

Bell Bay Gravity/Magnetic Survey

Delta Materials

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Memo completed by:



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12 May 2010

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G E O P H Y S I C S

1.0 Project Brief

Project P2010001 required the acquisition and processing of 145 new gravity stations over four separate traverses. As an adjunct to the gravity survey, magnetic data were also acquired along the same lines. The stations were located on tenements held by Delta Materials Ltd.

The survey area was named Bell Bay and was located approximately 10km south east of the township George Town, on the northern coast of Tasmania. The crew accessed the survey area using the East Tamar Highway and a network of State Forest and fire tracks. Terrain throughout the survey area was very unforgiving. The crew battled extremely steep terrain along with very thick scrub. The crew were accommodated at the Pier Hotel, George Town for the duration of the survey.

All four traverses were planned on a south west/north east orientation (Figure 1). Lines 1 and 4 were surveyed with a station spacing of 100m, whilst the inner lines, 2 and 3, were surveyed at 50m spacing. Magnetic data was acquired with the magnetometer sample rate set on 0.2 seconds. All data were collected on foot using three crew members.

The survey commenced on 19th January 2010. Acquisition was completed on the 22nd January 2010 with the final data delivered shortly thereafter.

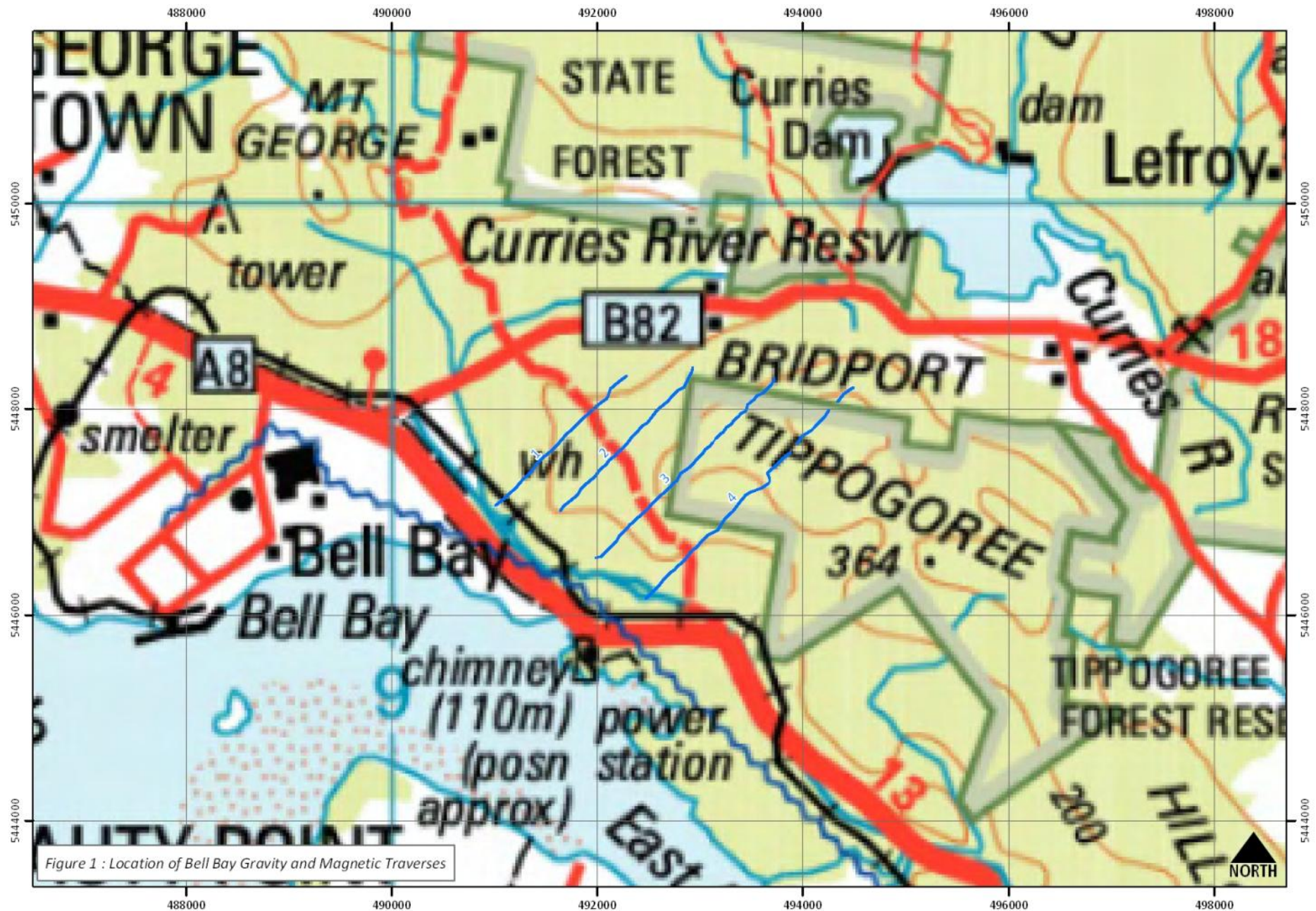


Figure 1 : Location of Bell Bay Gravity and Magnetic Traverses

2.0 Equipment and Instrumentation

The following equipment and instrumentation were used on the survey:

- One CG5 Autograv Gravity Meter (Serial Number 40361)
- Two Leica System 1200 GPS-Glonass receivers
- Two Pacific Crest data radios
- One Geometrics G858 magnetometer (rover)
- One Geometrics G856 magnetometer (base station)
- Two HP Laptop computers for data download and processing
- Magellan FX324 autonomous GPS receivers for navigation
- Personal Protective Equipment for all personnel
- Batteries, battery chargers, solar cells, UPS System
- Survey consumables
- Tools, engineering and maintenance equipment for vehicle servicing
- First aid and survival kits
- Tyres and recovery equipment

3.0 Gravity Acquisition and Processing

Gravity data were acquired concurrently with GPS data using a Scintrex CG5 gravity meter. Data were acquired in a single shift of 10 hours duration, with each shift consisting of a single loop controlled by observations at the gravity control station. Each loop contained a minimum of two repeated readings so that an interlocking network of closed loops was formed. A total of **5.52%** repeats were acquired for quality control purposes. Repeat readings were evenly distributed on a time-basis throughout each of the gravity loops.

All GPS/Glonass data were recorded using real-time kinematic (RTK) mode with the GPS antenna attached to a fixed length staff. As RTK mode was used, no post processing of the data was required. The Leica Geo Office software suite was used to import the data, apply a geoid correction and projections, and then output the data into Atlas Geophysics LGO standard format. The formatted data were then imported into Atlas Geophysics data processing software “AGRIS” (Atlas Geophysics Reduction and Interpretation Software) for reduction to Bouguer Anomaly. The reduced data were then profiled to check quality and consistency. This process was carried out on a daily basis.

