

Report
on

BELL BAY

GRAVITY SURVEY

in

Northern Tasmania

for

Delta Materials Pty Ltd
Sydney, NSW.

February 2010

Report number : 0906
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Disclaimer

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1. Introduction

Atlas Geophysics (Morley, Western Australia) carried out a gravity survey on tenement EL6-2009 near Bell Bay, Tasmania, during January 2010. Ground magnetics were also read. The aim of the survey was to see if useful information about dolerite thickness over the area could be gained from gravity, and possibly magnetic, modelling.

The gravity data was successfully modelled and it is the main concern of this report. The magnetic data is very noisy and not considered useful for the purpose of interpreting dolerite thickness.

2. Survey Design

Figure 1 shows the location of the survey lines. The survey comprised four lines at a bearing of approximately 045 degrees. This orientation was chosen as the best compromise for avoiding areas of very rugged topography, maintaining reasonable coverage of the Delta Materials “Work Program Area”, maintaining a reasonable angle to the outcropping dolerite contact in the north, and avoiding the wedge-tailed eagle exclusion zone.

Coordinate and height control was provided by a GPS base station located close to “Pump 2” and “Drill Water Tank” as shown on Figure 1 near the southern portion of line 3. A mobile GPS unit with a radio link to the base station provided the coordinate and height data for the survey lines.

Gravity readings were taken at a nominal interval of 50m along the central two lines at 100m along most of the outer two lines. Magnetic data was read continuously at walking pace using a 0.2 second sample time.

3. Basics of Field Data Correction - Gravity

Good gravity data requires accurate field readings in the order of 1 part in 10 million. Consequently gravity instrumentation is extremely sensitive and data is affected by several factors; latitude, height above a datum, average density of rock above the datum, topography, and local terrain anomalies.

Latitude and height correction are straightforward. Correction for the effect of the thickness of rock above a height datum (eg. sea level) is the Bouguer correction and requires an estimate of the average density of that rock; it ignores topographic variations and assumes an infinite flat slab of constant thickness. The terrain correction compensates for topography and its accuracy is dependent on the accuracy of the digital terrain model used. Any topographic features “on the ground” that are unrepresented in the digital terrain model are the local terrain anomalies.

Generally it is not possible to correct for local terrain anomalies because, by definition, they are unknown and unrepresented in the digital terrain model. In areas of rugged topography, as in some of the Bell Bay survey, these local terrain anomalies may be the cause of localised high or low gravity anomalies in the final corrected gravity data.

4. Processing of Bell Bay Survey Data - Gravity

A rock density of 2.67g/cc was used for applying gravity corrections to the Bell Bay survey data. The estimated in-situ dolerite density is 2.90g/cc [Alex Boronowski e-mail 19/Jan/2010]. There are at present no known accurate density measurements available for the underlying sandstone unit, therefore a typical sandstone density of 2.40g/cc was assumed. A density of 2.67g/cc is then a

reasonable average density for all of the rock occurring between the gravity station and the height datum, assuming an approximately equal proportion of dolerite and sandstone in that zone.

In areas of significant topography the application of a terrain correction will have a significant influence on the final corrected gravity data, and hence on any modelling that results from that data. Without terrain corrections, stations located in valleys (excess material above the station) and hills (lack of material below the station) will both have under-estimated gravity due to the assumption of a flat slab during the Bouguer correction.

In the Bell Bay survey the biggest terrain corrections are on line 4 and the magnitude of these corrections is in the same order as the total magnitude of the dolerite anomaly. Therefore application of a good terrain correction is critical for modelling of the dolerite.

Figure 2 and Figure 3 show stacked profiles of the terrain-corrected gravity on background images of aerial photography and coloured topography respectively.

5. Regional Gravity

Inspection of the gravity profiles reveals that the gravity anomalies remain very high on the northern ends of the lines even though here the data is well off the dolerite outcrop and north of the known dolerite-sandstone contact which lies approximately along the northern boundary of tenement EL6-2009. The high gravity on the northern ends of lines is due to the presence of a major NW-SE trending regional gravity gradient marking the edge of a major regional gravity high lying to the northeast. Figure 4 and Figure 5 show the terrain-corrected detailed gravity superimposed on a coloured image of the regional gravity.

To produce a good model of the dolerite thickness from the new detailed gravity survey it is necessary to first remove the effect of the regional gradient from the detailed data. The distribution of regional gravity stations is not suitable for producing a well-defined regional gradient over most of the detailed-survey area, consequently a large degree of judgement is required to define a suitable regional gradient for removal during modelling.

6. Modelling - Gravity

Figure 6 to Figure 9 show model sections and gravity data profiles for lines 1 to 4 respectively. Horizontal and vertical scales are the same. A separate body with a polygonal cross-section is used for each survey line. The sections are normal to the body strike direction, and the bodies extend into and out of each section half-way to the adjacent survey line. This in effect results in a quasi three-dimensional representation of the whole dolerite body when calculating the modelled gravity anomaly; this produces a better result than modelling one line at a time in isolation of the other lines, while avoiding the need to engage in a full and much more complicated three-dimensional modelling approach.

In Figures 6 to 9 a dolerite density of 2.90g/cc is used with a sandstone background density of 2.40g/cc. Because the survey lines are oriented SW-NE the x-axis on these sections shows the distance in metres from the start of each line at the SW end.

The pink profile shows the estimated regional gradient that is subtracted from the terrain-corrected gravity profile; the resultant anomaly is then used to calculate the shape of the dolerite body. As mentioned above, the regional gradient is not well defined due to the sparse regional gravity station

spacing, therefore these regional gradients have been estimated manually using the available regional data as a general guide.

At the NE ends of the survey lines the regional gradient is reasonably well-determined because we know from outcrop where the dolerite ends. This position is also clearly indicated by slope changes on the gravity profiles for lines 1, 3, and 4; it is not quite so clear-cut looking at the line 2 profile but nonetheless appears to be at about the 1200m position.

As we move nearer the SW ends of the survey lines there is diminishing reliability of the regional gradient defined by the pink line. This is because of both the poor definition of the gradient based on the regional gravity data and, unlike the NE ends of the lines, a lack of a known limit to the dolerite which might otherwise provide another “anchor point” for defining the gradient there. As a consequence the modelled dolerite thickness towards the SW ends of the survey lines will be increasingly influenced by the judgements made in manually defining the regional gradient.

The upper surface of each model body is fixed and defined by the topographic profile along the survey line.

The lower surface of each model body was initially determined using automatic inversion by the modelling software. In most cases this produced a lower surface with some unrealistic and very sharp high and low spikes in order to get the best match with the observed gravity profile. Body vertices at such spike positions were then manually moved to a more acceptable depth in relation to adjacent vertices. The result is a not-so-perfect match at some stations between the observed (black) and calculated (blue) gravity profiles. These poorer matches may well be explained by an imperfect terrain correction and the presence of local terrain anomalies (see Section 3 above).

7. Modelling – Gravity – Effect of a Different Background Density

The in-situ density of the sandstone that forms the background material for the modelling has not been measured and was assumed to be a typical value of 2.4g/cc for the modelling shown in Figures 6 to 9. This equates to a density *contrast* with the dolerite of 0.5g/cc.

Alternative models are shown in Figure 10 to Figure 13. Here the sandstone density has been increased to 2.5g/cc which is still a plausible value and equates to a lower density *contrast* with the dolerite of 0.4g/cc. The lower density contrast requires an increase in dolerite thickness to restore a similar match between observed and modelled gravity profiles. In order to approximately restore the profile match a uniform increase in dolerite thickness of 30% has been applied to these model bodies.

8. Dolerite Thickness Model – In Summary

The dolerite model sections from the modelling with a 2.4g/cc background density (Figures 6 to 9) are shown schematically in plan view on Figure 14. Here the green dolerite cross-sections for each of the respective survey lines have been rotated from vertical to horizontal to provide a simple visual impression of the dolerite model thickness over the survey area. The modelled dolerite thickness at any given position along the survey line (pink dots) can be measured directly from the width, in a NW-SE direction, of the corresponding green polygon using the same scale as the map.

