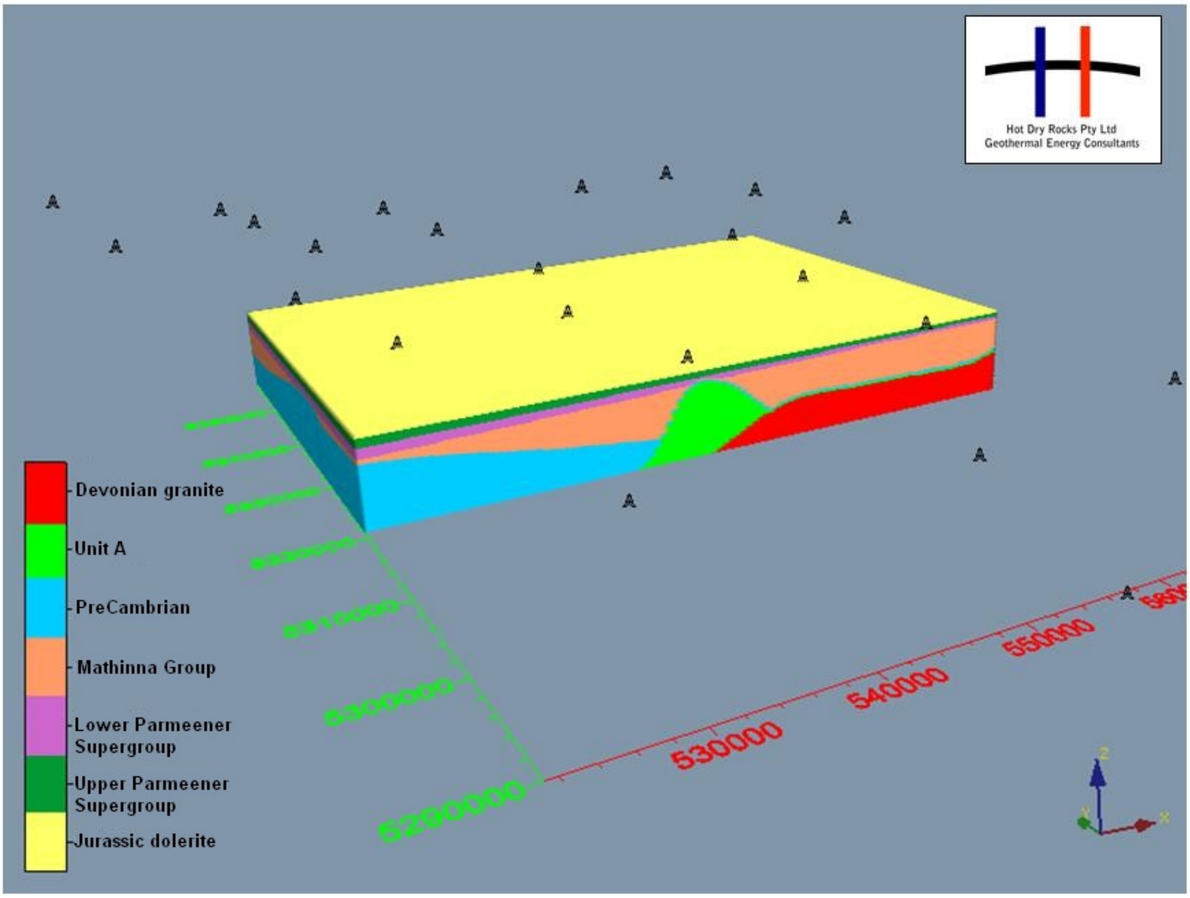

Figure 16: Earth model of the Charlton- Lemont area with the inclusion of Unit A (green polygon), produced by HDR PL.

Further modelling work indicated that both options (granodiorite or sediment) were able to satisfactorily explain the thermal field within the Charlton-Lemont area. In deciding between the two, it was noted that the sediment option required a thermal conductivity that was within the range observed for the anisotropic Mathinna Group.

This being the case, it was decided to assume that Unit A represents a body of Mathinna Group sediments which are aligned such that the dominant foliation is near-vertical. Appropriately, this proved to be a conservative approach, with predicted temperature at depth slightly less than that of the granodiorite model. Subsequent modelling trials indicated that, in areas outside of Unit A, the effects of thermal anisotropy in the Mathinna units (as simulated by high, median and low cases) were insignificant to the modelled result.