Projection from GPS derived WGS84/GDA94 coordinates to Map Grid of Australia (MGA) coordinates was conducted within the Leica Geo Office suite. For most practical applications where a horizontal accuracy of only a metre or greater is required, GDA94 coordinates can be considered the same as WGS84. MGA coordinates were obtained by projecting the GPS-derived WGS84 coordinates using a Universal Transverse Mercator (UTM) projection with zone 55S.

Gravity control was established via an ABABABA tie to George Town station 9002 at the intersection of Tamar Highway and Bridport Road. Accuracy of the tie would be better than 0.01 mGal. GPS control was established using AUSPOS with submission of three days worth

of logged static data. Expected accuracy of the resultant coordinates would be better than 0.01m. Appendix A contains a control station description for the new station.

3.1 Formulae Used in Processing

The following corrections were applied to the dataset to produce Spherical Cap Bouguer Anomalies on the GRS80 ellipsoid. For legacy reasons, Geoidal Bouguer Anomalies on the Australian Height Datum (AHD) have also been calculated. AHD heights have been derived using AUSGEOID98. The formulae below produce data in μms^{-2} or gravity units. To convert to mGal, divide by a factor of 10.

Instrument scale factor: This correction is used to correct a gravity reading (in dial units) to a relative gravity unit value based on the meter calibration.

$$r_c = 10 \cdot (r \cdot S(r))$$

where,

r_c corrected reading in gravit units
 r gravity meter reading in dial units
 $S(r)$ scale factor (dial units/milliGal)

Earth Tide Correction: The earth is subject to variations in gravity due to the gravitational attraction of the Sun and the Moon. These background variations can be corrected for using a predictive formula which utilises the gravity observation position and time of observation. The Scintrex CG5 gravity meter automatically calculates ETC but uses only an approximate position for the gravity observation so is not entirely accurate. For this reason, the Scintrex ETC is subtracted from the reading and a new correction calculated within AGRIS software.

$$r_t = r_c + g_{tide}$$

where,

r_t tide corrected reading in gravity units
 r_c scale factor corrected reading in gravity units
 g_{tide} Earth Tide Correction (ETC) in gravity units

Instrument Drift Correction: Since all gravity meters are mechanical they are all prone to instrument drift. Drift can be caused by mechanical stresses and strains in the spring mechanism as the meter is moved, knocked, reset, subjected to temperature extremes, subjected to vibration, unclamped etc. The most common cause of instrument drift is due to extension of the sensor spring with changes in temperature (obeying Hooke's law). To calculate and correct for daily instrument drift, the difference between the gravity control station readings (closure error) is used to assume the drift and a linear correction is applied.

$$ID = \frac{r_{cs2} - r_{cs1}}{t_{cs2} - t_{cs1}}$$

where,

ID Instrument Drift in gu/hour

r_{cs2}	control station 2nd reading in gravity units
r_{cs1}	control station 1st reading in gravity units
t_{cs2}	control station 2 time
t_{cs1}	control station 1 time

Observed Gravity: The preceding corrections are applied to the raw gravity reading to calculate the earth's absolute gravitational attraction at each gravity station. The corrections produced Observed Gravities on the AAGD07 and ISOGAL84 datums.

$$G_o = g_{cs1} + (r_t - r_{cs1}) - (t - t_{cs1}) \cdot ID$$

where,

G_o	Observed Gravity in gravity units (ISOGAL84 or AAGD07)
g_{cs1}	control station 1 known Observed Gravity in gravity units
r_t	tide corrected reading in gravity units
r_{cs1}	control station 1 reading in gravity units
t	reading time
t_{cs1}	control station 1 time
ID	instrument drift in gravity units/hour

Theoretical Gravity 1980: The theoretical (or normal) gravity value at each gravity station is calculated based on the assumption that the Earth is a homogeneous ellipsoid. The closed form of the 1980 International Gravity Formula is used to approximate the theoretical gravity at each station location and essentially produce a latitude correction. Gravity values vary with latitude as the earth is not a perfect sphere and the polar radius is much smaller than the equatorial radius. The effect of centrifugal acceleration is also different at the poles versus the equator.

$$G_{t80} = 9780326.7715((1 + 0.001931851353(\sin^2 l))/(SQRT(1 - 0.0066943800229(\sin^2 l)))$$

where,

G_{t80}	Theoretical Gravity 1980 in gravity units
l	GDA94 latitude at the gravity station in decimal degrees

Theoretical Gravity 1967: The theoretical (or normal) gravity value at each gravity station is calculated based on the assumption that the Earth is a homogeneous ellipsoid. The 1967 variant of the International Gravity Formula is used to approximate the theoretical gravity at each station location and essentially produce a latitude correction. Gravity values vary with latitude as the earth is not a perfect sphere and the polar radius is much smaller than the equatorial radius. The effect of centrifugal acceleration is also different at the poles versus the equator.

$$G_{t67} = (9780318.456 \cdot (1 + 0.005278895 \cdot \sin^2(l) - 0.000023462 \cdot \sin^4(l)))$$

where,

G_{t67}	Theoretical Gravity 1967 in gravity units
l	GDA94 latitude at the gravity station in decimal degrees

Atmospheric Correction: The gravity effect of the atmosphere above the ellipsoid can be calculated with an atmospheric model and is subtracted from the theoretical gravity.

$$AC = 8.74 - 0.00099 \cdot h + 0.0000000356 \cdot h^2$$

where,

AC Atmospheric Correction in gravity units

h elevation above the GRS80 ellipsoid in metres

Ellipsoidal Free Air Correction: Since the gravity field varies inversely with the square of distance, it is necessary to correct for elevation changes from the reference ellipsoid (GRS80). Gravitational attraction decreases as the elevation above the reference ellipsoid increases.

$$EFAC = -(3.087691 - 0.004398 \sin^2 l) \cdot h + 7.2125 \cdot 10^{-7} \cdot h^2$$

where,

EFAC Ellipsoidal Free Air Correction in gravity units

l GDA94 latitude at the gravity station in decimal degrees

h elevation above the GRS80 ellipsoid in metres

Geoidal Free Air Correction: Since the gravity field varies inversely with the square of distance, it is necessary to correct for elevation changes from the reference geoid (AHD). Gravitational attraction decreases as the elevation above the reference geoid increases.