The modelling suggests the base-of-dolerite at the northern ends of the survey lines has an *apparent* dip along the survey line direction averaging about 10° to 15° SW.

Modelled dolerite thickness towards the SW ends of the survey lines becomes less reliable due to uncertainties about the accuracy of the regional gravity gradient removal. Modelled dolerite thickness over the full length of the survey lines also depends on the choice of density for the sandstone unit; if the sandstone density is higher than the 2.4g/cc assumed then the dolerite will be thicker.

9. Magnetic Data

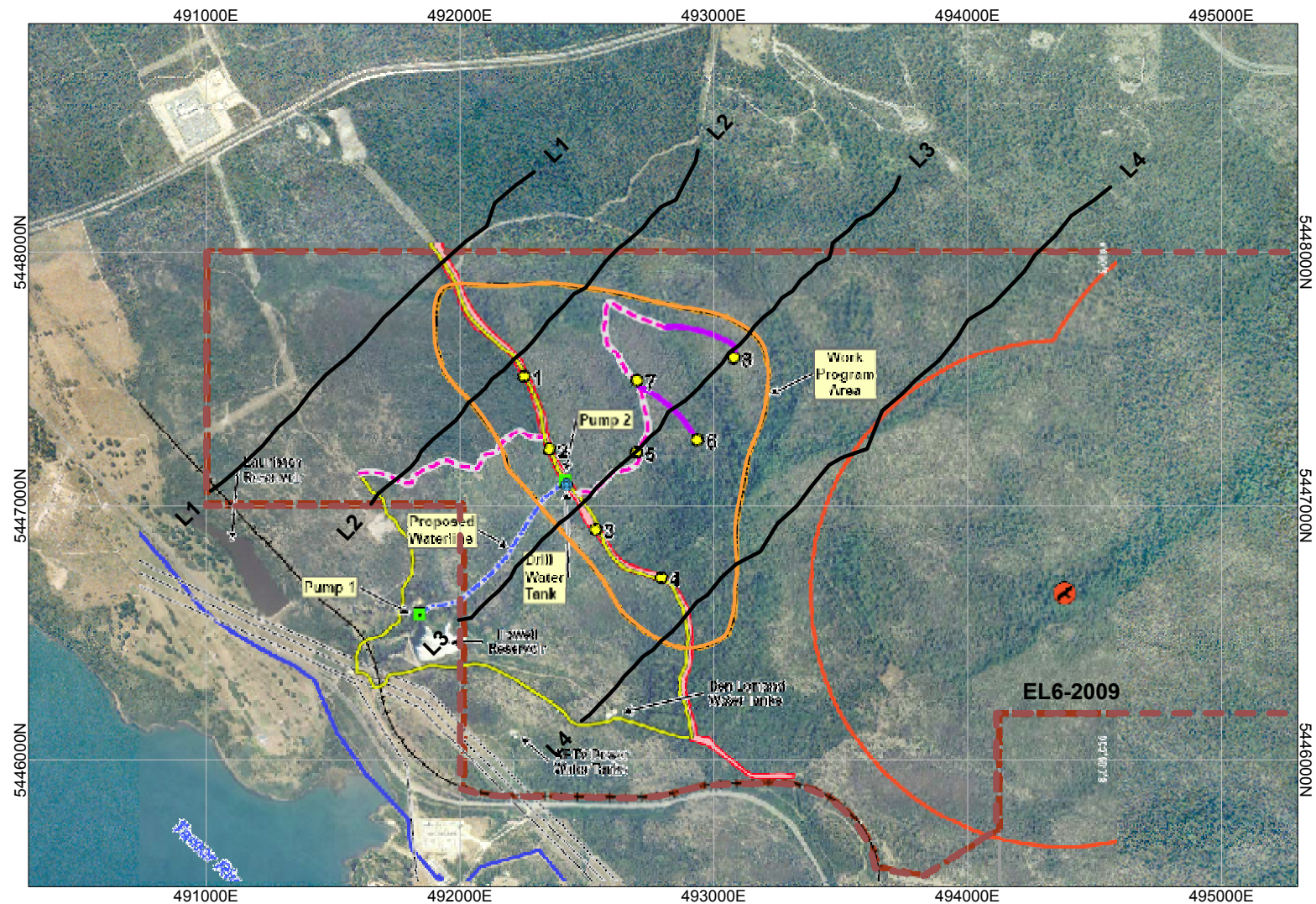
Stacked profiles of the ground magnetic data are shown in Figure 15.

The data show considerable “noise” which is likely due to taking magnetic measurements right on the surface of the magnetic source body.

The magnetic data shows good indications of crossing the dolerite-sandstone contact in the north on survey lines 1 and 2 where the magnetic response drops steeply as you head in a NE direction. There are similar but less obvious indications on line 3. Data problems on the northern quarter of line 4 preclude any reliable observations of magnetic change over the contact. For comparison, plotted on each survey line is a green symbol that corresponds to the dolerite contact determined from the gravity modelling.

Overall the magnetic data is not considered to be able to offer any improvement on modelling the dolerite thickness than that already provided by the gravity model. Therefore it is not cost-effective to put further effort into cleaning up and interpreting or modelling the magnetic data.

...Phil Muir
...12th February 2010



Central portion of image is taken from Delta Materials plot
 "Drill Site and Support Infrastructure Map"
 Figure 3 in document Work Program Report

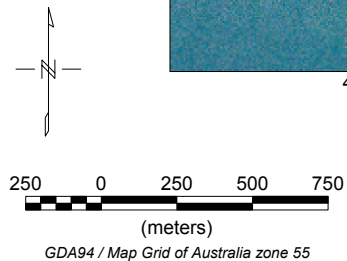
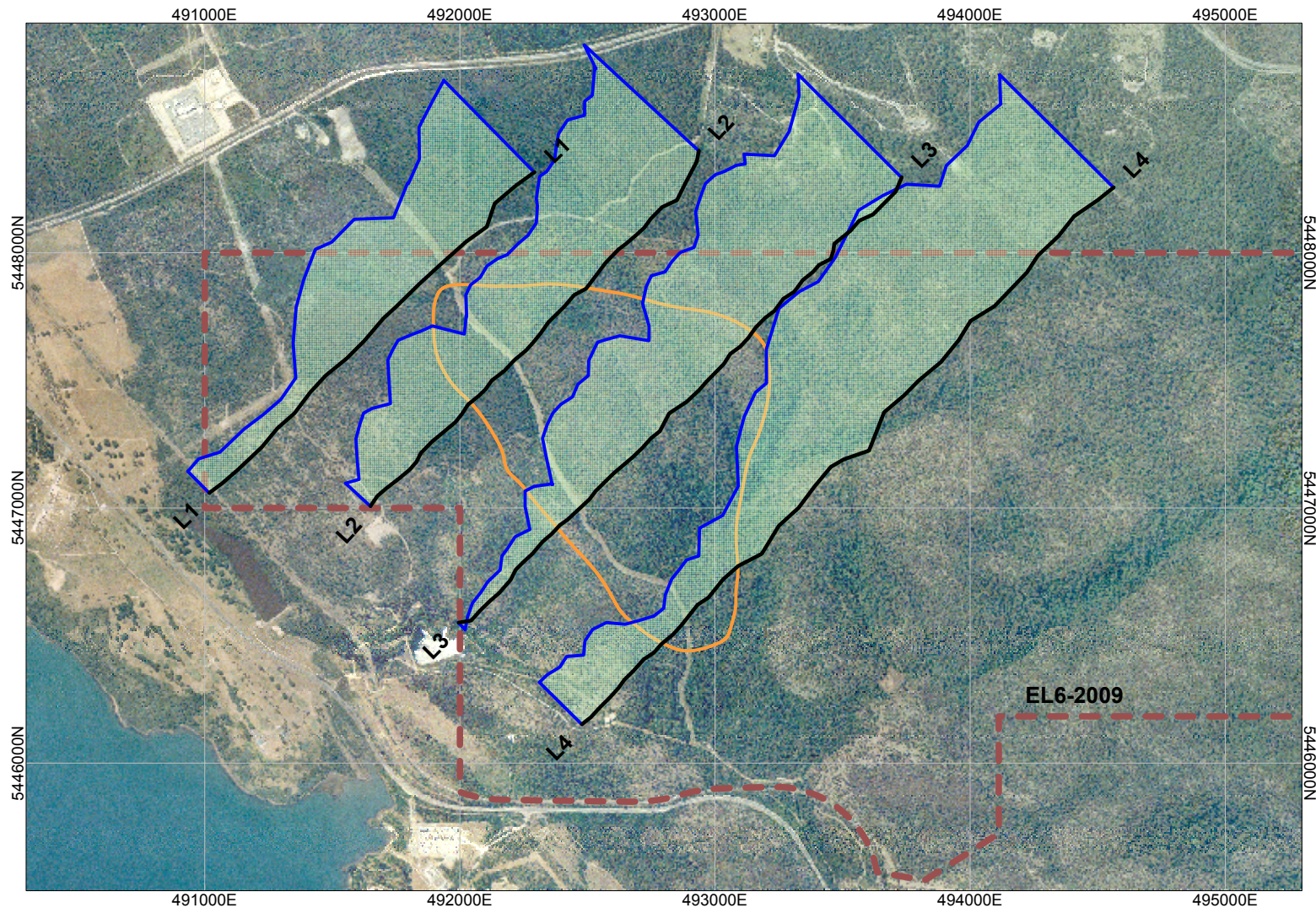
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Bell Bay Project - Gravity Survey 2010

