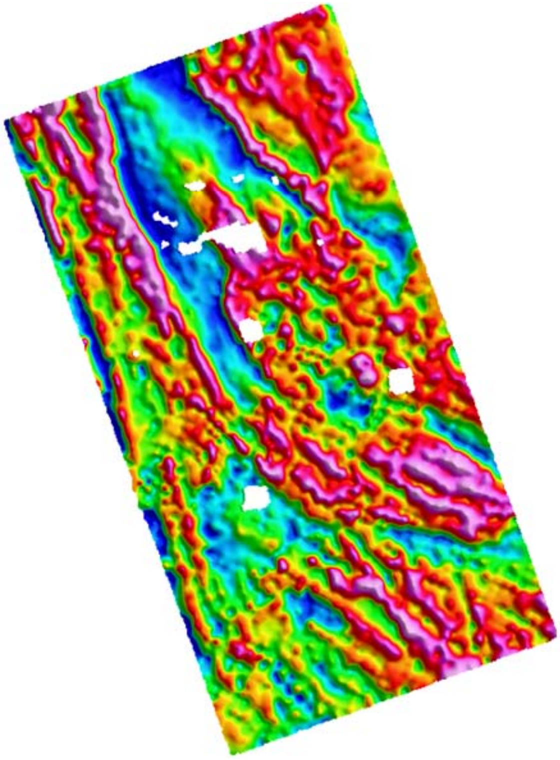
GEOSCIENCE AUSTRALIA
PATERSON GRAVITY SURVEY
PROJECT 200560

August 2005 – October 2005

Report Number 05003
LR Mathews



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1. INTRODUCTION

A precision GPS-Gravity survey was carried out between 31st August 2005 and October 6th 2005 on behalf of Geoscience Australia funded by the Geological Survey of Western Australia under GA project number 200560. A total of 4236 new gravity stations were surveyed over the Paterson region of northern Western Australia.

Gravity data were acquired using Scintrex CG3M/CG5 and Lacoste Romberg gravity meters. Position and level data were obtained using Ashtech Z12 geodetic grade GPS receivers operating in post-processed kinematic mode. Data were acquired using Daishsat helicopter-borne methods.

Gravity data were reduced using standard Geoscience Australia reductions on the ISOGAL84 gravity network. GPS data were reduced to MGA coordinates with levels expressed as metres above the Australian Height Datum.

2. SURVEY OVERVIEW

The gravity survey was located within a large area of the Paterson Province in the Great and Little Sandy Deserts which lie 1250 km north of Perth, Western Australia (Figure 1). The area is very remote, with the gold and copper mines of Nifty and Telfer being the only proximal places of significance.

Access to the survey is via the town of Marble Bar along the main road into Telfer mine. The area contains numerous sandy tracks which were utilized for helicopter refueling and service.

The survey area is dominated by WNW trending sand dunes up to 30m high and 100-500m apart (Photo 1) In the dune swales, minor scattered rock outcrops and gravels can be found. Intruding the vast dune fields, are the Throssel and Paterson Ranges which stretch from the centre of the survey to the south of survey and extend into the Rudall River national park (Photo 2). The main vegetation in the area is spinifex and desert grass, with some small trees including Eucalyptus and Acacia.

Climate in the region is semi arid, with the mean annual rainfall of about 300mm falling mainly between late November and March. The mean daily temperature during the survey varied between 30°C and 45°C.

Gravity surveying was conducted on a 2.5km x 2.5km spaced grid configuration, with a grid orientation of approximately 330 degrees (NNW). Several large areas were omitted from the survey due to clearance and native title issues. A single area to the west was omitted where gravity data already existed. Several stations in sensitive mining areas were acquired using a vehicle. Appendix A contains a plot of the final station locations.

Photo 1: Numerous dunes prevalent throughout the survey area.

Photo 2: Rocky outcrops within the Throssel Ranges.

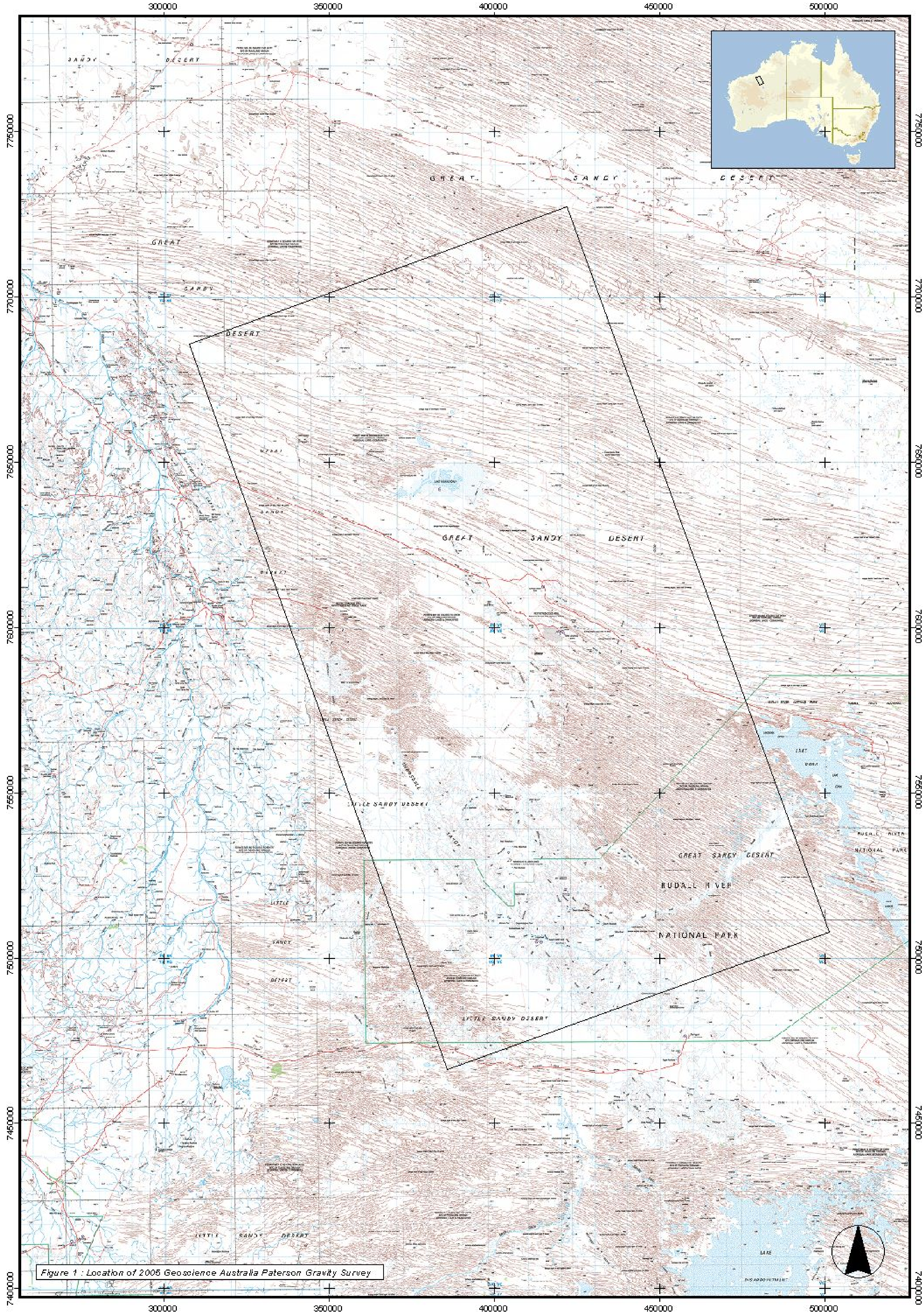


Figure 1 : Location of 2005 Geoscience Australia Paterson Gravity Survey

3. PERSONNEL AND EQUIPMENT

3.1 Personnel

The supervisor in charge of the project was David Daish. David was responsible for daily management of the job and for nightly data processing to ensure quality and integrity. Gravity and GPS measurements were carried out by:

Grant Coopes, Geophysicist – helicopter and control operations
Allan Cowie, Surveyor – helicopter operations
Matthew Ingall, Surveyor – gravity control

Two helicopter pilots were used for the helicopter surveying:

Peter Muddle – Chief pilot
Bruce Turner

Final data reduction, terrain correction, inspection and reporting were performed by the company geophysicist, Leon Mathews.

Photo: 3 – Chief pilot, Peter Muddle.