$$GFAC = (3.08768 - 0.00440 \sin^2(l)) \cdot h - 0.000001442 \cdot h^2$$

where,

GFAC Free Air Correction in gravity units

l GDA94 latitude at the gravity station in decimal degrees

h elevation above the reference geoid (AHD) in metres

Spherical Cap Bouguer Correction: If a gravity observation is made above the reference ellipsoid, the effect of rock material between the observation and the ellipsoid must be taken into account. The mass of rock makes a positive contribution to the gravity value. The correction is calculated using the closed form equation for the gravity effect of a spherical cap of radius 166.7km, based on a spherical Earth with a mean radius of 6,371.0087714km, height relative the ellipsoid and rock densities of 2.90, 2.67, 2.40 and 2.20 tm^{-3} (gm/cc).

$$SCBC = 2\pi G \rho ((1 + \mu) \cdot h - \lambda R)$$

where,

SCBC Spherical Cap Bouguer Correction in gravity units

G gravitational constant = $6.67428 \cdot 10^{-11} \text{m}^3 \text{kg}^{-1} \text{s}^{-2}$

ρ rock density (2.90, 2.67, 2.40 and 2.20 tm^{-3})

h elevation above the GRS80 ellipsoid in metres

R ($R_o + h$) the radius of the earth at the station

R_o mean radius of the earth = 6,371.0087714 km (on the GRS80 ellipsoid)

μ & *λ* are dimensionless coefficients defined by:

$$\mu = ((1/3) \cdot \eta^2 - \eta)$$

where,

$$\eta = h/R$$

$$\lambda = (1/3)\{(d + f\delta + \delta^2)[(f - \delta)^2 + k]^{\frac{1}{2}} + p + m \cdot \ln(n/(f - \delta + [(f - \delta)^2 + k]^{\frac{1}{2}}))\}$$

where,

$$d = 3 \cdot \cos^2 \alpha - 2$$

$$f = \cos \alpha$$

$$k = \sin^2 \alpha$$

$$p = -6 \cdot \cos^2 \alpha \cdot \sin(\alpha/2) + 4 \cdot \sin^3(\alpha/2)$$

$$\delta = (R_o/R)$$

$$m = -3 \cdot k \cdot f$$

$$n = 2 \cdot [\sin(\alpha/2) - \sin^2(\alpha/2)]$$

$$\alpha = S/R_o \text{ with } S = \text{Bullard B Surface radius} = 166.735 \text{ km}$$

Geoidal Bouguer Correction: If a gravity observation is made above the reference geoid, the effect of rock material between the observation and the ellipsoid must be taken into account. The mass of rock makes a positive contribution to the gravity value. The slab of rock makes a positive contribution to the gravity value. Rock densities of 2.90, 2.67, 2.40 and 2.20 t/m³ (gm/cc) were used in the correction.

$$GBC = 0.4191 \cdot \rho \cdot h$$

where,

GBC Geoidal Bouguer Correction in gravity units

ρ rock density (2.90, 2.67, 2.40 and 2.20 t/m³)

h elevation above the reference geoid (AHD) in m

Terrain Correction: The terrain correction accounts for variations in gravity values caused by variations in topography near the observation point. The correction accounts for the attraction of material above the assumed Bouguer slab and for the over-correction made by the Bouguer correction when in valleys. The terrain correction is positive regardless of whether the local topography consists of a mountain or a valley. Terrain corrections were applied on this project as the survey area was very rugged and there were extreme changes in elevation. RASTERTC software was used with rock densities of 2.67 and 2.90 t/m³. The DEM used in the terrain correction was supplied by the client and agreed well with heights derived from the GPS (average difference 0.33m).

Ellipsoidal Free Air Anomaly: The Ellipsoidal Free Air Anomaly is the difference between the observed gravity and theoretical gravity that has been computed for latitude and corrected for the elevation of the gravity station above or below the reference ellipsoid.

$$EFAA = G_{oAAGD07} - (G_{t80} - AC) - EFAC$$

where,

EFAA Ellipsoidal Free Air Anomaly in gravity units

G_o	Observed Gravity on the AAGD07 datum in gravity units
G_{t80}	Theoretical Gravity 1980 in gravity units
AC	Atmospheric Correction in gravity units
$EFAC$	Ellipsoidal Free Air Correction in gravity units

Geoidal Free Air Anomaly: The Geoidal Free Air Anomaly is the difference between the observed gravity and theoretical gravity that has been computed for latitude and corrected for the elevation of the gravity station above or below the reference geoid.

$$GFAA = G_{oISOGAL84} - G_{t67} + GFAC$$

where,

$GFAA$	Free Air Anomaly in gravity units
G_o	Observed Gravity on the ISOGAL84 datum in gravity units
G_{t67}	Theoretical Gravity 1967 in gravity units
$GFAC$	Geoidal Free Air Correction in gravity units

Spherical Cap Bouguer Anomaly: The Spherical Cap Bouguer Anomaly is computed from the Ellipsoidal Free Air Anomaly above by removing the attraction of the spherical cap calculated by the Spherical Cap Bouguer Correction.

$$SCBA = EFAA - SCBC$$

where,

$SCBA$	Spherical Cap Bouguer Anomaly in gravity units
$EFAA$	Ellipsoidal Free Air Anomaly in gravity units
$SCBC$	Bouguer Correction in gravity units

Geoidal Bouguer Anomaly: The Geoidal Bouguer Anomaly is computed from the Geoidal Free Air Anomaly above by removing the attraction of the slab calculated by the Geoidal Bouguer Correction.

$$GBA = GFAA - GBC$$

where,

GBA	Geoidal Bouguer Anomaly in gravity units
$GFAA$	Geoidal Free Air Anomaly in gravity units
GBC	Geoidal Bouguer Correction in gravity units

Complete Spherical Cap Bouguer Anomaly: This is obtained by adding the terrain correction to the Spherical Cap Bouguer Anomaly. The Complete Spherical Cap Bouguer Anomaly is the most interpretable value derived from a gravity survey as changes in the anomaly can be directly attributed to lateral density contrasts within the geology below the observation point.

$$CSCBA = SCBA + TC$$

where,

$CSCBA$	Complete Spherical Bouguer Anomaly in gravity units
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SCBA Spherical Cap Bouguer Anomaly in gravity units

TC Terrain Correction in gravity units

Complete Geoidal Bouguer Anomaly: This is obtained by adding the terrain correction to the Geoidal Bouguer Anomaly. The Complete Geoidal Bouguer Anomaly is the most interpretable value derived from a gravity survey as changes in the anomaly can be directly attributed to lateral density contrasts within the geology below the observation point.

$$CGBA = GBA + TC$$

where,

CGBA Complete Geoidal Bouguer Anomaly in gravity units

5.0 Magnetic Data and Processing

Magnetic data were acquired using a Geometrics G858 with a sample rate of 0.2 seconds. Diurnal data were acquired every 30 seconds using a Geometrics G-856 base station located near to the GPS base station, away from any man made interference.