Figure 1
 Location Map

Author: Phil Muir

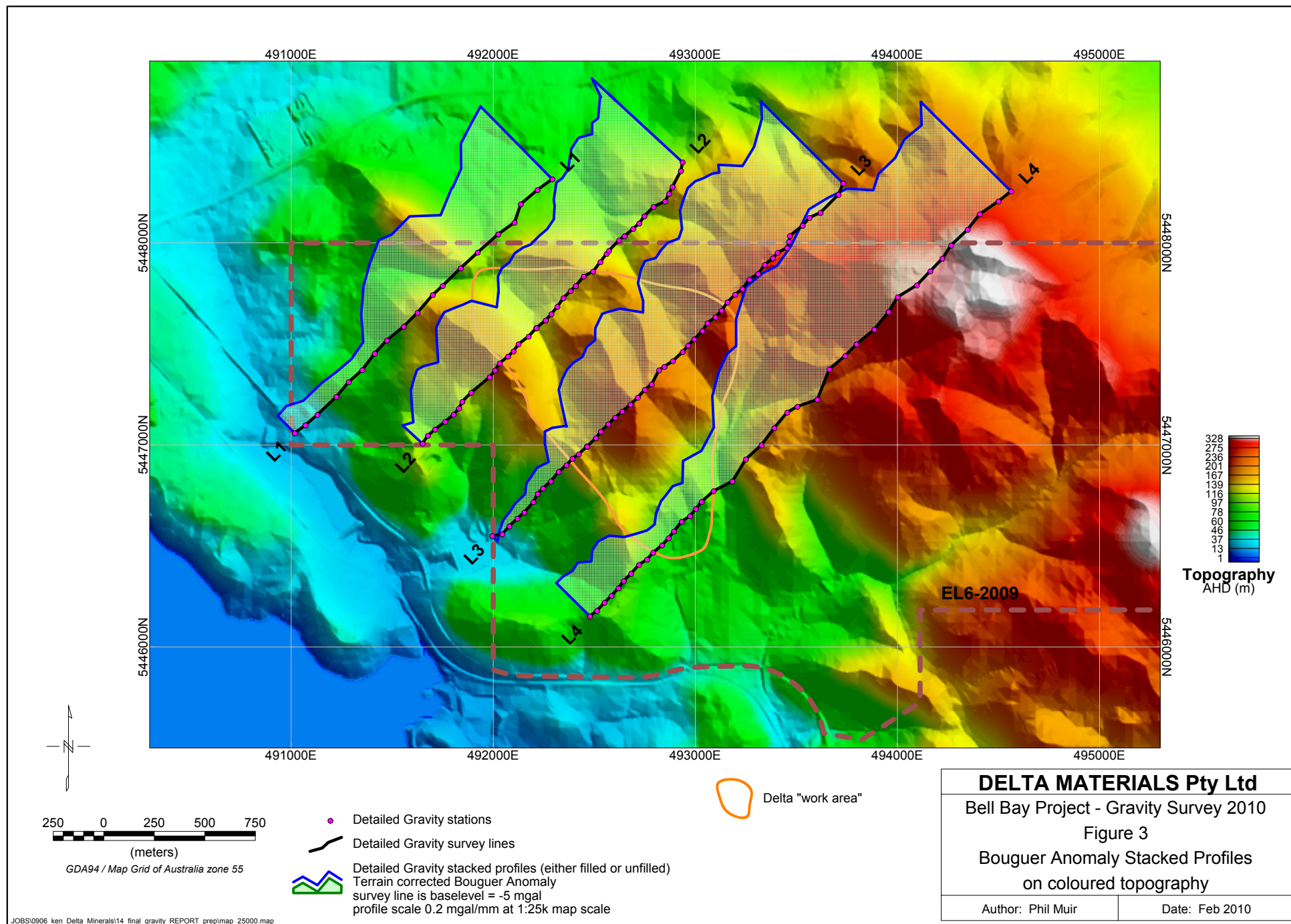
Date: Feb 2010

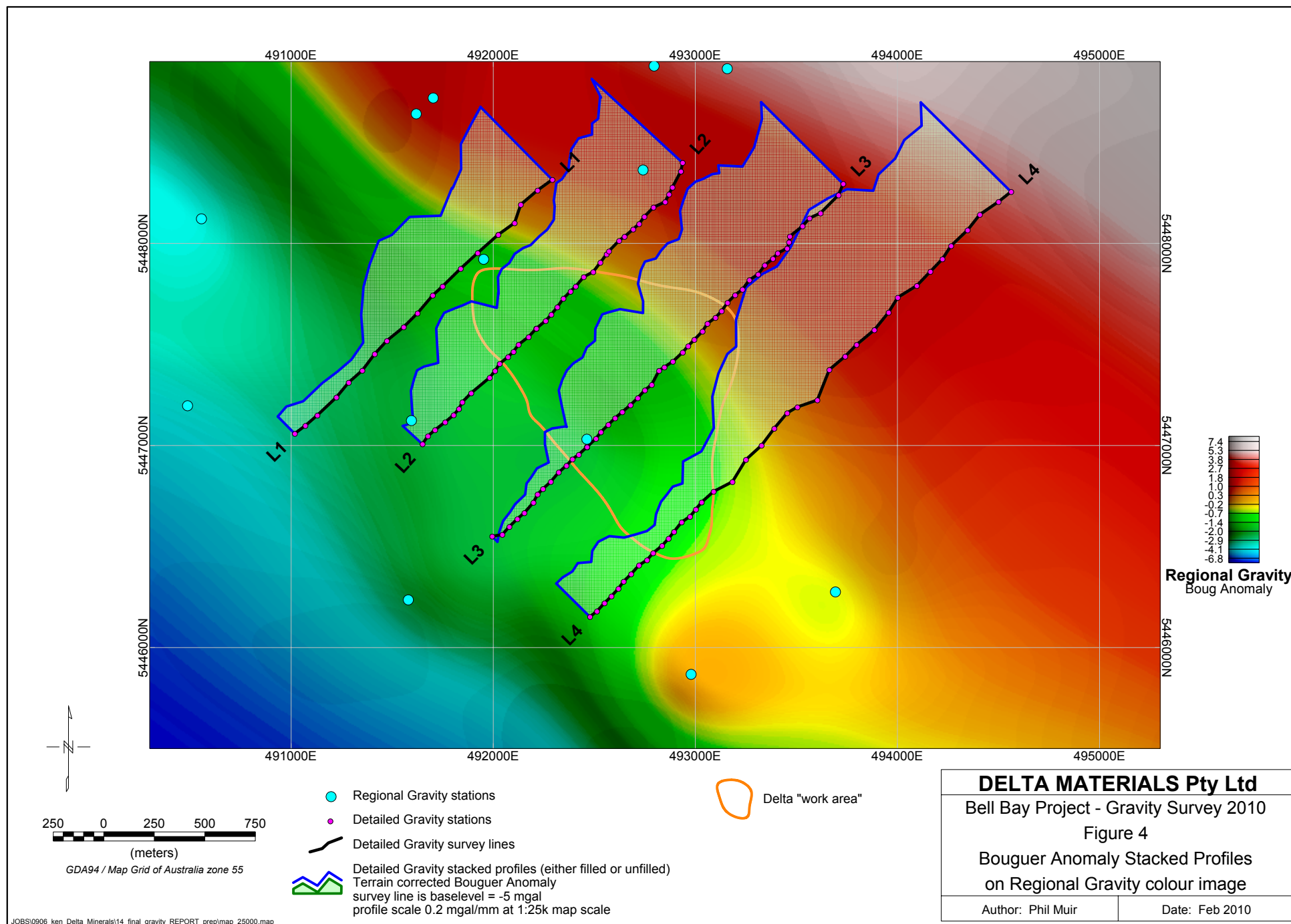


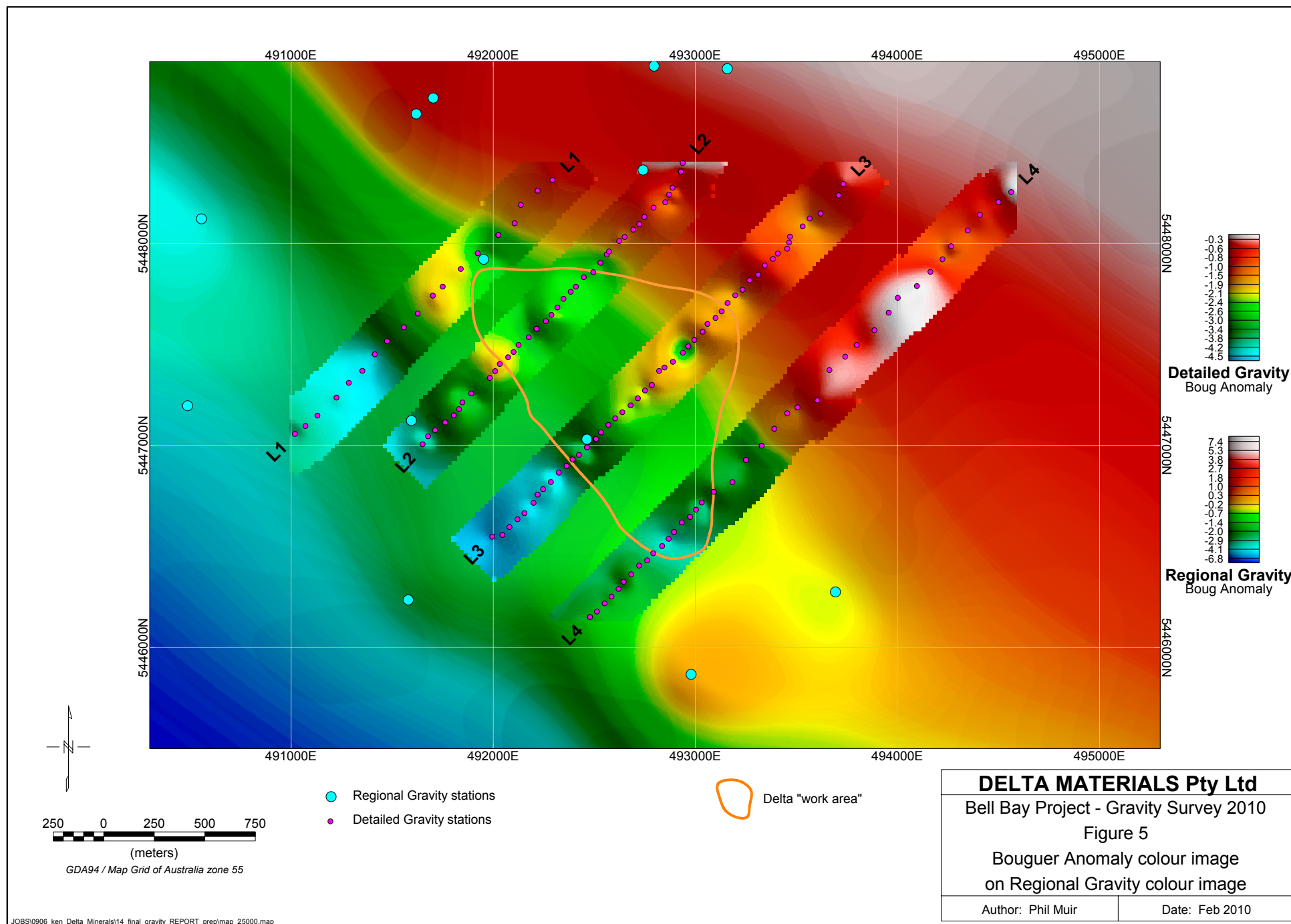
 Detailed Gravity survey lines
 Detailed Gravity stacked profiles (either filled or unfilled)