3.2 Survey equipment

The following survey equipment was utilized on the gravity survey:

- Two Scintrex CG-3M digital gravity meters:
  SN 408275 G
  SN 711410 S
- One Scintrex CG-5 digital gravity meters:
  SN 24921 A
- Two LaCoste Romberg gravity meters
  SN G80 M
  SN G711 L
- One Leica System 500 dual frequency GPS receiver
- Two Ashtech Z12 dual frequency GPS receivers
- Notebooks for data processing and backup
- Magellan FX324 GPS receiver for helicopter navigation
- Garmin Handheld GPS receivers for vehicle navigation
- Notebook computers for data processing and backup
- Various chargers, solar cells and batteries

3.3 Vehicles

Due to the type of terrain to be encountered, 4wd Landcruiser vehicles were used for the duration of the job. To maintain the high Daishsat safety record, vehicles were fitted with a range of safety equipment including:

- One 20l jerry can of water
- Dual fuel tanks
- Two spare tyres
- HF radio and satellite phone with car kit
- Self-recovery equipment including a hand winch, snatch straps and rope
- Tyre pliers to effect tyre repairs in the field
- Tools and spares to enable field repairs as necessary
- Survival kit with EPIRB emergency locator beacon

3.4 Helicopter

Ferry between the gravity stations was necessitated by a turbine powered Bell-47 Soloy helicopter – call sign VH-DTA (Photo 5). This particular type of helicopter was well suited to the project as large amounts of lift were required given the hot conditions.

Photo 4 – Helicopter, vehicles and caravan utilised on the Paterson survey.

Photo 5 – Daishsat helicopter VH-DTA with chief pilot, Peter Muddle.

3.5 Camp

Camping was facilitated through use of a single Daishsat caravan (Photo 6). The caravan was setup as the operations centre and was equipped with full satellite, radio and broadband communications as well as facilities for cooking, showering and equipment storage. A nearby bore was used to extract washing water, with drinking water obtained from Telfer mine.

Whilst camping, all rubbish was deeply buried and burnt so that it could not be later disturbed by the native fauna.

Photo: 6 – Daishsat field camp at Rocky Ridge.

3.6 Communications

The helicopter crew was equipped with hand-held Globalstar satellite phones as well as UHF and VHF transceivers.

Skeds were made by all crews to the communications centre at the camp at prescribed intervals. Communication with the Perth and Murray Bridge offices was ongoing for the duration of the job.

4. GPS SURVEYING AND PROCESSING

4.1 Set out of the grid

This was done concurrently with the gravity data acquisition using navigation grade receivers operating in autonomous mode. Where possible, the readings were taken as close to the ideal coordinates as possible. Some stations were offset or omitted due to the nature of the terrain, e.g. hilly or thickly vegetated areas. As the receivers were operating in autonomous mode, set out accuracy was usually better than 10m.

Raw kinematic GPS data were logged by a dual-frequency Ashtech Z-12 receiver inside the helicopter cabin, with the GPS antenna mounted on the rear tail shaft boom. Static GPS data were logged at each of the base stations using Ashtech Z-12 and Leica System 500 receivers for later post-processing.

At the repeat stations, a fence dropper marked with the station number was used for identification. At each station, the station number, position and RL were recorded digitally by the crew.

4.2 Survey datum and control

The gravity surveying, and hence any gravity reductions, used the Australian Height Datum (AHD) as the reference datum. All new GPS/Gravity base stations were established using at least three days worth of static data, and connections to ITRF stations using Geoscience Australia's online GPS processing system, AUSPOS. For more information on this system, please visit the Geoscience Australia website at http://www.ga.gov.au/geodesy/sgc/wwwgps/. Final deviations of better than 5mm were obtained for x, y and z, for all occupations. Appendix D contains the GPS base station information. The base stations were numbered in accordance with the GA format.

4.3 Processing of the position and level data

Depending on the receiver type, the raw GPS data were recorded onto either internal RAM or onto Compact Flash cards. The data were downloaded nightly onto laptop computer for post processing using Waypoint Grafnav v7.00.

Waypoint combines the processing components, GrafNav and GrafNet, in a complete package.

GrafNav processes data for one baseline (e.g. one base and one remote). GrafNav is normally used for kinematic data which it is extremely well suited for. It can also process single static baselines. Receiver types can be mixed and matched via the use of a common format. This component of Waypoint was used for processing the kinematic data acquired each day.

GrafNav and GrafNet share the same processing engine that has been under continuous development since its original inception by Waypoint in 1992. The core of this robust engine is its carrier phase kinematic (CPK) Kalman filter. Some of the major advantages of Waypoint's kernel are:

Fast processing - The GrafNav kernel is one of the fastest on the market. It will process ~0.8 epochs per MHz per second on a Pentium II.

Robust Kalman filter - From experience with processing GPS data from fast jets and NASA sounding rockets, the processing kernel has become extremely robust. Efforts have been made to account for all of the various data error possibilities given the different types of GPS receivers that GrafNav/GrafNet can handle.

Reliable OTF - Waypoint's on-the-fly (OTF) algorithm, called Kinematic Ambiguity Resolution (KAR), has had years of development and stresses reliability. Variations are implemented for both single and dual frequencies, and numerous options are available to control this powerful feature

Accurate Static Processing - Three modes of static processing are implemented in the processing kernel. Fixed static is the most accurate. A quick static solution is also available as an alternative, while the float and iono-free float solution is useful for long baselines.

Dual Frequency - Full dual frequency support comes with GrafNav/GrafNet. For ambiguity resolution, this entails wide/narrow lane solutions for KAR, fixed static and quick static. Ionospheric processing is very important with the peak of the ionosphere's cycle occurring in 2000. The GrafNav kernel implements two ionospheric processing modes including the iono-free and relative models. The relative model is especially useful for airborne applications where initialization is near the base station, and this method is much less susceptible to L2 phase cycle slips.

Forward and Reverse - Processing can be performed in both the forward and reverse directions. Both GrafNav and GrafNet also have the ability to combine these two solutions to obtain a globally optimum one.

Velocity Determination - Since the GrafNav kernel includes the L1 Doppler measurement in its Kalman filter, velocity determination is very accurate. In addition to this, a considerable about of code has been added specifically for the detection and removal of Doppler errors.

Long Baseline - Because precise ephemeris and dual frequency processing is supported, long baselines accuracies can be as good as 0.1 PPM.

For more information about Waypoint processing software, and in particular, Grafnav, please visit the Waypoint http://www.waypnt.com/grafnav_d.html.

Simple transformations to MGA and AHD were done using the GPS derived WGS84 positions.

MGA94 coordinates were obtained by simply projecting the GPS-derived WGS84 coordinates using a UTM projection with zone 51S. For all practicable purposes, the WGS84 geodetic coordinates are equivalent to GDA94 geodetic coordinates, so no transformation is necessary. For more information about GDA94 and MGA94, please visit http://www.ga.gov.au/geodesy/datums/gda.jsp.

AHD heights were calculated via Waypoint software using the latest geoid model for Australia, AUSGEOID98. Information about the geoid and the modeling process used to extract separations (N values) can be found at http://www.ga.gov.au/geodesy/ausgeoid/. To obtain AHD heights, the modeled N value is subtracted from the GPS derived WGS84 ellipsoidal height (Figure 4).

$$H_{AHD}=h_{WGS84}-N$$

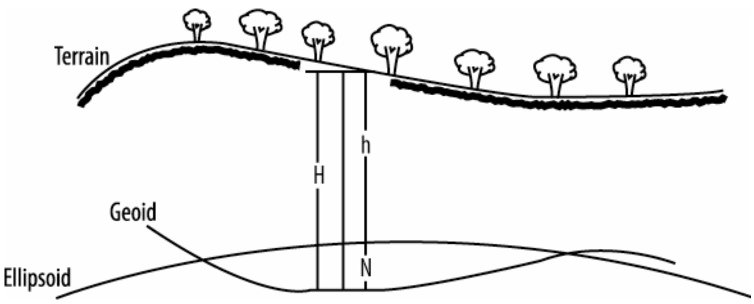


Figure: 2: Geoid-Ellipsoid separation

4.4 GPS Performance

Performance from the Ashtech and Leica receivers was exceptional. Contributing to this was the lack of trees and other vegetation, as well as the excellent satellite geometry, or DOP that was present for the duration of the survey.

5. GRAVITY SURVEYING AND PROCESSING

5.1 Gravity data acquisition

Gravity observations were made concurrently with the GPS measurements (Photo 7). Multiple observations were made at each station so that any seismic or instrumental noise could be immediately detected. The tolerance between readings was set at 0.03 of a dial reading (0.3gu). Vertical and horizontal levels were restricted to 5 arc seconds at all times. At each station, the station number, time and two gravity readings (in dial units) were recorded in DAISHSAT carbon-copy gravity field books. The Scintrex meters also automatically record the station, time and readings digitally to allow for downloading to computer.