Diurnal correction and spike removal were conducted with Magmapper software. There were numerous drop outs removed where the sensor was out of orientation; this was mainly due to the operator tripping over when traversing the rough, rocky terrain. There was also some cultural noise, but this has been left in the data e.g. powerlines, old fences. Coordinates for the magnetic data were interpolated from the GPS positions obtained from the gravity survey.

Due to synchronisation issues, the generation of coordinates for Line 04 resulted in some along line errors and there are portions of dubious/missing data along this line (especially along the northern half of the line).

5.0 Results

The Bell Bay gravity and magnetic survey was carried out with a minimum of fuss despite difficult and testing terrain. An average production rate of 40 gravity stations per day was achieved for the duration of the project. A copy of the full production report is contained on the data CD.

Final data have been delivered to a technically excellent standard. Repeatability of the data was excellent, with the standard deviation of the elevation repeats 0.022m and the standard deviation of the gravity repeats 0.022 mGal.

5.1 Data Formats

Final reduced gravity data for the project have been delivered in Atlas format. Table 2 overleaf details the format of the final gravity database supplied. All fields are comma delimited.

Diurnally corrected magnetic data have been supplied as a Geosoft Oasis Montaj database.

Appendix B contains plots of final station locations as well as profiles of Spherical Cap Bouguer Anomaly and Total Magnetic Intensity.

Raw GPS-GNSS and gravity data in their respective native formats have been included on the data CD as Appendix C. Table 1 below summarises the deliverables.

Final Delivered Data	Format	Data DVD	Hardcopy
Gravity Database	Comma Space Delimited .csv	•	
Magnetic Database	Geosoft GDB Format	•	
Raw Positional Data	AGRIS format, comma delimited	•	
Raw Gravity Data	Scintrex CG5 format	•	
Profiles	Jpeg	•	•
Acquisition Memorandum	PDF .pdf	•	•

Table 1: Final Deliverables

Field Header	Field Description	Format	Units
PROJECT	Atlas Geophysics Project Number	A9	None
STATION	Unique Station ID	I8	None
STATIONCODE	Unique Station Code	A13	None
TYPE	Observation Type : Base, Field or Repeat	A8	None
MGAEAST	Coordinate Easting MGA94/GDA94	F11.3	m
MGANORTH	Coordinate Northing MGA94/GDA94	F12.3	m
ZONE	MGA Zone Number	F8.0	NA
GDA94LAT	Coordinate Latitude GDA94	F15.10	DD
GDA94LONG	Coordinate Longitude GDA94	F15.10	DD
ORTHOHTM	Coordinate Elevation Orthometric	F9.3	m
GRS80HTM	Coordinate Elevation Ellipsoidal	F9.3	m
NAG98	Geoid Separation	F8.3	m
AMG84EAST	Coordinate Easting AMG84	F11.3	m
AMG84NORTH	Coordinate Northing AMG84	F12.3	m
DATE	Observation Date	I8	None
TIME	Observation Time	I8	None
DIALMGAL	Gravity Dial Reading	F9.3	mGal
ETCMGAL	Earth Tide Correction (Longman)	F8.3	mGal
SCALE	Scale Factor Applied to Dial Reading	F9.6	None
OBSG84MGAL	Observed Gravity ISOGL84	F11.3	mGal
OBSG84GU	Observed Gravity ISOGL84	F11.2	gu
OBSGAAGD07GU	Observed Gravity AAGD07	F13.2	gu
OBSGAAGD007MGAL	Observed Gravity AAGD07	F16.3	mGal
DRIFTMGAL	Drift Applied to Dial Readings	F10.3	mGal
TGRAV80GU	Theoretical Gravity 1980	F11.2	gu
TGRAV80MGAL	Theoretical Gravity 1980	F12.3	mGal
TGRAVGU	Theoretical Gravity 1967	F11.2	gu
GFACGU	Geoidal Free Air Correction	F8.2	gu
GFACMGAL	Geoidal Free Air Correction	F9.3	mGal
GFAAGU	Geoidal Free Air Anomaly	F8.2	gu
GFAAMGAL	Geoidal Free Air Anomaly	F9.3	mGal
GBC267GU	Geoidal Bouguer Correction 2.67 tm ⁻³	F9.2	gu
GBC240GU	Geoidal Bouguer Correction 2.40 tm ⁻³	F9.2	gu
GBC220GU	Geoidal Bouguer Correction 2.20 tm ⁻³	F9.2	gu
GBC267MGAL	Geoidal Bouguer Correction 2.67 tm ⁻³	F11.3	mGal
GBC240MGAL	Geoidal Bouguer Correction 2.40 tm ⁻³	F11.3	mGal
GBC220MGAL	Geoidal Bouguer Correction 2.20 tm ⁻³	F11.3	mGal
GBA267GU	Geoidal Bouguer Anomaly 2.67 tm ⁻³	F9.2	gu
GBA240GU	Geoidal Bouguer Anomaly 2.40 tm ⁻³	F9.2	gu
GBA220GU	Geoidal Bouguer Anomaly 2.20 tm ⁻³	F9.2	gu
GBA267MGAL	Geoidal Bouguer Anomaly 2.67 tm ⁻³	F11.3	mGal
GBA240MGAL	Geoidal Bouguer Anomaly 2.40 tm ⁻³	F11.3	mGal
GBA220MGAL	Geoidal Bouguer Anomaly 2.20 tm ⁻³	F11.3	mGal
TGRAV80ACGU	Theoretical Gravity 1980 Atmospheric Corrected	F11.2	gu
EFACGU	Ellipsoidal Free Air Correction	F9.2	gu
EFAAGU	Ellipsoidal Free Air Anomaly	F8.2	gu
SCBC267GU	Spherical Cap Bouguer Correction 2.67 tm ⁻³	F10.2	gu
SCBC240GU	Spherical Cap Bouguer Correction 2.40 tm ⁻³	F10.2	gu
SCBC220GU	Spherical Cap Bouguer Correction 2.20 tm ⁻³	F10.2	gu
SCBA267GU	Spherical Cap Bouguer Anomaly 2.67 tm ⁻³	F10.2	gu
SCBA240GU	Spherical Cap Bouguer Anomaly 2.40 tm ⁻³	F10.2	gu
SCBA220GU	Spherical Cap Bouguer Anomaly 2.20 tm ⁻³	F10.2	gu
SCBA267MGAL	Spherical Cap Bouguer Anomaly 2.67 tm ⁻³	F12.3	mGal
SCBA240MGAL	Spherical Cap Bouguer Anomaly 2.40 tm ⁻³	F12.3	mGal
SCBA220MGAL	Spherical Cap Bouguer Anomaly 2.20 tm ⁻³	F12.3	mGal
TCINNERGU	Inner Terrain Correction	F8.2	gu
TCINNERMGAL	Inner Terrain Correction	F8.3	mGal
QFINNER	Quality Factor Inner TC	I2	None
TCOUTERGU	Outer Terrain Correction	F8.2	gu
TCOUTERMAL	Outer Terrain Correction	F8.3	mGal
QFOUTER	Quality Factor Outer TC	F2	None
TCTOTALGU	Total Terrain Correction	F8.2	gu
TCTOTALMGAL	Total Terrain Correction	F8.3	mGal
CGBA267GU	Complete Geoidal Bouguer Anomaly 2.67 tm ⁻³	F11.3	gu
CGBA267MGAL	Complete Geoidal Bouguer Anomaly 2.67 tm ⁻³	F11.3	mGal
CSCBA267GU	Complete Spherical Cap Bouguer Anomaly 2.67 tm ⁻³	F12.2	gu
CSCBA267MGAL	Complete Spherical Cap Bouguer Anomaly 2.67 tm ⁻³	F12.2	mGal
DIFFEASTM	Repeat Error for Easting Observation	F8.3	m
DIFFNORTHM	Repeat Error for Northing Observation	F8.3	m
DIFFHTM	Repeat Error for Elevation Observation	F8.3	m
DIFFOBBSGMAL	Repeat Error for Observed Gravity	F8.3	mGal
DIFFOBBSGU	Repeat Error for Observed Gravity	F8.2	gu
METERSN	Serial Number of Gravity Instrument	I8	None
CLOSUREGU	Loop Closure in gu	F8.2	gu
CLOSUREMGAL	Loop Closure in mGal	F8.3	mGal
GRVBASE	Gravity Base	A11	None
GPSBASE	GPS Base	A11	None