 Terrain corrected Bouguer Anomaly
 survey line is baselevel = -5 mgal
 profile scale 0.2 mgal/mm at 1:25k map scale

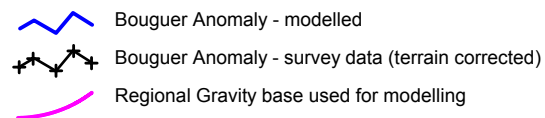
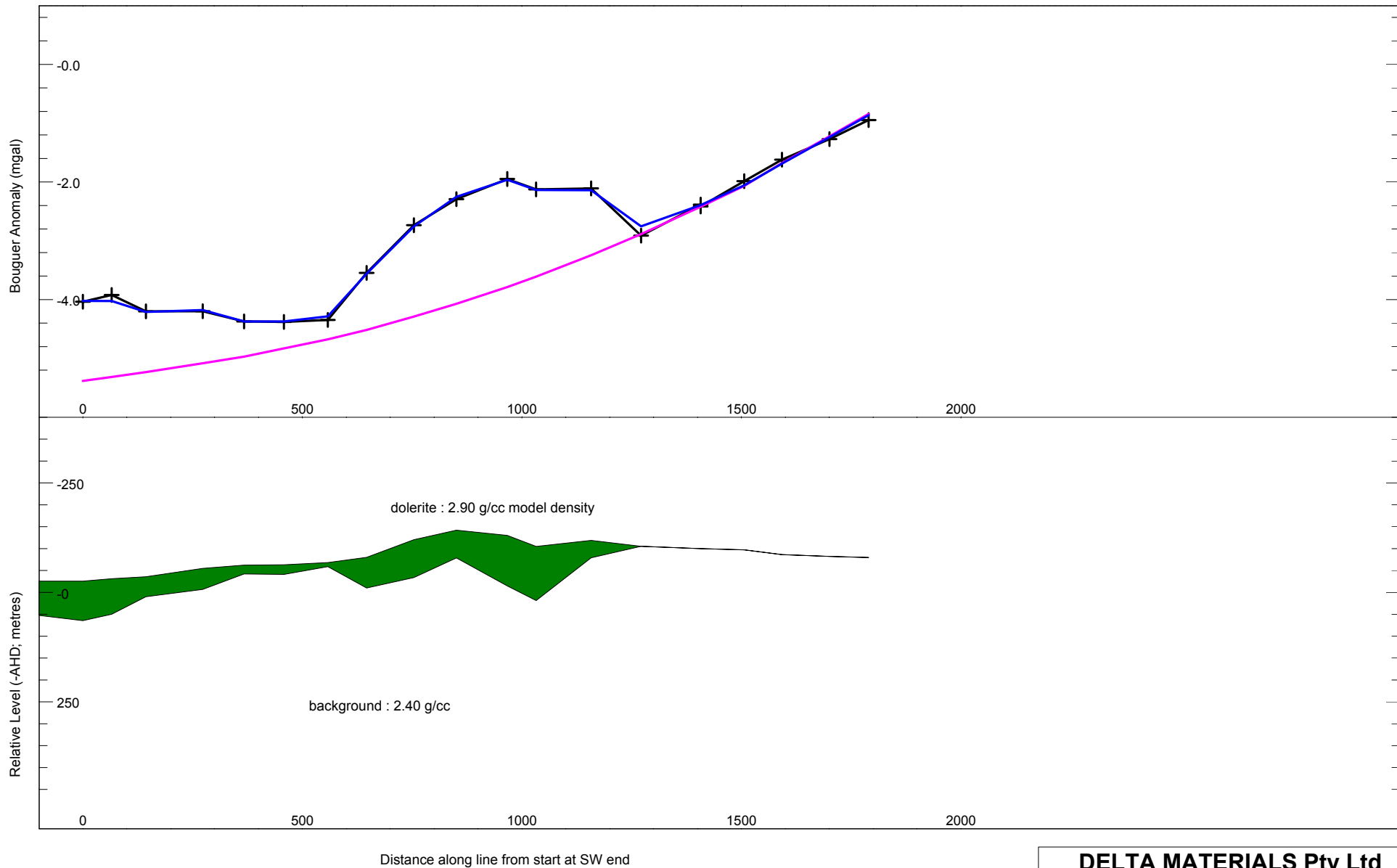
 Delta "work area"