Photo 7 : Gravity observation in the Paterson Ranges.

5.2 Gravity base stations

Gravity base stations were used for calculation of absolute gravity and drift determination. Details of the gravity bases utilised are contained in Appendix D. When in the field, a base station reading was taken in the morning before observing, and at evening after the last observation. When taking a base station reading, the observed gravity values were stacked over 60 seconds and the readings repeated to 0.010 mGals (0.1gu) of a dial reading or less to ensure accuracy

A primary gravity base station (2005600006) was established at Telfer Aerodrome through an ABABA loop tie to the Newman AFGN station (9893.1602) with thee gravity meters. Ferry between the two stations was facilitated through use of a light aircraft. The tie was conducted over about six hours.

Secondary base stations were established via ABABA ties with multiple meters to the primary base station at Telfer.

Expected accuracy of the tie control surveys would be better than 0.1gu.

Photo 8 : Surveyor Matt Ingall taking a tie reading at the Newman AFGN station.

5.4 Gravity data processing

Raw gravity data were processed on a daily basis to check for quality and integrity. This interim process produced a set of Bouguer Gravity values which were contoured and imaged to provide a check for any anomalous readings that would need repeating. Geosoft GRAVRED software was used for the gravity reduction in the field. Upon conclusion of the job, the data were reprocessed using the contract specified GA formulae with Daishsat proprietary software. Other software used on this project includes Arcview, ChrisDBF, RasterTC, Waypoint and ERMapper. The formulae used for final processing are listed below.

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

Tidal correction: This correction was used to correct for background variations due to changes in the relative position of the moon and sun. The Scintrex calculated ETC was removed and a new ETC calculated using Geosoft Formulae and the surveyed GPS latitude. The formulae used are contained in Appendix G.

Instrument Drift: Since gravity meters are mechanical, they are prone to drift (extension of the spring with heat, obeying Hooke's law). If two base readings are taken one can assume that the drift between the two readings is linear and can therefore be calculated. The drift and tidal corrected value is referred to as the *observed gravity*.

Normal Gravity: The theoretical value of gravity was calculated using the 1967 variant of the International Gravity Formula and used to latitude correct the observed gravity.

$$Gn=9{,}780{,}318.456*(1+0.005\ 278\ 895*\sin^2\phi+0.000\ 023\ 462*\sin^4\phi)$$

where ϕ represents degrees of latitude;

Free-Air Correction: Since gravity varies inversely with the square of distance, it is necessary to correct for changes in elevation between stations to reduce field readings to a datum surface (in this case, AHD).

$$(3.08768 - 0.00440 \sin^2\phi)*h - 0.000001442*h^2 \quad \mu ms^{-2} \text{ per metre}$$

Bouguer Correction: This correction accounts for the attraction of material between the station and datum plane that is ignored in the free-air calculation. A value of 2.67 tm^3 was used in the correction.

$$0.4191*\rho \quad \mu ms^{-2} \text{ per metre}$$

where ρ = density 2.67 tm^3

Terrain Correction: This 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. See Section 5.6 for a more in-depth discussion.

Free Air Anomaly: This is obtained by applying the free air correction (FAC) to the observed gravity reading.

$$FAA=G_{OBSG84}-Gn+FAC$$

Bouguer Anomaly: This is obtained when all the preceding reductions or corrections have been applied to the observed gravity reading.

$$BA267=G_{OBSG84}-Gn+FAC-BC$$

Complete Bouguer Anomaly: This is obtained by adding the terrain correction to the Bouguer Gravity Anomaly

$$COMPLETE\_BA267=G_{OBSG84}-Gn+FAC-BC+TC$$

5.4 Gravity meter calibration and scale factors

The gravity meters used on the project were calibrated pre survey at the Kensington Park - Norton Summit calibration range in Adelaide. At the conclusion of the survey, the meters were calibrated again at the Kensington Park – Norton Summit range or at the Mundaring Weir – Mt Gungin calibration range east of Perth. Table 1 shows the pre and post survey results. The LaCoste and Scintrex meters used for the initial control were not calibrated post-survey as they were overseas undergoing service. There was good agreement with the known value for the control values for each range which indicated that the scale factors for each meter (Table 2) were valid.

Gravity Meter	PRE SURVEY OBSG84 (gu)	POSTSURVEY OBSG84 (gu)
G 9408275	9796300.910 NS	9796301.130 NS
S 9711410	9796300.950 NS	9793989.283 MG
A 24921	9796300.647 NS	
L G711	9796300.960 NS	NA
M G80	9796300.720NS	NA

Known Norton Summit (NS) OBSG84 value = 9796301.000 gu

Known Mount Gungin (MG) OBSG84 value = 9793990.000 gu

Table 1: Results from pre and post calibration runs

Gravity Meter	Scale Factor
G 9408275	1.000000
S 9711410	1.000000
A 24921	1.000000
L G711	1.017560
M G80	1.042280

Table 2 : Scale factors for each gravity meter

5.5 Gravity meter drift calibration

While the survey was in progress, the Scintrex meters were cycled overnight as a check on instrument drift. Changes were made to the drift constant where appropriate.

5.6 Terrain Corrections

Terrain corrections were rigorously applied to the final data in an effort to minimize the effect of terrain encountered near areas of moderate to high relief. Digital elevation data supplied from the client were used with program RASTERTC to perform near zone to far zone corrections. The software utilized was coded by Geophysical Software and is ideally suited to this project. For more details regarding the method and a more in depth discussion of the algorithm used, please visit http://geopotential.com.

The terrain correction procedure corrects gravity measurements for the effect of terrain from a distance Rmin to a distance Rmax. Each gravity station is processed independently, and therefore corrections calculated for a particular station do not depend upon possible location errors of other stations.

The correction procedure divides the circular area enclosed by Rmax into an inner zone and an outer zone; the radius separating the inner and outer zones is denoted Rmed. A surface is fit to the elevations between Rmin and Rmed; this surface is numerically integrated to calculate that portion of the terrain correction that is due to the terrain located in the interval Rmin <= R <= Rmed. The figure below illustrates the subdivision of areas used in the calculation.

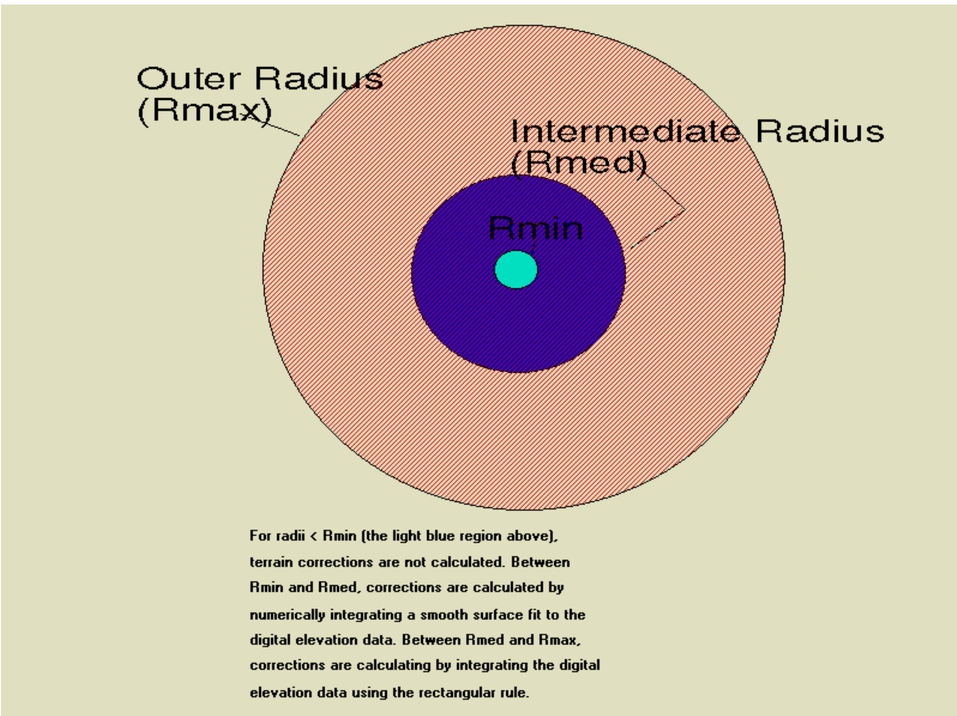


Figure 2: Calculation areas used by RASTERTC

The program uses triangulation and interpolation procedures to interpolate elevations between Rmin and Rmed. Between Rmed and Rmax, the terrain effect is calculated by assuming that each elevation sample represents the elevation of a rectangular compartment; a line element formula is used to calculate the effect of each such compartment. Terrain compartments lying between Rmed and Rmax that partially intersect the circular radius Rmed are treated in such a way that only the effect of that portion lying outside Rmed is added to the overall terrain effect. A similar procedure is applied to those compartments that partially intersect the outer radius Rmax

Note that the numerical integration procedure used to calculate the effect of terrain lying between Rmin and Rmed essentially integrates the effect of a line element between the two radii. This integration is repeated every 8° to obtain the effect of all the terrain lying within the circular region. The radial portion of the integration is performed using an adaptive technique called QUAN8.