Table 2: Final Gravity Database Format

APPENDIX A

Control Station Description

GRVGPS0095 – Bell Bay

GDA94/GRS80		MGA Z55		AMG Z55	
<i>Latitude</i>	-41 7 41.1737	<i>Easting</i>	492,456.268	<i>Easting</i>	492,342.411
<i>Longitude</i>	146 54 36.4603	<i>Northing</i>	5,447,018.150	<i>Northing</i>	5,446,835.166
<i>Ellipsoidal Height</i>	153.566	<i>Orthometric Height</i>	154.237	<i>Orthometric Height</i>	154.237

OBSERVED GRAVITY

<i>gu AAGD07</i>	9802345.29				
<i>mGal ISO GAL84</i>	980234.607				

Occupation Method/Location Details

At this control station, the GPS control point consists of a steel picket driven into the ground with approximately 15cm protruding. The gravity control point consists of a small concrete slab set into the ground, opposite the GPS control point. The control station is witnessed by an Atlas Geophysics survey plaque attached to a 1.5 metre steel picket placed within 0.5m of the both control points

Gravity Control was established via an ABABABA loop with the project meter to George Town station 9002 located at the intersection of the Tamar Highway and Bridport Road. Expected accuracy would be better than 0.01 mGal.

GPS Control was established using AUSPOS. Three separate 10 hour sessions were submitted to AUSPOS's online processing system where returned coordinates were accurate to better than 0.01m.

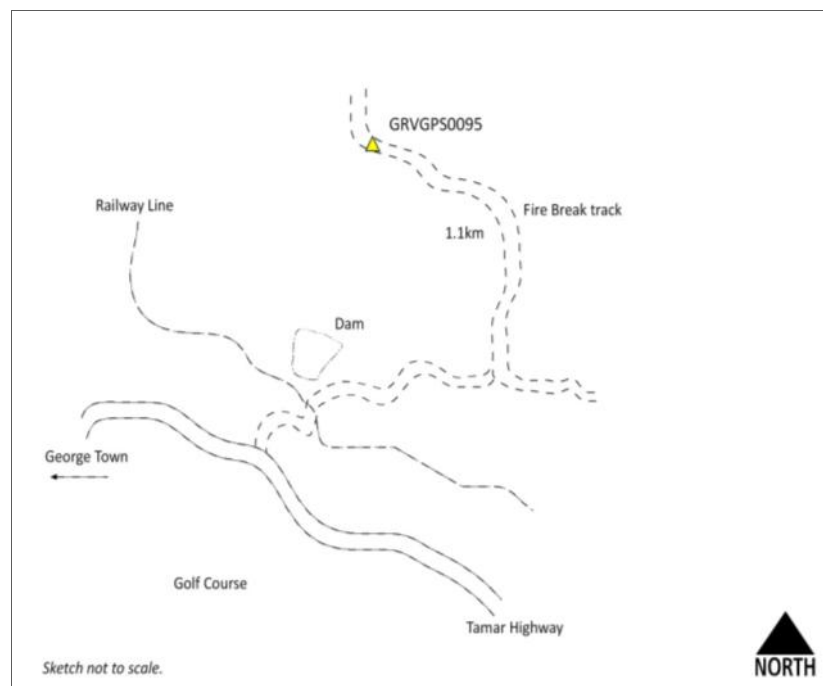
The station is located in the middle of the fire break, adjacent to a large rock approximately 0.5m in diameter. The station can be accessed from the track that runs off the Tamar Highway. Take the track opposite the George Town golf course, go through the locked gate, cross over the railway line and drive for 1.6km. After 1.6km you will hit a fork in the track, take the left fork. Continue along the fire break track for another 1.1km. GRVGPS0095 is visible from the fire break track.