Following completion of the best-case thermal model a stored-heat estimation was carried out. Stored-heat or thermal-energy-in-place represents the amount of heat contained within a volume of rock. For the purposes of resource estimation, only that portion of the stored-heat energy which has reasonable prospects for eventual economic extraction should be considered.

A Hot Rock reservoir was defined based upon a cut-off temperature of 150°C and a maximum depth of 5km. Cut-off temperature is the minimum economic reservoir fluid temperature for commercial energy extraction and in this instance was based upon the requirements of a low-temperature organic rankine-cycle binary power plant. The areal extent of the resource was defined as the polygon formed by the intersection of the 150°C isotherm with the 4km depth contour (Figure 17). Within this area a volume of 1019km^3 of rock was identified as meeting the criteria for Hot Rock reservoir. Lithologies included within this volume are Granite, Mathinna Sediments (standard and Unit A) and Pre-Cambrian basement.

A stored-heat estimation was made for the reservoir by assigning values of heat capacity and density to the relevant lithologies in the thermal model (Table 8). The stored-heat estimate considered only that portion of energy present above a 'base' or 'rejection' temperature of 70°C. This value represents the temperature at which a low-temperature organic rankine-cycle binary power plant rejects fluid and is therefore the limit on the amount of energy that can be drawn from the geothermal resource.

Results of the stored heat estimation are presented in Table 10. Based upon the available data and the current level of uncertainty this estimate is considered to be an Inferred Geothermal Resource, as defined by the Australian Code for Reporting of Exploration Results, Geothermal Resources and Geothermal Reserves (2008) ("Geothermal Code"). Methods used in determining this resource estimate are in accordance with those outlined in the accompanying Geothermal Code Lexicon (2008) and the estimate has the approval of Dr Graeme Beardsmore, who is a Competent Person as defined under the Geothermal Code. Dr Beardsmore's full formal resource statement is included in Appendix 11.