A terrain surface is used close to the station location because the elevations provided by the DTM are samples and do not actually represent mean elevations of rectangular compartments. The use of a surface provides a terrain representation that should be much closer to reality than the use of compartments of constant mean elevation. At a certain distance from the station, the procedure of considering the elevation samples as representing the mean elevation of a rectangular compartment should yield numerical results than are not distinguishable from the results that would be obtained by actually using mean elevations of compartments whose size would necessarily be larger than 30 m on a side. In fact, the method used is equivalent to numerically integrating the terrain effect (at distances greater than Rmed) using a rectangular rule. Because the compartment size is relatively small, use of the rectangular rule should be rather accurate.

The elevation of the gravity station is not directly used during the computation of the effect of terrain effects. Instead, the elevation at the horizontal location of the gravity station is calculated from the multiquadric representation of the terrain surface, and this calculated elevation is used in the computation of the effect of terrain. The actual elevation of the gravity station is not used at all.

Numerically, the procedures used for the calculation of the terrain effect are extremely accurate, especially when compared to terrain corrections calculated using template methods. However, the corrections calculated are no better than the terrain data that are used to represent the terrain about each gravity station.

Various parameters were experimented with to obtain the optimum result for this particular survey. A brief discussion of the process and trials used to obtain the final result follows. All output files from the correction procedure have been included on the DATA CD to make follow-up interpretations easier. Note that all terrain corrections used a rock density of 2.67 tm^3.

5.6.1 DEM Preparation

Before attempting terrain corrections, the provided DEM was checked for consistency and then converted into a suitable format for input into the RASTERTC algorithm. The elevation data were from an SRTM (Shuttle Radar Topography Mission) grid excerpt and were at a grid cell size of 90m. Terrain over the area varied from about 10m to 700m above sea level, with some quite severe terrain proximal to the stations (Figure 3).

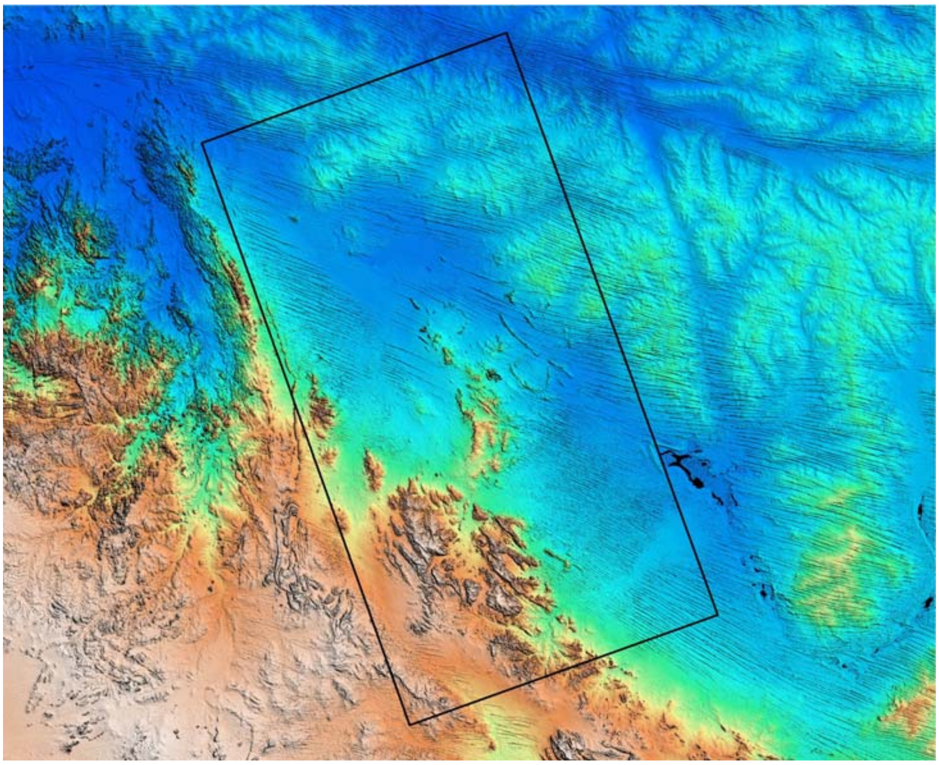


Figure 3 : Digital Elevation Model for Paterson and surrounds.

5.6.2 RASTERTC Correction

A terrain correction from 90m to 20000m from the gravity station was conducted using RASTERTC, with the following radius parameters:

Rmin = 90m
Rmed = 600m
Rmax = 20000m
Azimuthal Integration Angle = 8 degrees

Rmin was selected to correct for all terrain in the immediate vicinity of the station. Rmax was specified to allow correction for the extreme terrain at large distances from the station (outer zone). Rmed of 600m was chosen so that the terrain would be "sampled" at an interval close to that of the grid cell size when using an integration angle of 8 degrees. During the radial integration, near the maximum radial portion of the integration (600m), the terrain surface is being sampled at approximately Rmed(sin(angle)), where "angle" is the azimuthal integration angle selected and R is the maximum radius chosen for the surface integration.

The correction process works in two parts, with an inner and outer correction calculated. The inner correction is calculated quite rapidly, with terrain in the vicinity of the station (up to 600m distance) used for the calculation. The outer zone correction takes much longer, and calculates a correction based on the zone 600m – 20000m. The complete correction for each station is obtained by adding the two corrections together.

When calculating the RASTERTC correction, the station GPS elevations were not used. Instead, the elevation at the horizontal location of the gravity station was calculated from the multiquadric representation of the terrain surface, and this calculated elevation was used in the computation of the effect of terrain. The actual elevation of the gravity station is not used at all. The use of the actual elevation, rather than one consistent with the DTM terrain, effectively leads to gravity stations being located in deep holes or on very steep hills, whereas in fact such terrain features probably do not exist in the immediate vicinity of the gravity station.

5.6.3 Accuracy of the corrections

The terrain correction procedure produced highly accurate corrections for the most part. As with any terrain correction procedure, the accuracy of the final correction is dependant on the accuracy of the DEM used.

It was found that a slight bias existed between the GPS derived heights from the survey and the heights from the SRTM data. This bias was about 5-6m and was corrected for using grid arithmetic on the SRTM data. After correcting the data, excellent agreement between the survey data and SRTM data was achieved. RASTERTC outputs a difference variable for each survey station and it is found that for most of the survey, these differences are less than 5m, which is insignificant when dealing with terrain corrections. The average difference is -0.008m, with a standard deviation of 2.1m. Figure 6 shows the distribution of these differences.

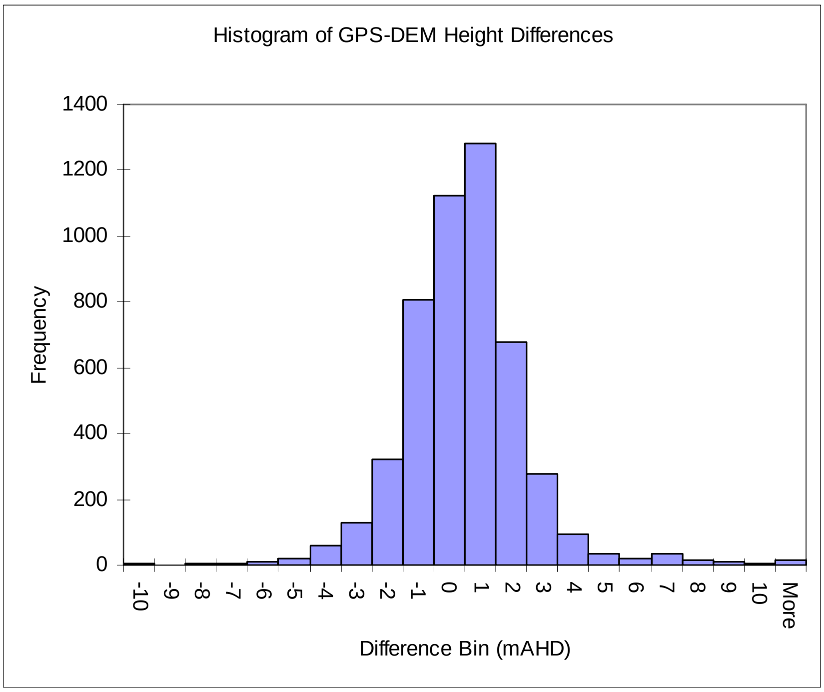


Figure 6 : *Difference between interpolated DEM elevation and station GPS elevation*

Since the DEM has been confirmed as being accurate, one can rely on the corresponding terrain corrections as being also highly accurate. Indicators of quality are provided for both the innermost terrain correction and the outer terrain correction. On the listing and the output files, such indicators are listed under the column headings "QF-Inner" and "QF-Outer", respectively. If the TC calculation is OK, the quality factors should be 0 for both the inner- and the outer-zone portion of the calculation. Otherwise, the quality factors provide an indication of what might be wrong.