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Bell Bay Project - Gravity Survey 2010	
Figure 2	
Bouguer Anomaly Stacked Profiles (terrain corrected gravity)	
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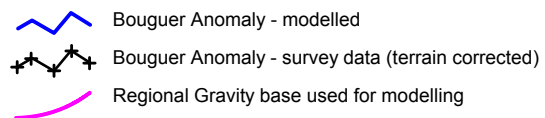
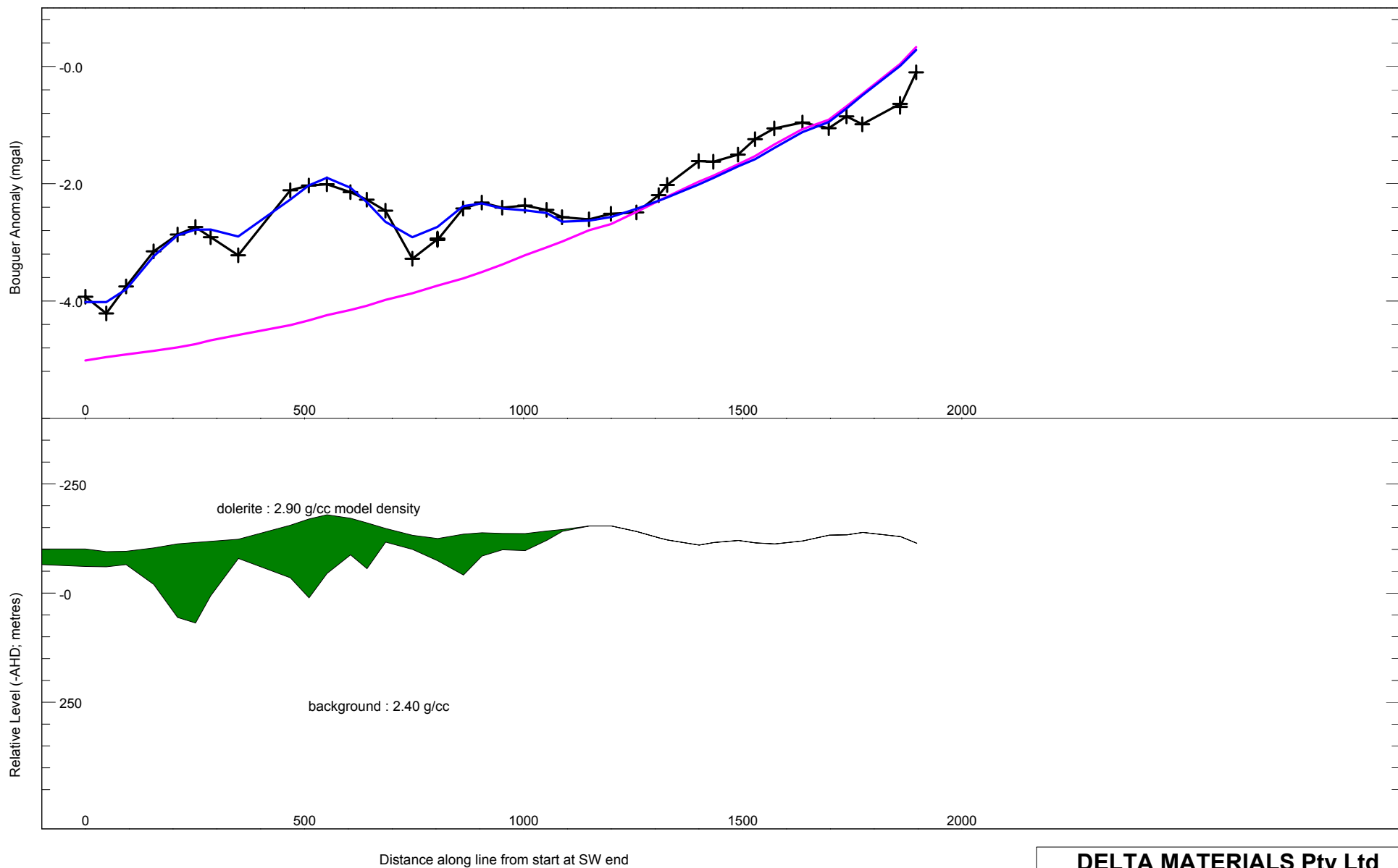