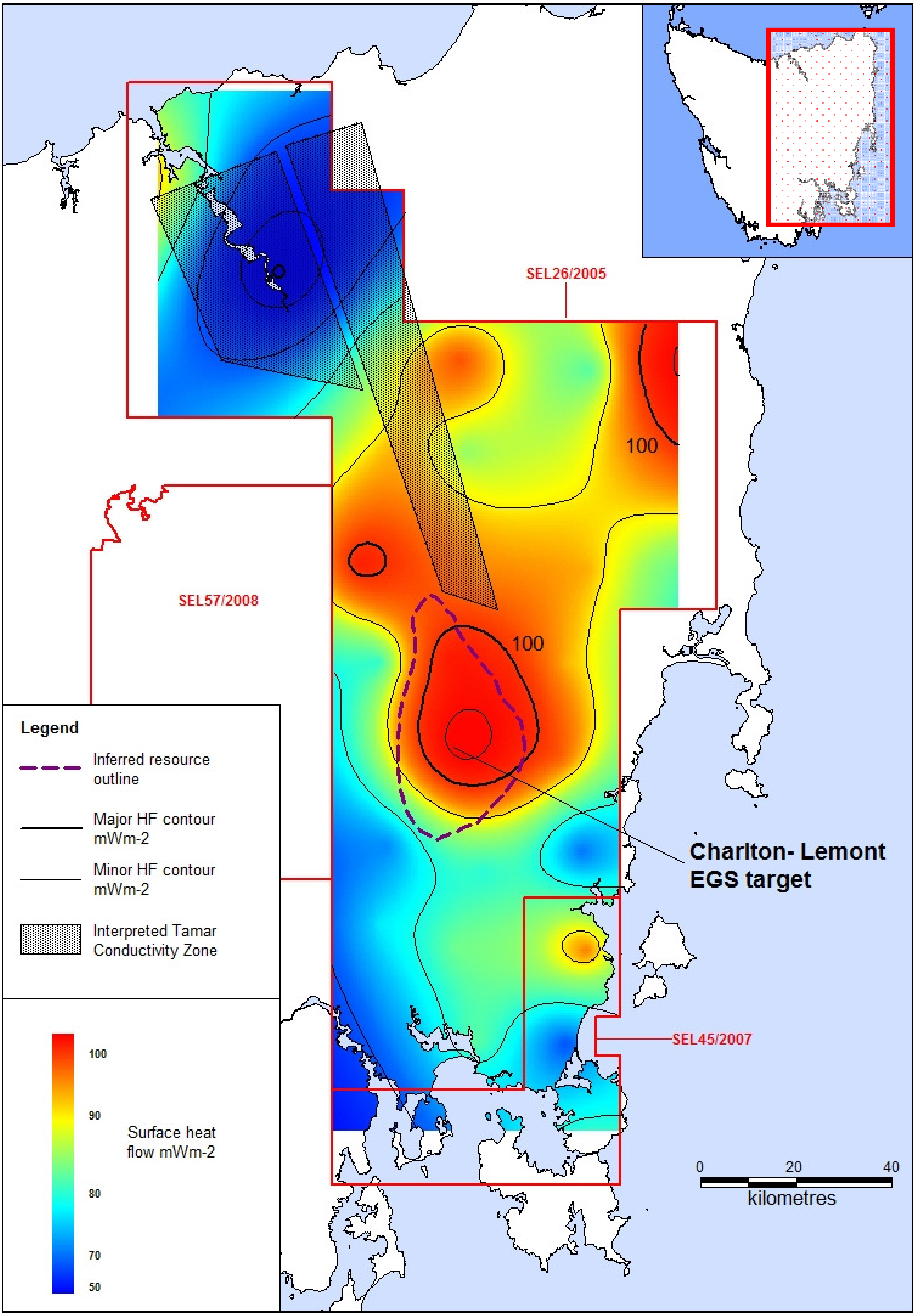

Figure 17: The Charlton- Lemont Inferred resource is defined by the purple dashed line and covers a significant area in the central Midlands of Tasmania.

Geological unit	Thermal conductivity (W/mK)	Heat generation (μW/m³)
Jurassic dolerite	2.17	0.00
Upper Parmeener	2.30	0.00
Lower Parmeener	2.12	0.00
Mathinna Supregroup	3.80	1.61
Granites	3.50	7.33
Precambrian	4.98	0.00

Table 9: Input parameters for Figure 15 3D earth model. See Appendix 11 for further details.

Reservoir	Stored Heat (PJ)	Volume (km³)	Inferred Geothermal Resource (PJ)
Mathinna Supregroup	54,260	230	54,000
Granites	26,300	108	26,000
Unit A	101,840	402	102,000
Precambrian	73,490	279	73,000
Total	**255,890**	**1019**	**260,000**

Table 10: Estimation of stored heat in the Charlton-Lemont resource area reported by HDR PL. See Appendix 11.

3.6 Direct heat investigations

The inclusion of the Hobart and Launceston metropolitan areas within the extent of SEL 26/2005 allows for the possibility of the development of local warm or hot sedimentary aquifers for direct heat applications. Heat flow data returned from the shallow drilling program infer that Launceston is less likely to be a promising target for geothermal development of this kind although Hobart remains of interest. Throughout the year discussions were held with the engineering firm responsible for the development of the proposed new Royal Hobart Hospital (now deferred) and the UTAS both of whom indicated strong levels of interest in the possibility of direct use geothermal for space heating. However, relatively little information is available regarding the depth and suitability of aquifers in the Hobart area and it was concluded that drilling would be required to progress this project. Whilst this has not been ruled out, it must necessarily be ranked against other project priorities when determining available expenditure.

4 Research activities

Several research projects with KUTh support were completed or were underway during the reporting period.

4.1 H. Goh Honours project 2008

An author (Hilary Goh) of this report undertook a sponsored Honours project during 2008 (Feb-Nov) at the University of Tasmania. The purpose of this project was to record various petrophysical, geochemical and thermal properties of the Mathinna Group and Devonian granites of Tasmania. These basic rock property data are necessary for geophysical and thermal modelling and were used in the recent Inferred Resource estimation. A copy of the thesis (Goh, 2008) can be found at the School of Earth Sciences (UTAS) and the MRT Library.

As part of this project, and in conjunction with the UTAS, KUTh Energy contributed to the purchase of a Portable Electronic Divided Bar (PEDB) which will remain on the premises of the University. The PEDB was used to determine thermal conductivity values for rocks in Eastern Tasmania.

4.2 K. Rast Honours project 2009

A second sponsored Honours project is currently underway at the UTAS. This project, which is expected to be completed in November 2009, has similar objects to the H.Goh project and will be investigating rock properties of the Parmeener Supergroup of Tasmania.