Additionally, a rough indicator of how well the terrain in the immediate vicinity of a gravity station is represented by the available elevation samples is obtained by examining the spatial distribution of the elevation samples. In the radial interval Rmin to Rmed, RasterTC counts the number of samples falling within the 8 octants surrounding the station. If any of these octants are missing elevation samples, that fact is noted, and the tabulated quality factor simply notes how many of octants are missing samples (see Table 3).

The QF-Outer codes are simple to interpret. A result of 0 means that the outer-zone calculation proceeded successfully. If a portion of the outer-zone terrain is missing from the elevation grids supplied, the value of QF-Outer will reflect the per cent of terrain that was available (rounded to the nearest per cent). For example, if QF-Outer is 91, the implication is that 9% of the terrain in the outer zones was missing for some reason, and that the terrain correction calculated for that particular station is too small by some amount.

QF-Inner	Meaning of Error Code
0	Inner-zone terrain calculation OK
1	No elevation samples occur in 1 octant surrounding the gravity station
2	No elevation samples occur in 2 octants surrounding the gravity station
3	No elevation samples occur in 3 octants surrounding the gravity station
4	No elevation samples occur in 4 octants surrounding the gravity station
5	No elevation samples occur in 5 octants surrounding the gravity station
6	No elevation samples occur in 6 octants surrounding the gravity station
7	No elevation samples occur in 7 octants surrounding the gravity station
22	Duplicate elevation nodes encountered while calculating terrain gradients
23	All elevation nodes collinear or triangulation structure corrupted
24	Invalid parameters passed to gradient calculation routine
26	Convergence not attained in calculation of terrain gradients
48	Internal logic error while attempting to delete duplicate nodes
49	Unable to allocate memory while deleting duplicate nodes
96	Internal error occurs while attempting to triangulate nodes near station
99	Less than 3 elevation samples are available near station
101	Duplicate nodes occur in elevation samples near station
-99	Unable to allocate sufficient memory for inner-zone TC calculation

Table 3 : QF-Inner Error Codes

5. RESULTS

Raw and processed GPS and gravity data are contained on CDROM as Appendix H. Hardcopy plots of station location and coloured images are contained in Appendix A. Existing data from another Daishsat project (Project 05013) has been merged into data collected on this project and forms part of the final database.

6.1 Stations Surveyed and Survey Progress

In total, 4236 new stations were acquired during the survey. A brief production summary for the survey is shown in Table 4 below. Generally, production during the survey was excellent. Production was hindered only by helicopter maintenance that was required at the prescribed intervals. There was no downtime due to geophysical/GPS equipment failure.

Paterson Survey		
Gravity stations acquired (including repeats)	4441	stations
Gravity station repeats	205	4.6%
New gravity stations acquired	4236	stations
Total accidents	0	accidents
Total hours lost from accidents	0	hours

Table 4 : Gravity Production Summary

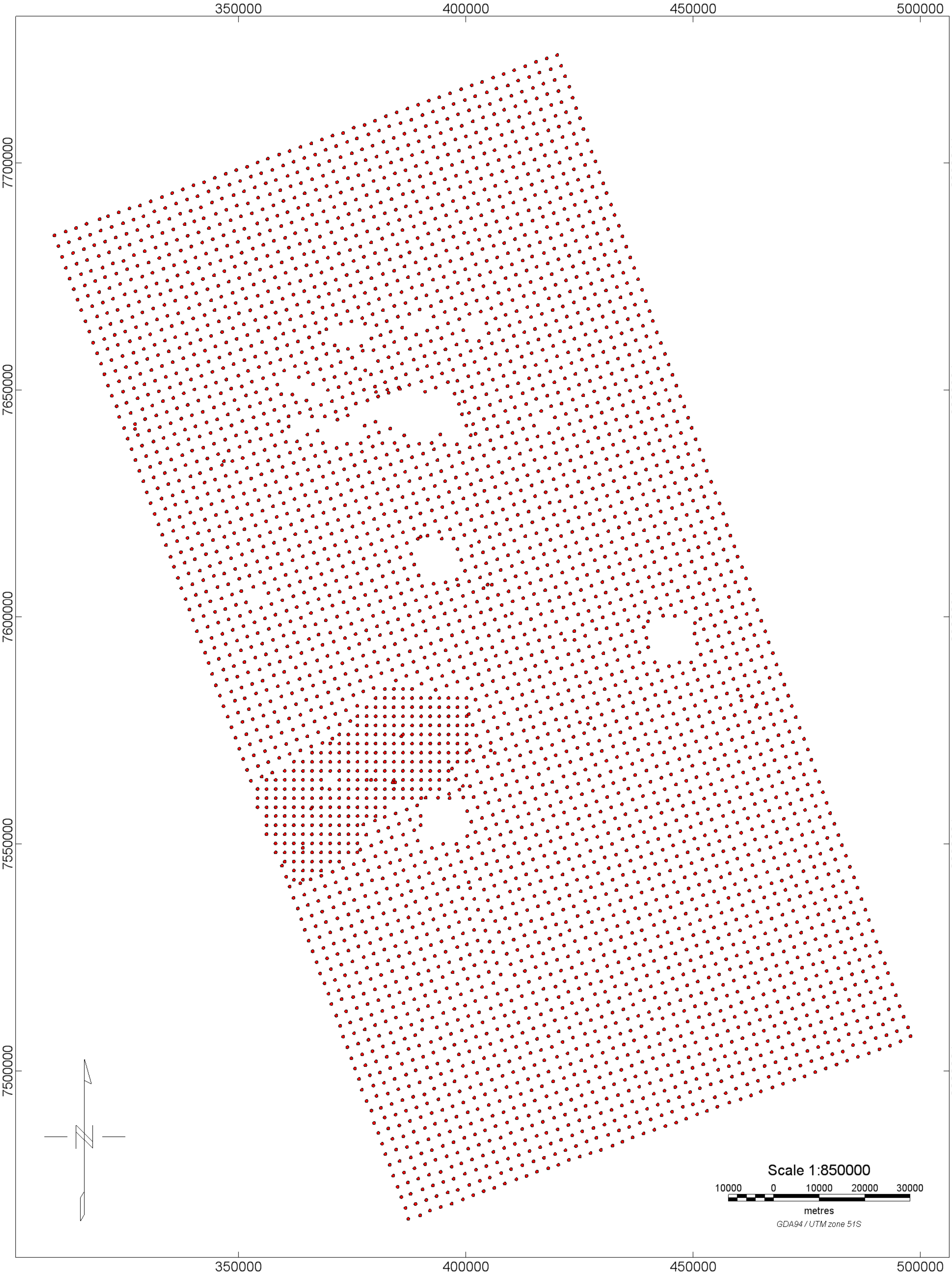
6.2 Data Repeatability

Analysis of the repeat data shows that measurement repeatability is excellent for both GPS and gravity observations. Appendix B contains histograms and summary statistics from the analysis, as well as a tabulation of the repeat data. Based on the repeat data, one can assume the following typical accuracies for the observables:

Z position observation : < 0.10 m
Gravity observation : < 0.37 gu (0.037 mGals)