Photograph of Control Station GRVGPS0095 and Surrounds



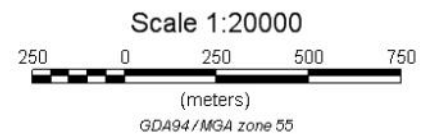
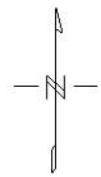
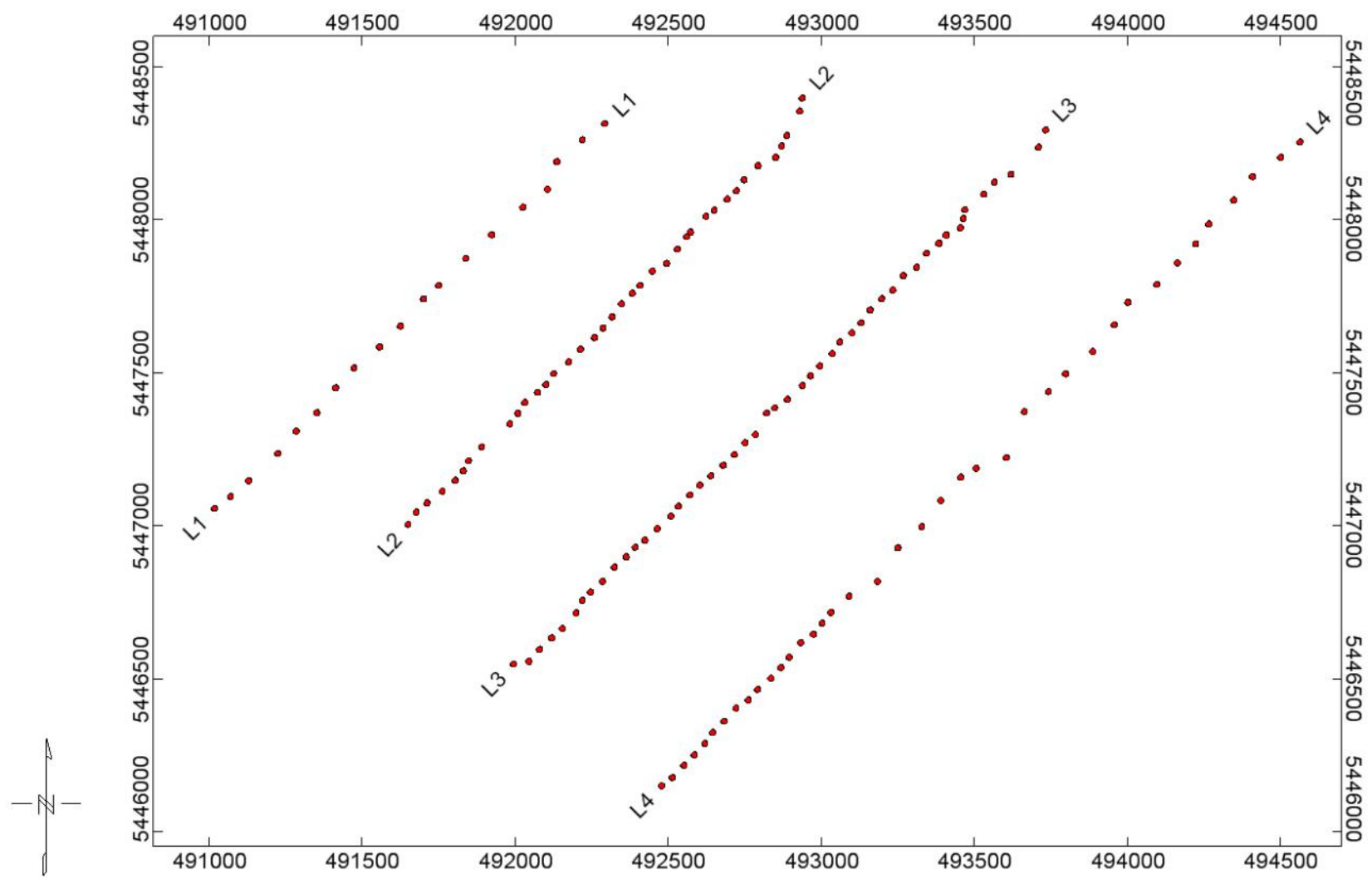
Location of Control Station GRVGPS0095



Locality Sketch of Control Station GRVGPS0095

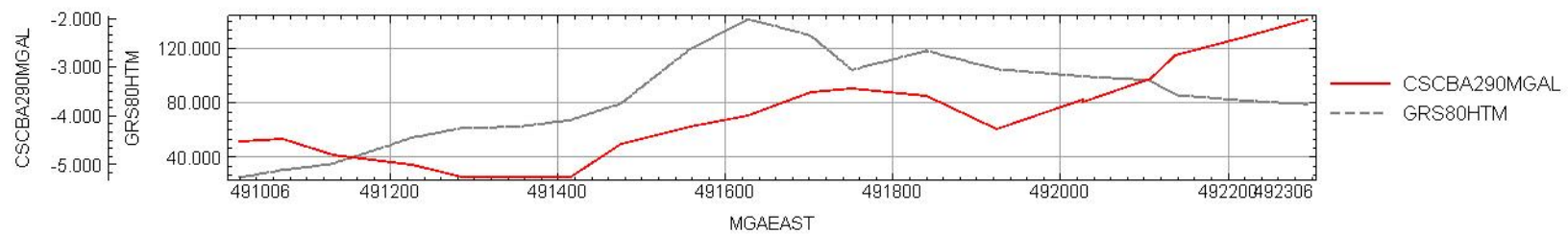
APPENDIX B

Plots and Profiles



DELTA MATERIALS LTD
P2010001 DELTA MATERIALS BELL BAY GRAVITY MAG
Plot of Acquired Gravity Stations
ATLAS GEOPHYSICS PTY LTD FINAL DATA RELEASE www.atlasgeo.com.au
<i>drawn by : LM</i>

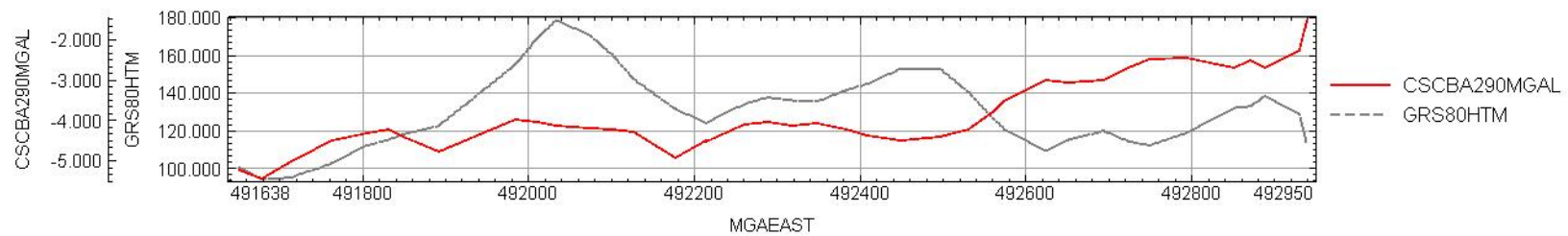
Line 01 Complete Spherical Cap Bouguer Anomaly



database: I:\0_atlas\projects\projects\2010\p2010001_delta_materials_bell_bay\fp\grv\gravity.gdb line/group: L1