4.3 Ambient Seismic Energy Technique 1 (ASET1) Dec'08- July '09

Dr Anya Reading, Senior Lecturer in Geophysics at the UTAS, was leader and co-ordinator for this project which was a pilot study ahead of ARC-linkage project '3D Seismic Velocity Structure for Geothermal Exploration' due to commence in the second half of 2009. The aim of the pilot project was to establish ways in which ambient seismic energy could be used to determine structure in the upper 10 km of the crust and hence the structure under the ASET1 spread.

A total of 10 seismic stations were deployed in December 2008, requiring the installation of solar panels and Orion recording units (Figure 18). All sites were located on private land in the Tunbridge area and were emplaced with the permission of the landowners. Data was collected from the stations once a month until they were uplifted in June 2009. At the time of reporting, data processing and interpretation were ongoing. Dr Reading intends to publish the results of her work after the interpretations are complete.

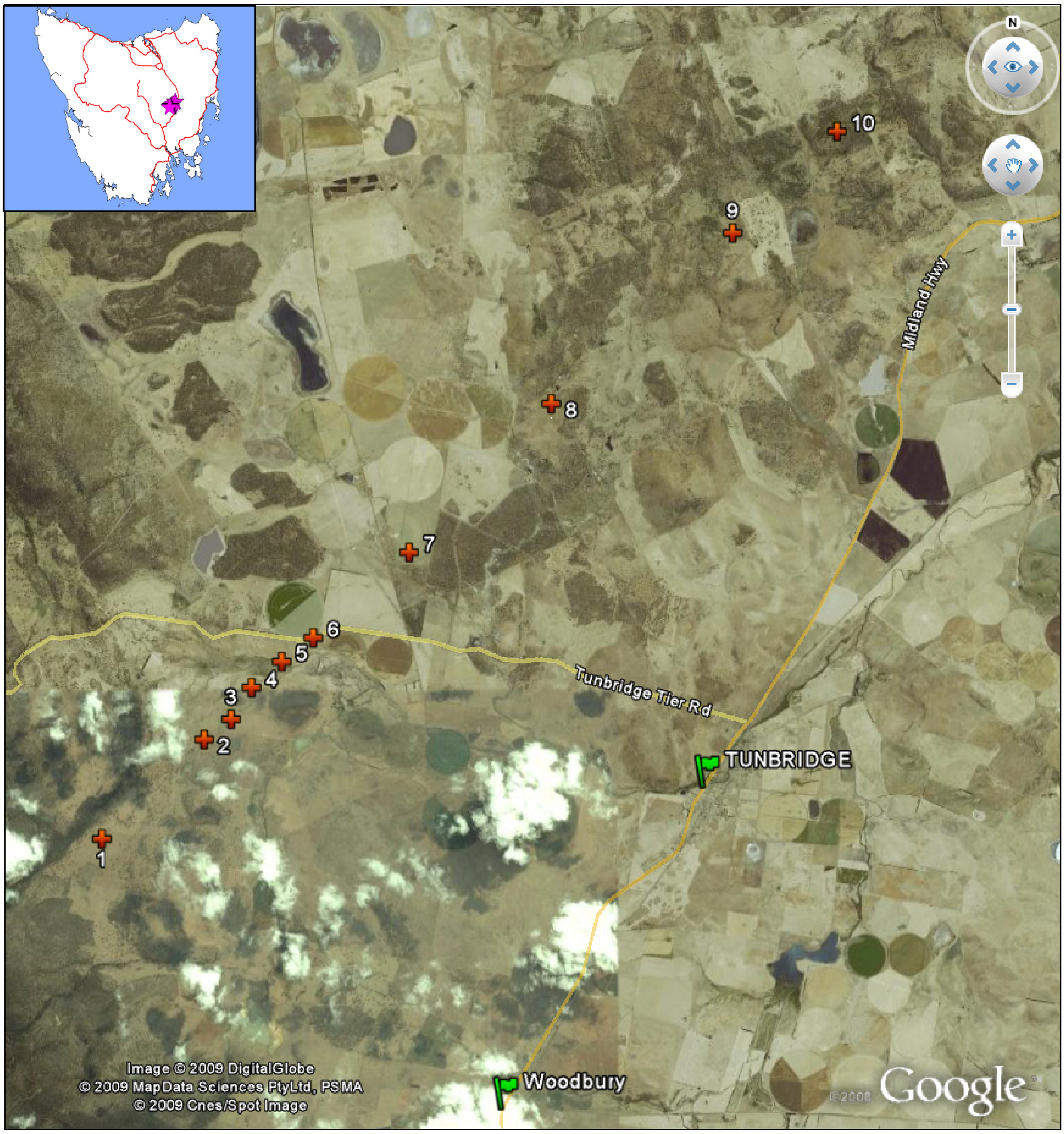

Figure 18: Location map for the ASET1 pilot project. The 10 seismic stations were located west of the Midlands Highway in the Tunbridge area. (Image from Google Earth 2008).