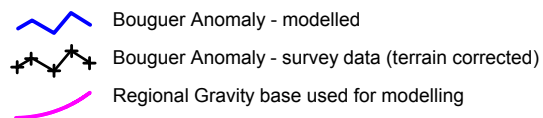
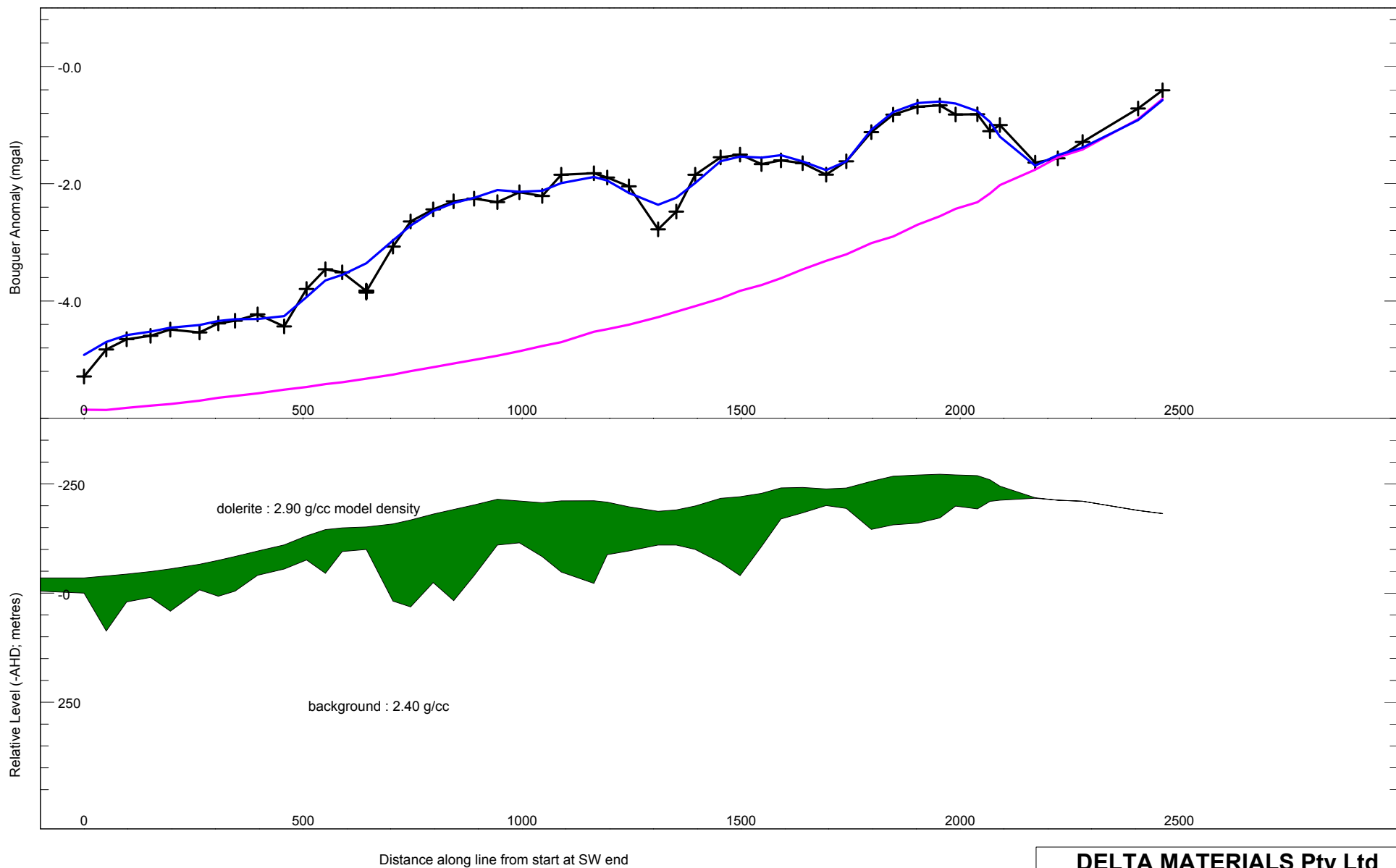




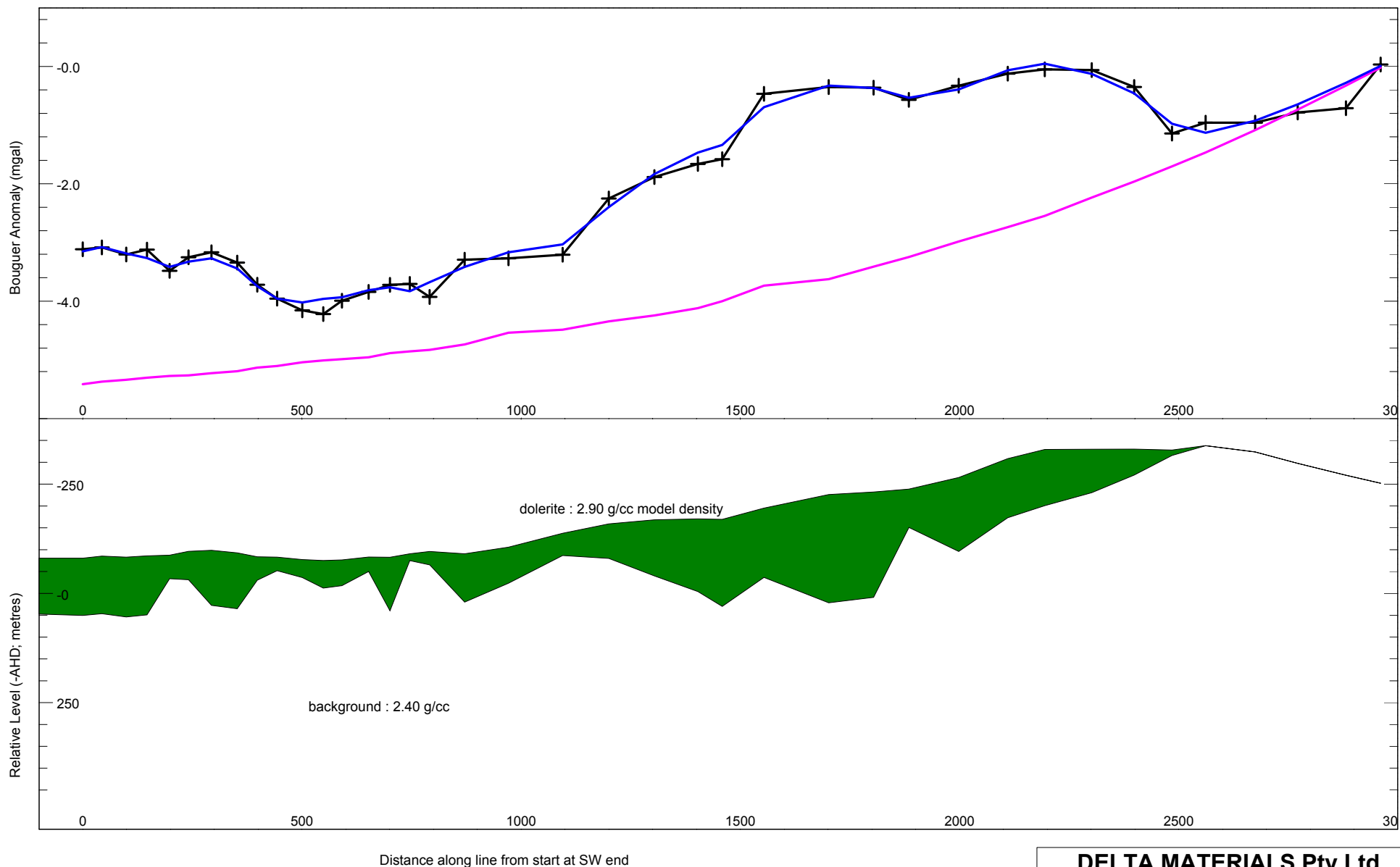
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Bell Bay Project - Gravity Survey 2010	
Figure 6	
Gravity Model Section - Line 1	
(background density 2.4 g/cc)	
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Bell Bay Project - Gravity Survey 2010	
Figure 7	
Gravity Model Section - Line 2	
(background density 2.4 g/cc)	
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Bell Bay Project - Gravity Survey 2010	
Figure 8	
Gravity Model Section - Line 3	
(background density 2.4 g/cc)	
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 Bouguer Anomaly - modelled
 Bouguer Anomaly - survey data (terrain corrected)
 Regional Gravity base used for modelling

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Bell Bay Project - Gravity Survey 2010