APPENDIX A

Plots of station location / Images



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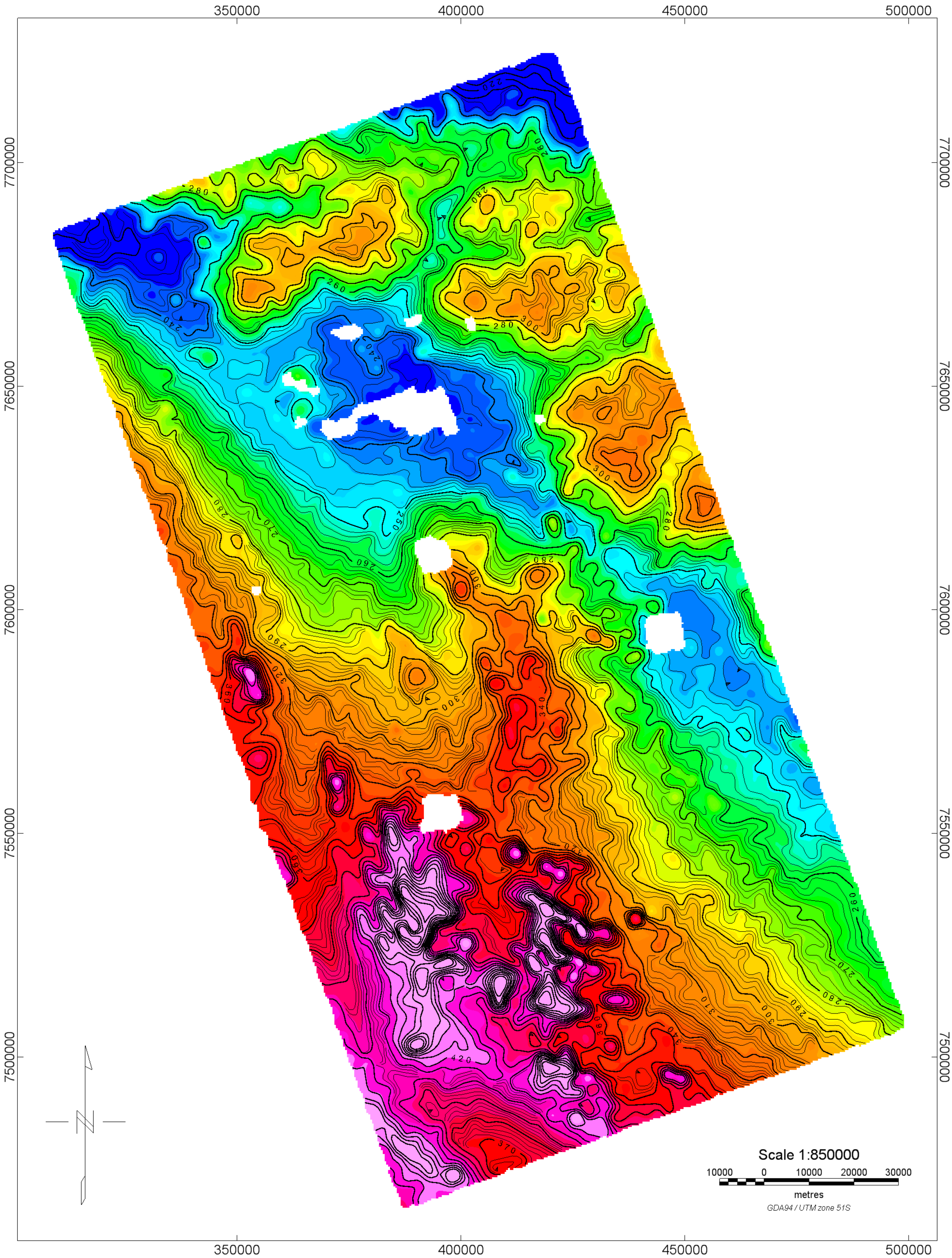
PATERSON GRAVITY SURVEY
Plot of Gravity Station Locations
Gravity stations at 2500m x 2500m spacing

survey by Daishsat Geodetic Surveyors
August 2005 - October 2005 DSPROJECT 05003
www.daishsat.com

drawn by : LR Mathews



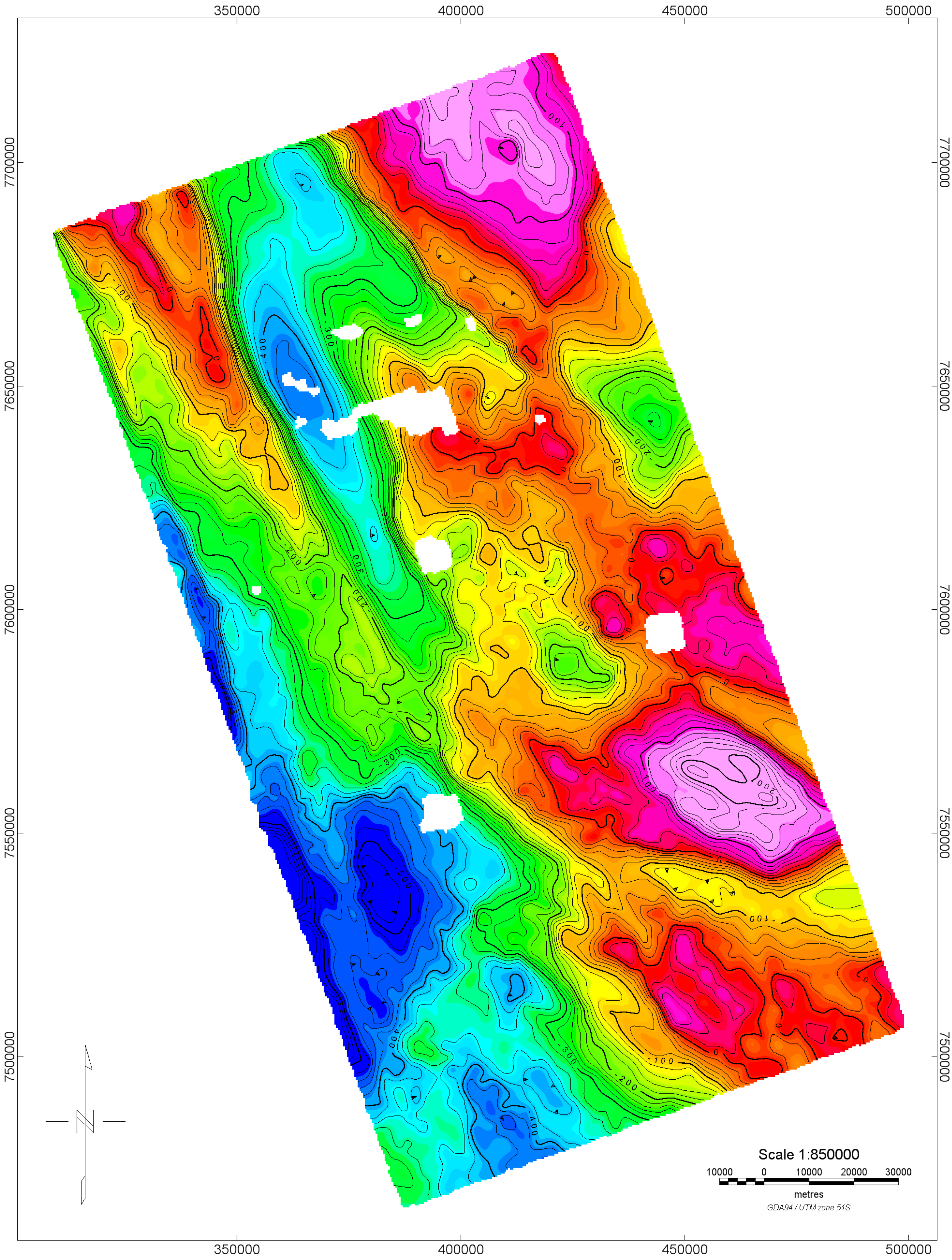
GPS Derived Elevation
(mAHD)
234.922 253.429 272.771 292.140 326.652 406.572

GEOSCIENCE AUSTRALIA PROJECT 200560

PATERSON GRAVITY SURVEY
Image of GPS Derived Elevation
Histogram Equalisation, Contour Interval 2m

Grid Cell Size 400m, Search Radius 4000m
survey by Daishsat Geodetic Surveyors
August 2005 - October 2005 DSPROJECT 05003
www.daishsat.com