5 Discussion

Work completed across the tenements to date has revealed the presence of several thermal anomalies within eastern Tasmania. The most significant of these is over 4000km^2 and coincides broadly with the location of inferred granite bodies at depth. Included within this zone are several smaller regions of very high heat flow (>100mWm^{-2}) which appear to be the strongest targets for future EGS development. The largest of these zones, centred upon the Charlton and Lemont drill holes, is currently estimated to contain some 260,000PJ of available heat in a 1019km^3 reservoir of granite and sediment. In addition to these primary targets, a number of secondary EGS prospects are available within the portion of the anomaly where heat flow is estimated to be >90mWm^{-2}. Also present is an isolated anomaly centred upon the Rheban drill hole in the south of the tenement area. A map of prospective geothermal plays is provided in Figure 19.

Cutting across the tenements is the electrically conductive body known as the TCZ. This feature, which comprises at least one extensive north-south striking east-dipping body, remains open to the south where it lies directly along strike from the Charlton-Lemont resource area (Figure 19). A second west-dipping body is observed in the north of the tenement area but has not yet been confirmed to extend into the south. The nature of the geological feature responsible for the TCZ remains uncertain, however, it is probable that it may represent fluid and/or alteration associated with a large fracture zone. Intersection of this feature with a thermally anomalous zone may imply the presence of fracture permeability at depth. Such a situation would potentially be favourable for the development of an EGS as it may reduce the risk, and cost, of reservoir development.

Although conductive heat flow modelling of the Charlton-Lemont resource was successful it nonetheless required the addition of a previously unrecognised geological unit to fully account for the high values of observed heat flow. Intersection of the TCZ with the Charlton-Lemont resource raises the possibility that there may be an advective contribution to heat flow in this area. The volume of advecting fluid required and its potential effect on the thermal gradient at depth are unknown. A small program of water-sampling and geothermometry is planned in this area to see if it is possible to detect a signature from geothermal fluids in springs and groundwater at surface. Generally speaking, areas affected by the advective transportation of heat are expected to be characterised by a high overlying thermal gradient underlain by a zone of little or no increase in temperature. The potential impact of a TCZ intersection with the Charlton-Lemont resource area is thus mixed and will depend greatly on the nature, location and depth of this feature.