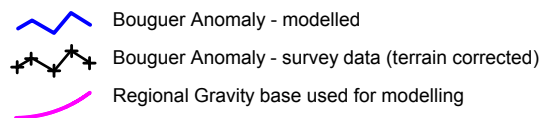
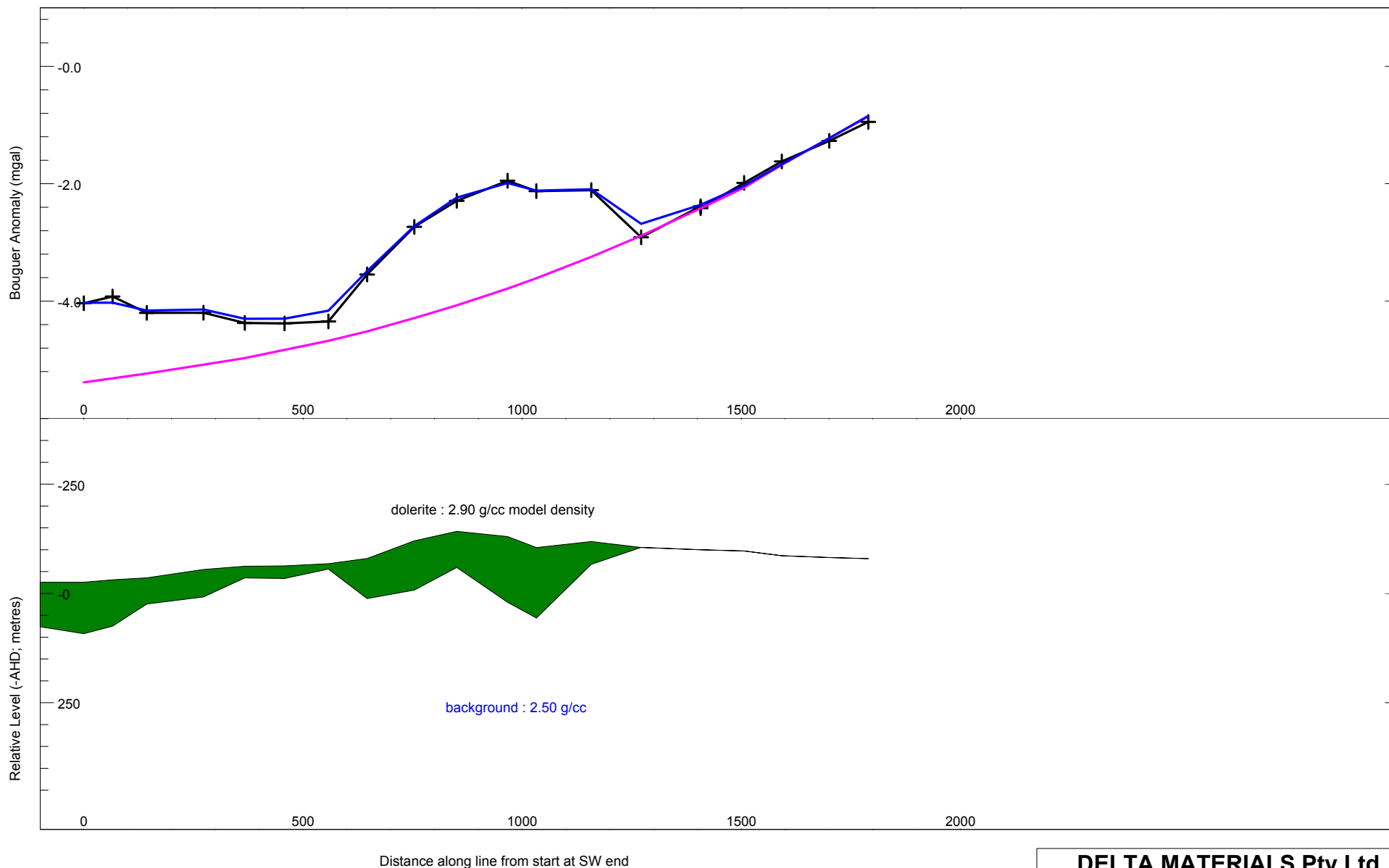
Figure 9

Gravity Model Section - Line 4

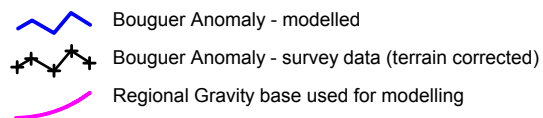
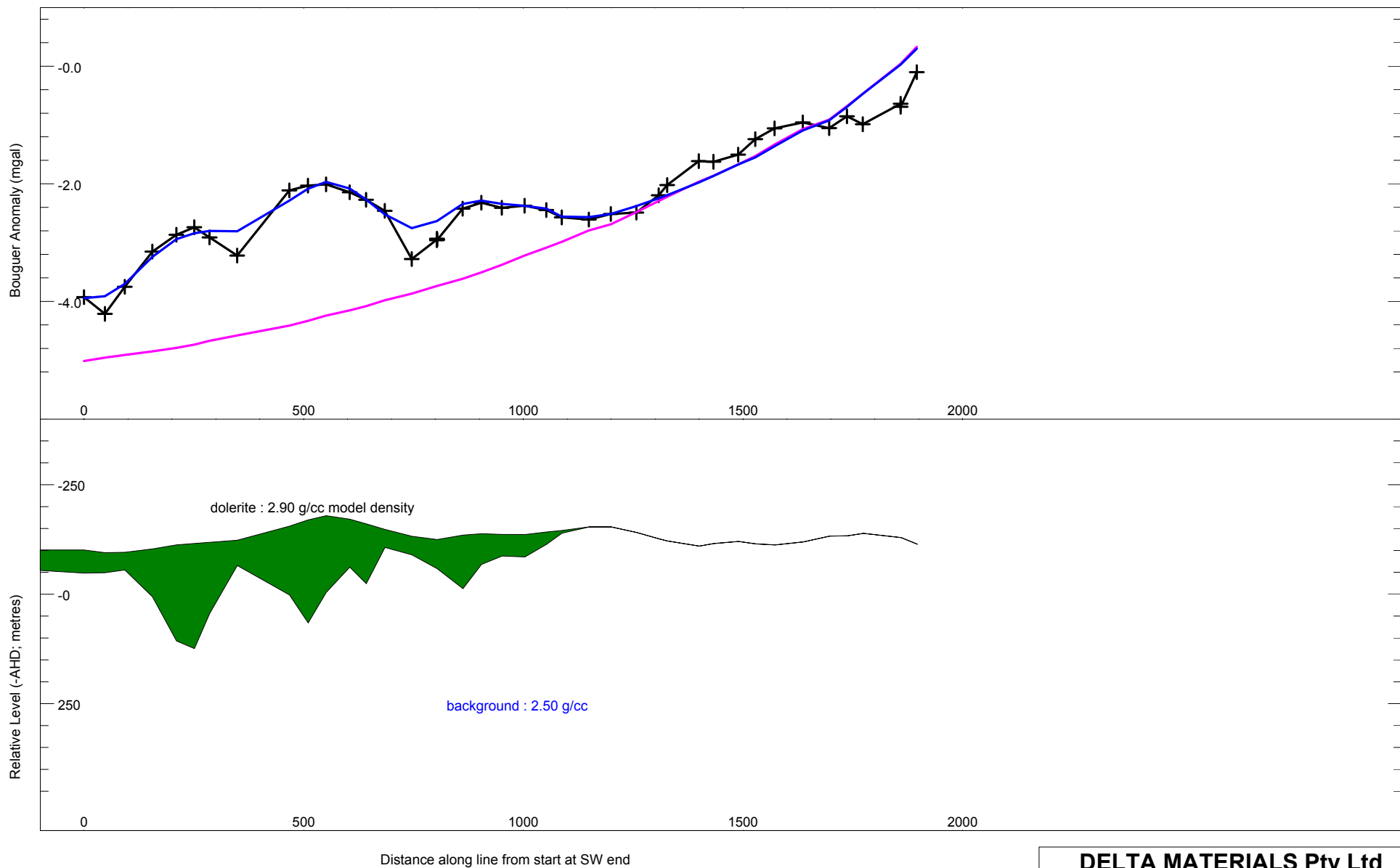
(background density 2.4 g/cc)