drawn by : LR Mathews



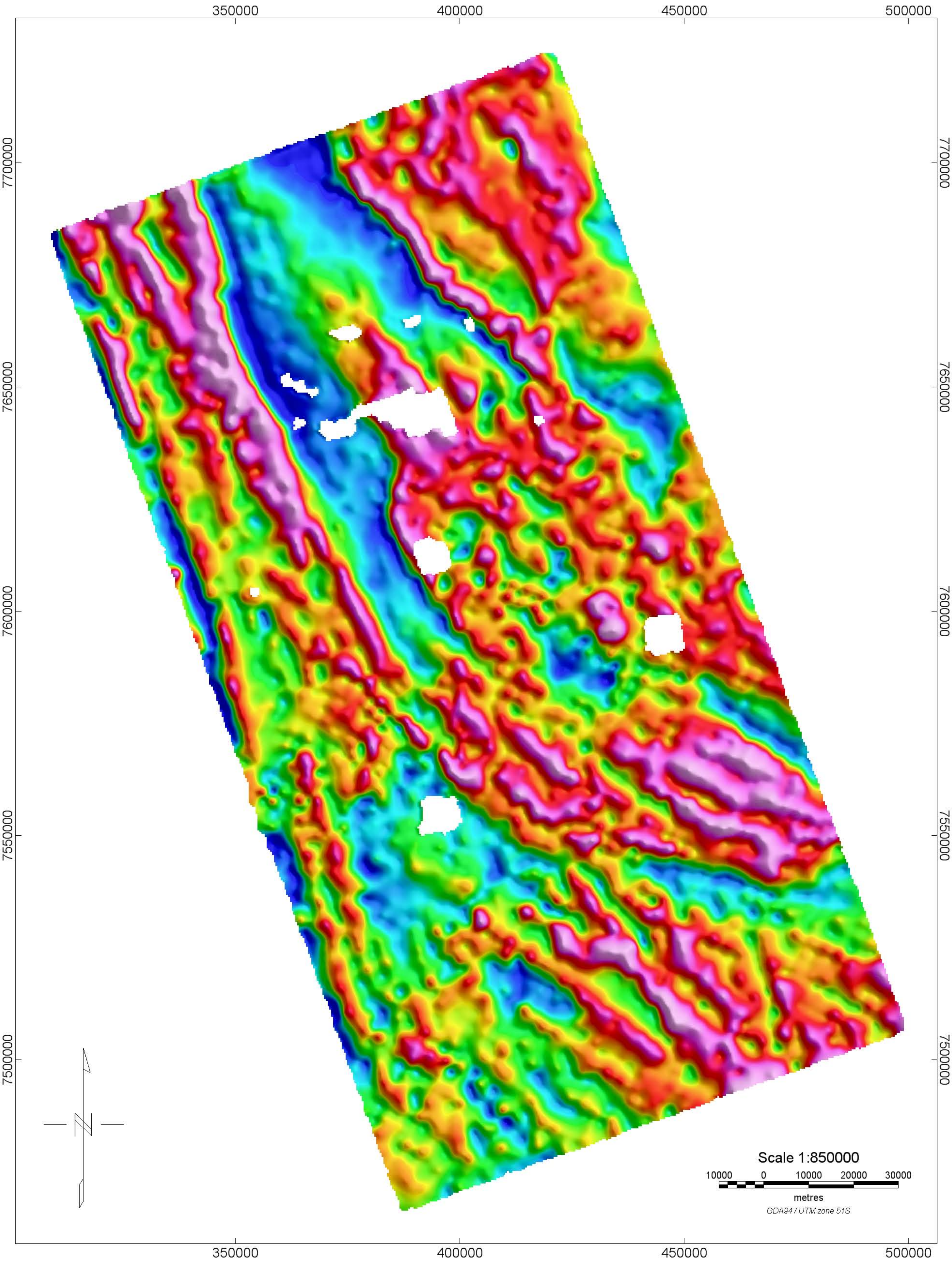
Complete Bouguer Anomaly 2.67 tm^3
(gu)
-472.113 -344.013 -210.699 -101.012 -22.172 72.447

GEOSCIENCE AUSTRALIA PROJECT 200560

PATERSON GRAVITY SURVEY
Image of Complete Bouguer Anomaly 2.67 tm^3
Histogram Equalisation, Contour Interval 20gu

Grid Cell Size 400m, Search Radius 4000m
survey by Daishsat Geodetic Surveyors
August 2005 - October 2005 DSPROJECT 05003
www.daishsat.com

drawn by : LR Mathews



1VD of Complete Bouguer Anomaly

-0.039 -0.016 -0.008 -0.001 0.003 0.008 0.012 0.019

GEOSCIENCE AUSTRALIA PROJECT 200560

PATERSON GRAVITY SURVEY
Image of 1VD of Complete Bouguer Anomaly tm^3
Histogram Equalisation, NE Sunshading

Grid Cell Size 400m, Search Radius 4000m
survey by Daishsat Geodetic Surveyors
August 2005 - October 2005 DSPROJECT 05003
www.daishsat.com

drawn by : LR Mathews

APPENDIX B
Repeat Listing and Analysis

STATION	dEAST (m)	dNORTH (m)	dAHD (m)	dOSBG84 (gu)	MGA51EAST	MGA51NORTH	DATE	AHD	TIME	OBSG84 (gu)	METER_SN
2005601010	0.438	-0.355	-0.008	0.347	439187.620	7619087.325	31/08/2005	265.977	11:36:05	9786735.160	408275
2005601010	0.498	0.500	0.158	-0.443	439187.680	7619088.180	08/09/2005	266.143	12:33:23	9786734.370	711410
2005601024	11.933	-5.824	0.019	-0.250	449657.821	7641632.610	31/08/2005	292.362	15:16:43	9786348.250	408275
2005601030	0.505	-1.786	0.185	-0.250	451758.980	7628583.960	31/08/2005	306.801	14:36:28	9786524.530	408275
2005601039	5.556	5.421	-0.186	-0.700	433623.047	7619733.458	31/08/2005	263.928	13:51:44	9786718.610	408275
2005601061	1.630	0.384	0.167	0.400	444129.920	7642149.992	31/08/2005	314.514	16:23:37	9786249.160	408275
2005601063	-11.308	4.899	0.035	0.670	448845.011	7643866.964	31/08/2005	302.706	15:22:08	9786295.730	408275
2005601090	-0.158	-3.909	0.070	0.630	429421.100	7623590.344	01/09/2005	275.300	07:08:53	9786685.500	408275
2005601120	0.357	-0.085	0.002	-1.030	435190.183	7652198.137	03/09/2005	291.048	14:11:51	9786317.490	711410
2005601137	0.172	0.211	0.116	-1.000	431177.072	7656054.976	03/09/2005	271.150	16:16:08	9786397.530	711410
2005601153	-0.170	0.934	-0.037	-0.760	425502.449	7627488.762	03/09/2005	273.033	12:38:11	9786676.050	711410
2005601183	0.195	-0.845	0.182	-0.120	436126.460	7679150.834	03/09/2005	296.708	15:20:19	9786243.630	711410
2005601204	-0.178	0.557	-0.065	0.513	427946.022	7657578.156	04/09/2005	268.496	06:44:09	9786409.910	711410
2005601204	0.275	-0.446	0.037	-0.147	427946.475	7657577.153	04/09/2005	268.598	11:12:22	9786409.250	711410
2005601242	-0.246	0.158	-0.010	-0.760	427220.516	7689280.939	04/09/2005	268.669	10:06:07	9786387.820	711410
2005601259	0.510	0.785	0.118	-0.550	417734.949	7723002.664	04/09/2005	189.237	15:47:48	9786409.380	711410
2005601266	0.262	-0.106	-0.027	-0.430	423723.567	7706410.477	04/09/2005	225.412	15:13:36	9786457.240	711410
2005601284	-0.058	-0.623	-0.040	-0.060	429266.738	7668620.104	04/09/2005	283.326	14:03:18	9786415.070	711410
2005601295	-1.524	-2.035	-0.075	-0.780	428959.251	7647183.344	04/09/2005	298.951	13:10:26	9786356.950	711410
2005601303	-0.854	-0.708	-0.062	0.243	420681.314	7662972.031	05/09/2005	294.082	06:45:55	9786403.050	711410
2005601303	0.373	0.080	-0.045	-0.567	420682.541	7662972.819	05/09/2005	294.099	10:42:48	9786402.240	711410
2005601317	1.002	-0.786	-0.037	0.020	420817.062	7692205.361	04/09/2005	292.031	16:55:34	9786414.250	711410
2005601351	-9.385	-4.455	0.046	-0.580	422669.684	7679536.241	05/09/2005	288.690	07:26:30	9786431.770	711410
2005601367	0.059	0.062	-0.174	-0.360	416940.758	7688154.440	05/09/2005	285.189	09:58:37	9786436.740	711410
2005601383	-0.248	1.345	-0.020	-0.280	408298.254	7719579.487	05/09/2005	212.817	14:38:03	9786429.220	711410
2005601394	0.346	0.395	-0.108	0.100	411217.716	7696733.951	05/09/2005	264.933	14:01:14	9786438.000	711410
2005601440	0.401	-0.082	0.123	-0.220	408008.998	7698204.861	05/09/2005	260.481	15:24:25	9786443.750	711410
2005601451	-0.113	-0.310	0.024	0.340	403541.813	7717785.477	06/09/2005	208.637	08:33:04	9786457.530	711410
2005601483	0.146	-0.103	0.085	0.720	421006.026	7646968.146	06/09/2005	281.015	06:31:55	9786534.450	711410
2005601514	0.503	-0.157	-0.162	0.270	409219.407	7680094.491	09/09/2005	267.268	07:40:02	9786421.210	711410
2005601543	0.177	1.953	-0.145	0.300	398468.848	7702684.083	09/09/2005	265.303	08:58:33	9786431.220	711410
2005601547	-0.253	-0.198	-0.063	-0.280	423497.580	7610763.295	08/09/2005	272.240	14:27:48	9786681.560	711410
2005601568	-0.066	0.273	-0.021	-0.090	455749.740	7617300.652	08/09/2005	282.989	16:33:27	9786707.150	711410
2005601585	-0.098	0.068	0.148	0.790	417415.244	7605910.591	18/09/2005	304.358	17:14:54	9786621.490	711410
2005601615	0.248	-0.074	-0.049	0.480	426023.018	7603706.511	20/09/2005	276.571	16:45:38	9786749.310	711410
2005601620	0.325	-0.478	-0.040	0.630	415447.679	7648012.175	09/09/2005	257.192	10:29:00	9786586.710	711410
2005601649	3.222	1.315	-0.183	-0.430	391815.939	7713701.508	09/09/2005	227.275	14:58:07	9786450.610	711410