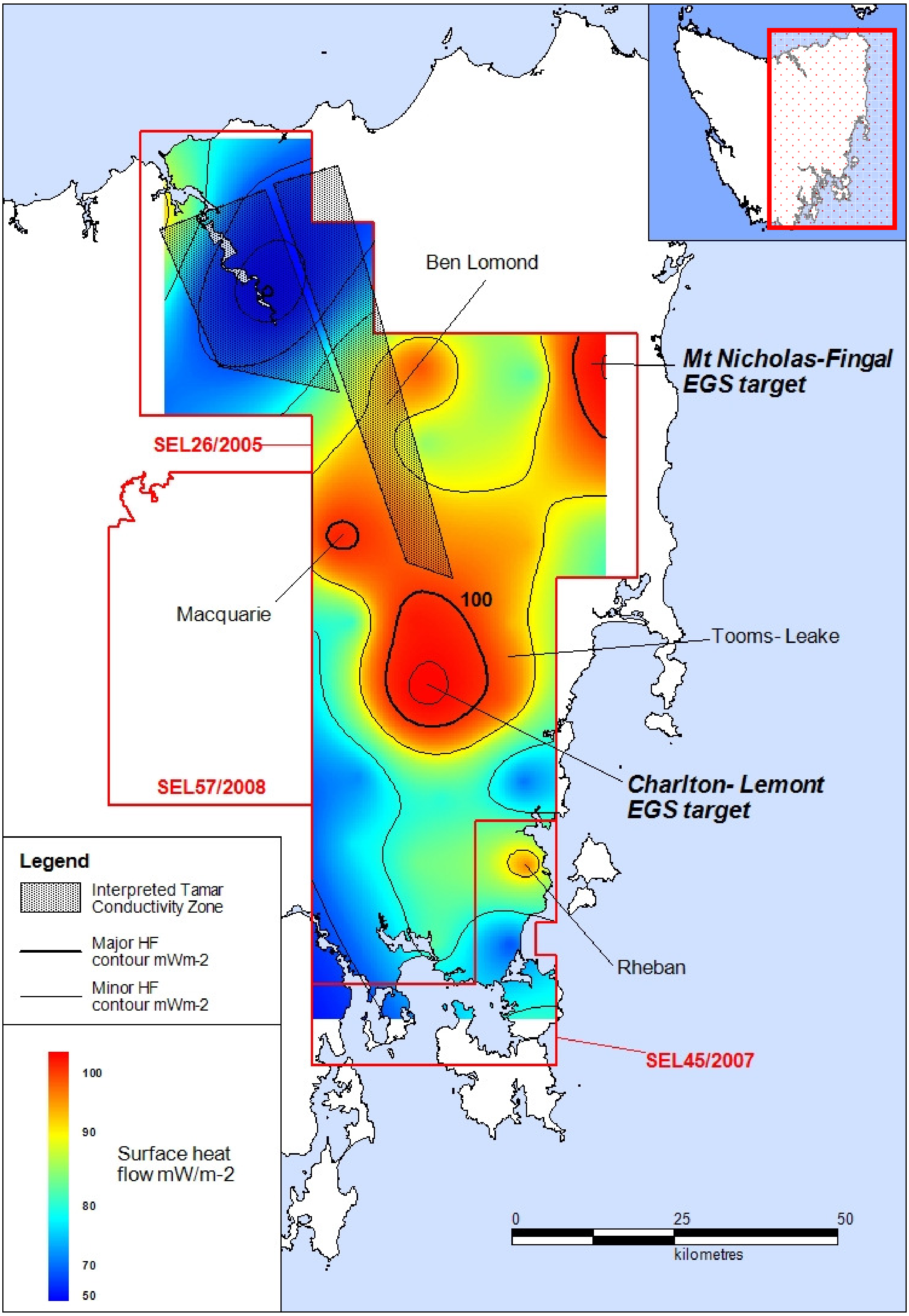

Figure 19: Six EGS targets in KUTh's tenements as indicated by the labels, they are named according to their geographic region. Bold indicates a primary EGS target.

Further progress on the Charlton-Lemont resource investigation clearly requires more information regarding the location and extent of the TCZ. It is anticipated that data from the 2009 MT program, currently underway, will better define this feature. In the absence of these data several different possibilities are available for the further development of this area. Reservoir units identified in this resource include granite in the east and Mathinna equivalents in the west. This implies a range of development potential from classic granite Hot Dry Rock EGS, to less conventional Heat-Exchange-Within-Insulator models. Current modelling suggests that highest temperatures are to be expected in the area above the inferred Unit A to the west of the main granite body and this area is thus of prime interest for future investigation.

The high level of geological uncertainty present in the area underlain by Unit A supports the drilling of an intermediate depth drill hole (<3km) to better define the nature of this play. Intersection of the TCZ with this zone would also support the drilling of an intermediate depth hole to ascertain the nature of this feature. This drilling could be achieved by using either a slimline diamond or petroleum-style drill rig. By contrast, areas of the resource inferred to be underlain by granite are less uncertain implying that drilling extending to reservoir depth (4-5km) would be most beneficial. At present options for undertaking this drilling appear to be limited to petroleum-style rigs. Overall options for the type, depth and location of drilling on the Charlton-Lemont resource are currently being assessed and will be reviewed and refined as new geophysical data arrives.

The prospect of EGS development in the Charlton-Lemont area raises issues of potential seismic risk within Eastern Tasmania. To better understand these KUTh will contribute to the emplacement of an array of seismographs within the Charlton-Lemont resource area. The primary role of these instruments will be to provide data for the recently granted ARC-linkage project '3D Seismic Velocity Structure for Geothermal Exploration' which is to be undertaken in conjunction with Dr Anya Reading from the UTAS. This project, which aims to assess the potential of ambient seismic tomography as a tool for mapping and geothermal exploration, will also serve as an effective seismic monitoring array for studies of seismic risk.