2011/01/17

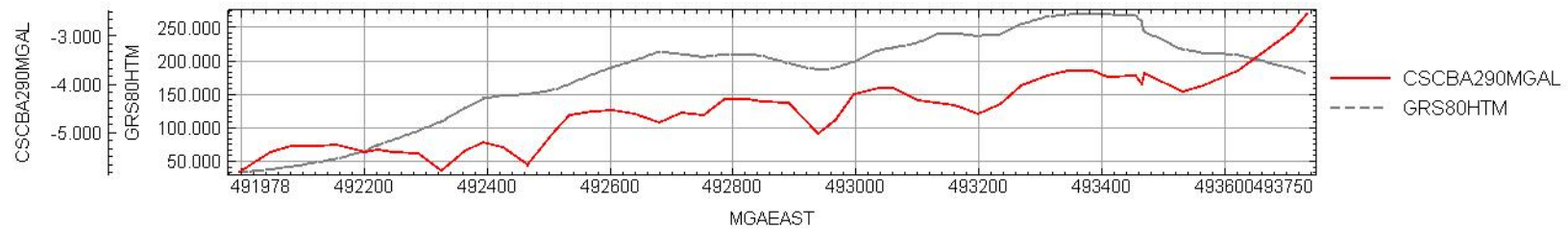
Line 02 Complete Spherical Cap Bouguer Anomaly



database: I:\0_atlas\projects\projects\2010\p2010001_delta_materials_bell_bay\fp\grv\gravity.gdb line/group: L2

2011/01/17

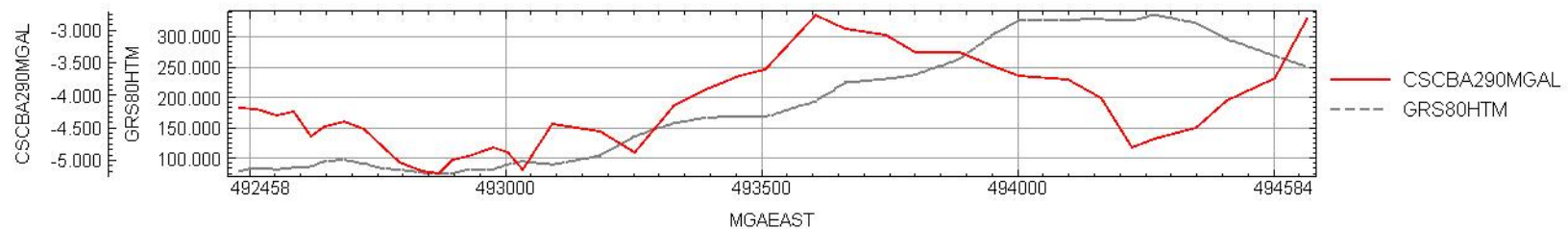
Line 03 Complete Spherical Cap Bouguer Anomaly



database: I:\0_atlas\projects\projects\2010\p2010001_delta_materials_bell_bay\fp\grv\gravity.gdb line/group: L3

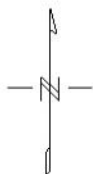
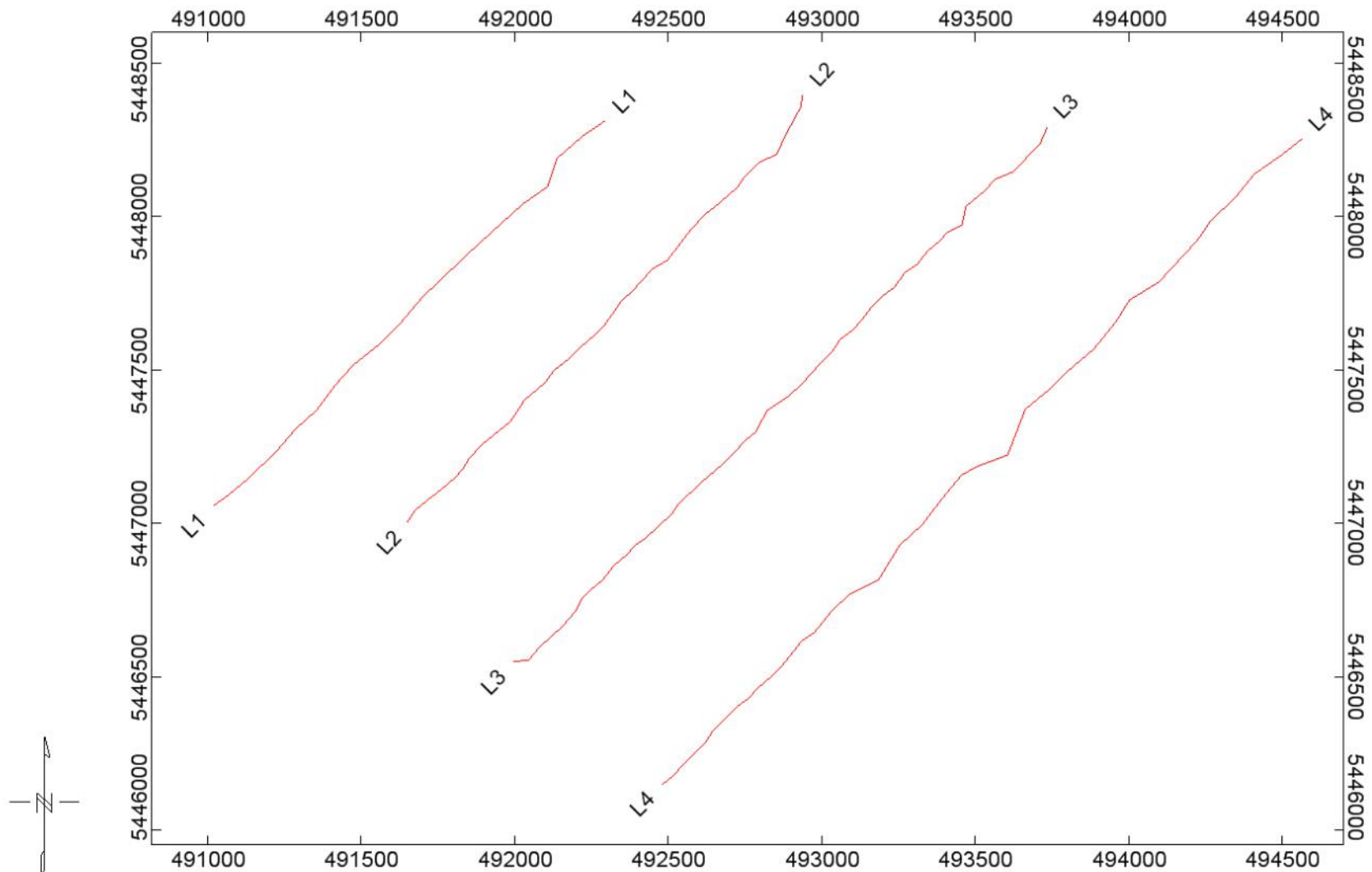
2011/01/17