Author: Phil Muir

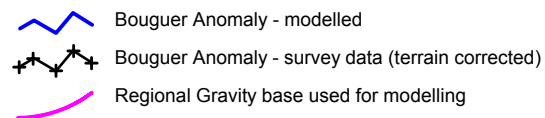
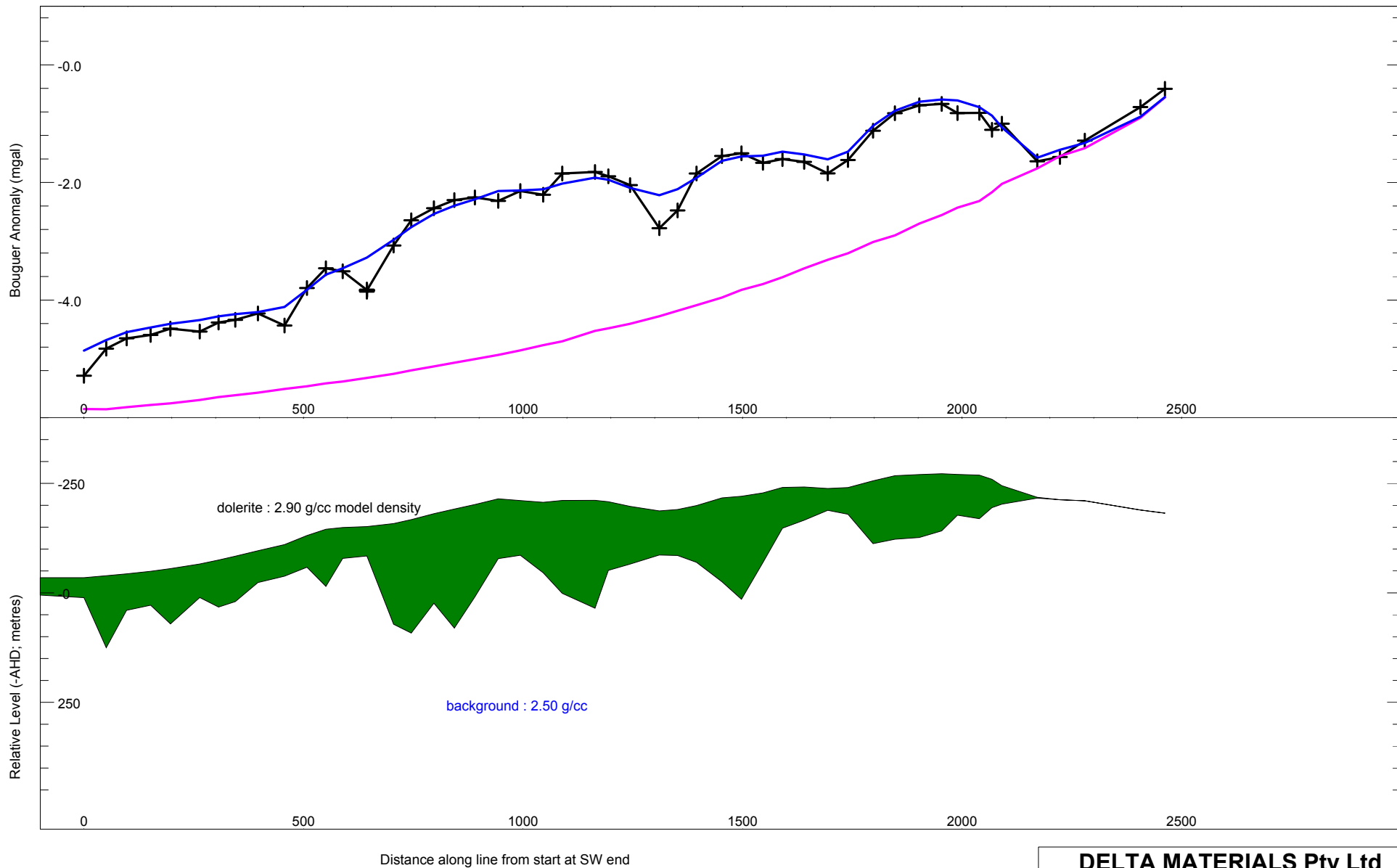
Date: Feb 2010



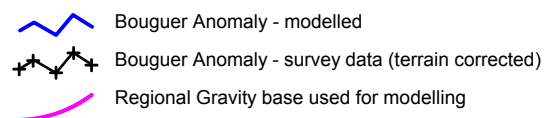
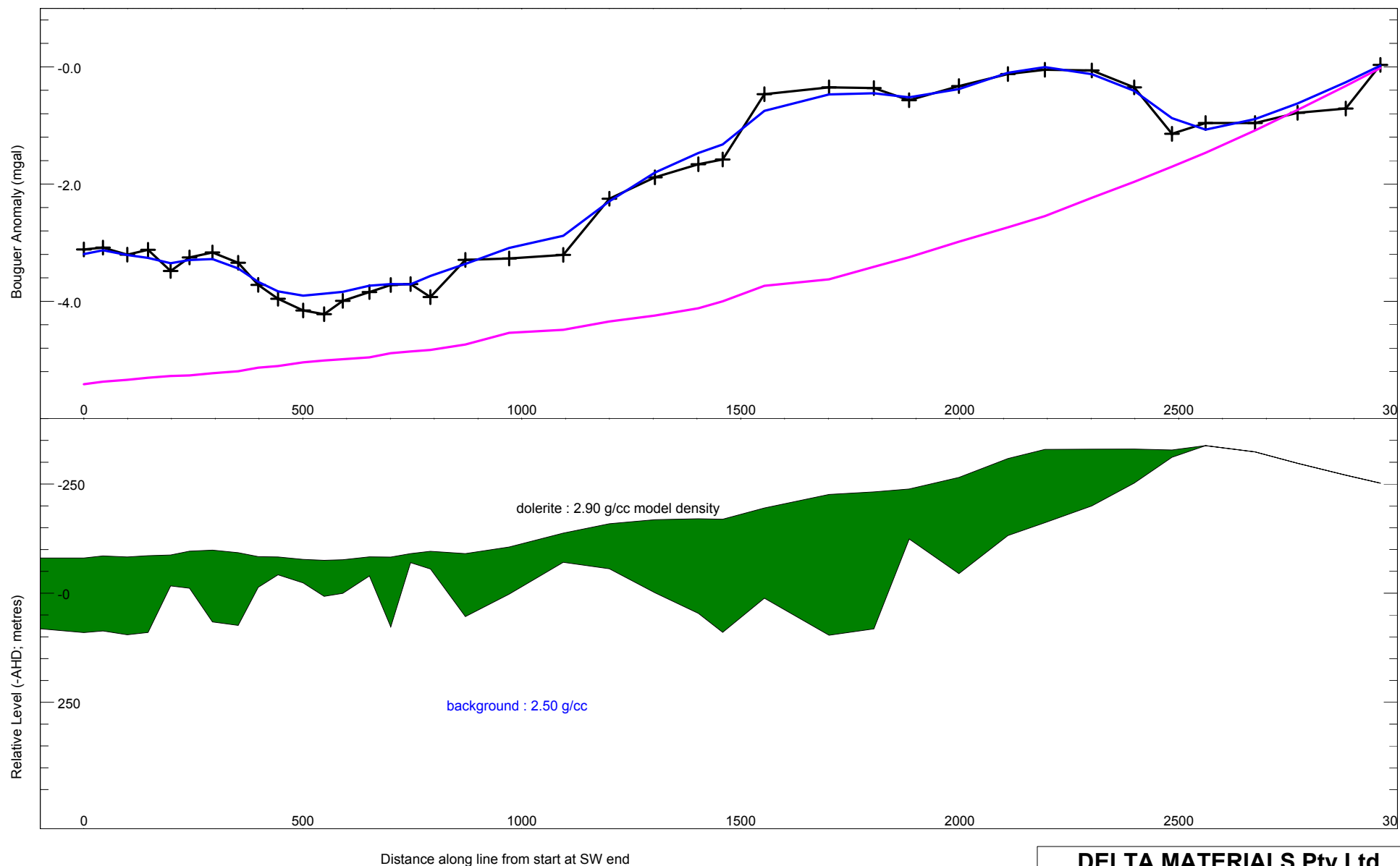
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Bell Bay Project - Gravity Survey 2010	
Figure 10	
Gravity Model Section - Line 1	
(background density 2.5 g/cc)	
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Bell Bay Project - Gravity Survey 2010	
Figure 11	
Gravity Model Section - Line 2	
(background density 2.5 g/cc)	
Author: Phil Muir	Date: Feb 2010



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Bell Bay Project - Gravity Survey 2010	
Figure 12	
Gravity Model Section - Line 3	
(background density 2.5 g/cc)	
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Bell Bay Project - Gravity Survey 2010

Figure 13

Gravity Model Section - Line 4

(background density 2.5 g/cc)

Author: Phil Muir

Date: Feb 2010