Further work is also required on alternative geothermal targets in the Mt Nicholas – Fingal and Macquarie areas of SEL 26/2005 and the Rheban anomaly of SEL 45/2007. Extension of the 3D earth model used in the Charlton Lemont resource across the north-east of the tenement area is currently underway. It is anticipated that a geothermal model and resource analysis of this area will be completed by end 2009. Data compilation and geological assessment of anomalies located at Macquarie and Rheban will also be undertaken in anticipation of future modelling and resource analysis.

6 Conclusion and Recommendations

Work completed to date has successfully defined a number of significant geothermal targets for EGS development in Eastern Tasmania. 3D geothermal modelling infers a Geothermal Resource of ~260,000PJ within the Charlton-Lemont area. Recommendations for future work on these tenements include:

- *Completion of the detailed 3D magnetotelluric survey currently underway across the Midlands to better define the location and extent of the southern TCZ ($90,000)*

- *Extension of the 3D geothermal model to cover the northern portion of SEL 26/2005 to quantify the resource present in this area ($10,000).*

- *Installation of a temporary seismic array to monitor and record local, ambient and teleseismic data as part of ARC-linkage project '3D Seismic Velocity Structure for Geothermal Exploration' in collaboration with Dr Anya Reading and the UTAS ($45,000).*

- *Drilling of an 'intermediate' depth bore hole (2-3km) to validate the resource target and 3D model and to investigate the geology at depth in the Charlton Lemont resource area (~$1M).*

- *Data compilation and geological assessment of the Rheban area ($20,000).*

With the expectation of drilling and the completion of geophysical work expenditure on SEL 26/2005 is anticipated to be of the order of $1.2M in the 2009 – 2010 year. Expenditure on SEL 45/2007 will be considerably less ($20,000) reflecting the lower priority assigned to the Rheban geothermal anomaly.

7 Environment

7.1 Drill pad rehabilitation

The flexibility of the drilling program meant that drill sites were able to be located at sites suitable for rig access and no bulldozing or clearing of pads or tracks was required. Where sumps were required for diamond drilling, topsoil was selectively removed and was stockpiled separately from other material.

Drill pads were rehabilitated progressively throughout the year. Drill sumps were filled using the stockpiled soil with the original topsoil replaced and seeded as the final layer. Landowners were consulted post-rehabilitation to ensure their satisfaction. The rehabilitation program is now considered to be complete. Before and after images of drill sites are included in Appendix 12.

7.2 MT station rehabilitation

Environmental disturbance due to the MT survey was minimal. In all cases MT station sites were assessed for the presence of rare or endangered plant species prior to digging. Digging of the vertical Hz component was carried out using a petrol powered post-hole digger. All other components were dug using suitable hand-tools. Care was taken at all sites to ensure that equipment was cleaned on completion of digging. Upon removal of equipment all trenches/holes were rehabilitated by replacement of the original soil and divots. Before and after shots of selected MT stations are also included in Appendix 12.

8 Expenditure

Expenditure on both SEL 26/2005 and SEL 45/2007 exceeded commitment in the year 2008-2009. Details of expenditure across this period are captured in Table 11 below.

	SEL 26/2005	SEL 45/2007
Geoscience Costs	$	$
Geology	208,859	15,174
Geochemistry	-	-
Geophysics	479,179	12,418
Remote Sensing	-	-
Drilling & Gridding	-	-
Gridding	-	-
Drilling	675,364	216,217
Land Access Costs	603	-
Rehabilitation Costs	7,589	951
Feasibility Study Costs	29,370	1,942
Other Costs	37,470	4,205
Administrative Costs	16,069	14,143
TOTAL	1,454,503	265,050
Committed Expenditure (2008-09)	1,000,000	47,000
Net Variance	454,503	218,050

Table 11: Total expenditure on KUTh tenements SEL 26/2005 and SEL 45/2007 in the year 2008-2009.

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10 Keywords

Geothermal exploration

HDR (Hot Dry Rock)

HFR (Hot Fractured Rock)

EGS (Enhanced Geothermal System)

High Heat Producing (HHP) granite

Tamar Conductivity Zone (TCZ)

Magnetotelluric

Aeromagnetic

Thermal conductivity

Thermal gradient

Surface heat flow

Shallow grid drilling

Deep drilling

Inferred Resource