Line 04 Complete Spherical Cap Bouguer Anomaly



database: I:\0_atlas\projects\projects\2010\p2010001_delta_materials_bell_bay\fp\grv\gravity.gdb line/group: L4

2011/01/17



Scale 1:20000



(meters)

GDA94/MGA zone 55

DELTA MATERIALS LTD

P201001 DELTA MATERIALS BELL BAY GRAVITY MAG

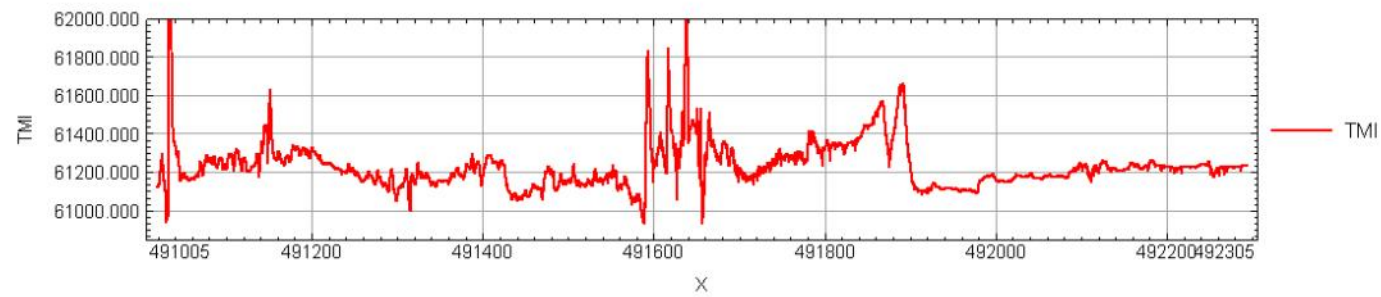
Plot of Acquired Magnetic Lines

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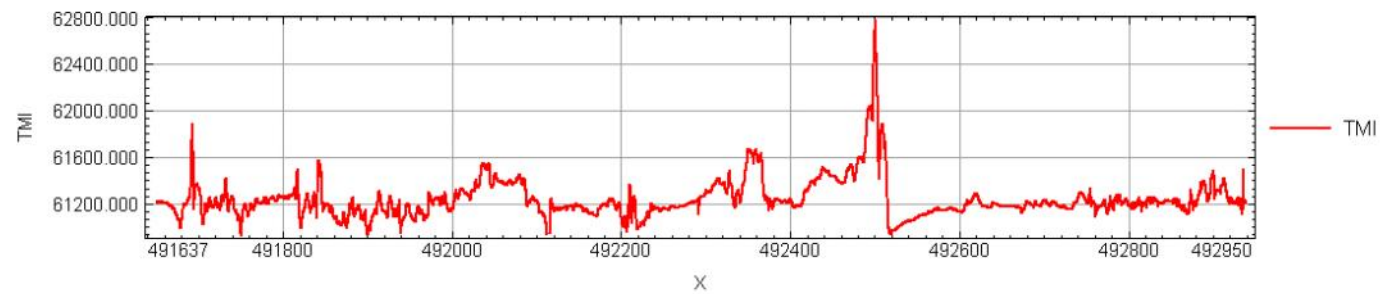
drawn by : LM

Line 01 TMI



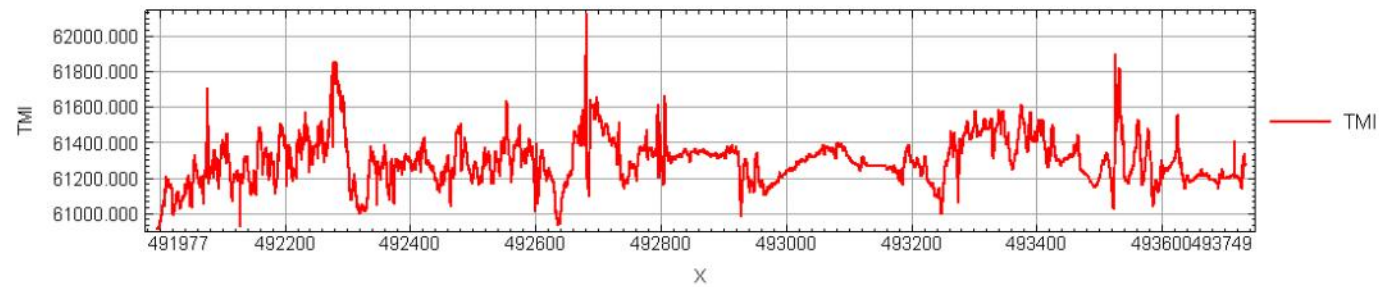
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Line 02 TMI



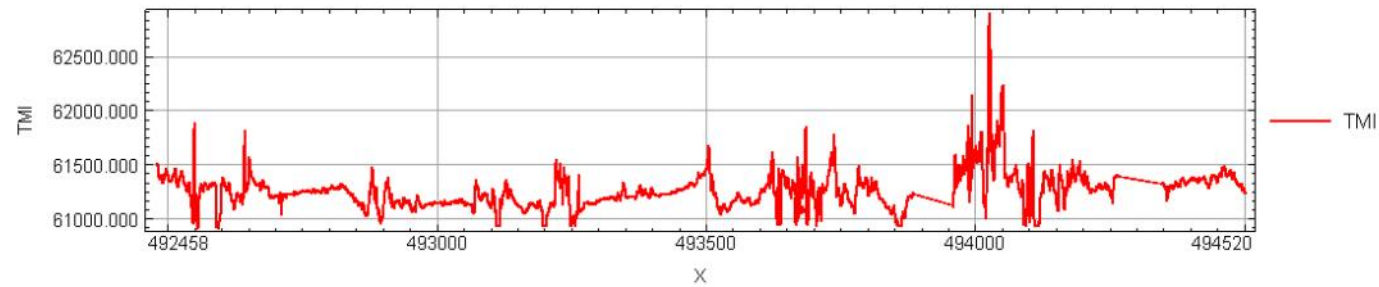
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Line 03 TMI



database: L:\0_atlas\projects\projects\2010\2010001_DELTA_MATERIALS_Bell_Bay\mag\2010001_DELTA_MATERIALS_Bell_Bay_Magnetics.gdb line/900101137

Line 04 TMI



database: L:\0_atlas\projects\projects\2010\2010001_DELTA_MATERIALS_Bell_Bay\mag\2010001_DELTA_MATERIALS_Bell_Bay_Magnetics.gdb line/900101137