STATION	dEAST (m)	dNORTH (m)	dAHD (m)	dOSBG84 (gu)	MGA51EAST	MGA51NORTH	DATE	AHD	TIME	OBSG84 (gu)	METER_SN
2005601666	0.063	-0.289	0.164	-0.040	403027.572	7675284.534	09/09/2005	289.405	13:50:28	9786340.010	711410
2005601697	0.120	0.302	-0.120	0.040	411723.284	7643641.083	10/09/2005	241.614	06:47:25	9786605.880	711410
2005601716	1.941	-3.367	-0.033	0.400	397139.668	7691570.202	09/09/2005	252.955	16:57:40	9786441.080	711410
2005601742	0.255	0.361	0.182	0.080	400686.318	7674323.173	10/09/2005	294.083	07:41:12	9786323.210	711410
2005601767	-0.739	0.100	-0.067	-0.230	395690.467	7680677.089	10/09/2005	266.540	09:52:43	9786344.730	711410
2005601803	-1.092	-1.671	-0.089	-0.450	401052.658	7658612.716	10/09/2005	255.303	13:27:33	9786418.400	711410
2005601829	-0.132	0.028	0.019	0.080	404596.984	7641369.112	10/09/2005	235.930	16:49:06	9786620.420	711410
2005601829	0.091	-0.287	-0.072	-0.220	404597.207	7641368.797	11/09/2005	235.839	06:42:10	9786620.120	711410
2005601853	-0.401	-0.218	0.009	-0.330	384363.528	7697729.599	10/09/2005	276.977	15:18:49	9786321.690	711410
2005601877	-0.337	0.435	-0.115	-0.220	392893.532	7666166.241	11/09/2005	262.662	07:25:31	9786252.190	711410
2005601923	0.227	-0.402	0.067	-0.460	385663.113	7679383.719	11/09/2005	277.817	09:38:45	9786111.620	711410
2005601939	-0.192	-0.400	-0.135	0.430	374882.199	7702113.762	11/09/2005	267.220	14:15:03	9786178.070	711410
2005601955	-0.210	0.162	-0.138	-0.260	385963.932	7663740.537	11/09/2005	245.382	13:17:36	9786290.320	711410
2005601973	-0.433	-0.561	-0.109	0.020	414064.638	7615234.994	11/09/2005	259.374	17:14:22	9786686.940	711410
2005601985	0.226	0.327	-0.089	-0.030	387553.920	7651149.718	11/09/2005	234.046	16:03:03	9786593.820	711410
2005601985	-0.134	-0.141	0.067	0.180	387553.560	7651149.250	06/10/2005	234.202	06:21:33	9786594.030	711410
2005602031	-0.933	-0.297	0.072	-0.300	389740.835	7638134.763	12/09/2005	240.779	06:50:40	9786664.670	711410
2005602072	0.019	0.003	0.013	0.690	374584.702	7672997.809	12/09/2005	267.899	10:03:29	9786150.100	711410
2005602085	-0.010	1.007	-0.169	-0.140	362100.042	7700274.345	12/09/2005	265.770	14:25:27	9785936.140	711410
2005602151	-0.607	0.209	-0.060	-0.280	372434.285	7664593.998	12/09/2005	237.869	16:38:59	9786286.560	711410
2005602161	-0.464	0.297	-0.156	0.230	367150.852	7686513.649	12/09/2005	273.882	16:09:18	9785996.280	711410
2005602179	-0.112	0.012	-0.012	-0.430	338660.308	7691908.517	13/09/2005	256.611	07:40:49	9786369.620	711410
2005602226	0.016	0.188	-0.096	0.260	350492.535	7688194.323	13/09/2005	252.689	09:02:17	9786084.370	711410
2005602252	-0.087	0.051	-0.034	0.010	349009.065	7684963.089	13/09/2005	250.067	14:27:47	9786108.470	711410
2005602268	-1.564	1.447	-0.111	-0.100	368607.539	7660179.767	13/09/2005	240.574	13:20:54	9786240.480	711410
2005602287	0.234	0.191	-0.144	-0.150	386911.740	7624084.325	13/09/2005	245.775	12:10:37	9786630.090	711410
2005602312	1.294	-1.105	0.076	0.070	367118.529	7656857.749	13/09/2005	246.964	16:36:12	9786193.950	711410
2005602328	0.133	0.345	-0.101	-0.490	347482.154	7681751.716	13/09/2005	249.601	15:36:42	9786156.910	711410
2005602368	-0.306	0.479	-0.088	0.510	371537.923	7637209.800	14/09/2005	241.235	07:04:52	9786307.160	711410
2005602380	-0.009	0.880	0.082	0.210	372502.935	7626897.167	14/09/2005	246.292	16:58:17	9786388.600	711410
2005602380	-0.097	-0.391	-0.025	0.420	372502.847	7626895.896	15/09/2005	246.185	16:26:02	9786388.810	711410
2005602399	-1.417	0.723	0.160	-0.360	355618.352	7674015.304	14/09/2005	298.634	15:33:17	9786007.160	711410
2005602439	-0.116	-0.058	-0.006	-0.280	312844.383	7674511.085	14/09/2005	256.436	12:40:31	9786242.170	711410
2005602509	0.305	0.501	-0.137	-0.580	356590.331	7663737.222	15/09/2005	251.631	07:03:37	9786128.070	711410
2005602529	-0.671	0.432	-0.100	0.050	361024.238	7641951.198	15/09/2005	247.501	15:33:11	9786322.940	711410
2005602550	-0.082	0.020	0.020	0.090	332042.707	7665521.537	15/09/2005	241.286	08:47:28	9786500.610	711410
2005602583	-0.164	-0.173	0.066	-0.110	336048.610	7661632.964	15/09/2005	243.793	13:18:24	9786525.070	711410
2005602611	-0.186	0.073	-0.162	-0.130	331003.016	7646551.839	17/09/2005	270.802	09:11:48	9786414.400	711410

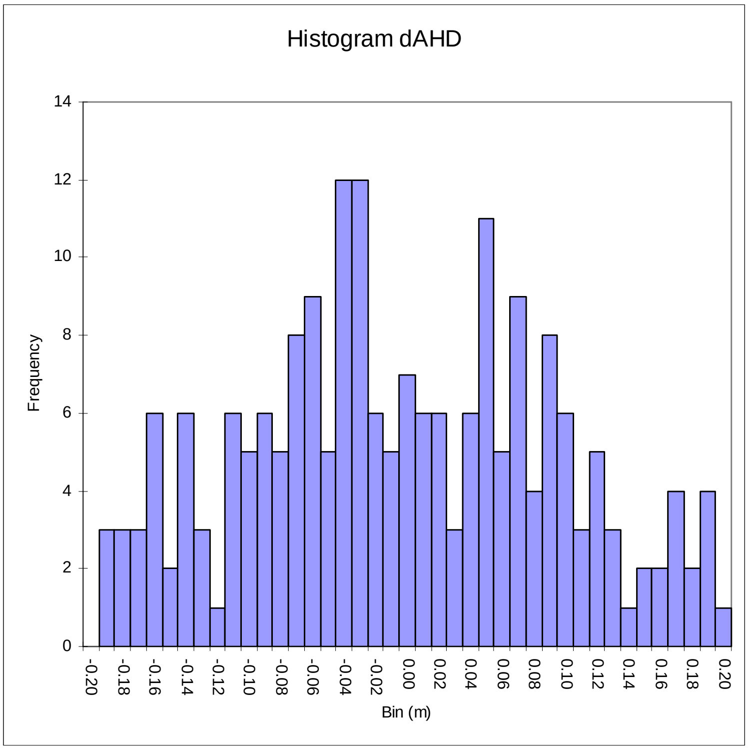
STATION	dEAST (m)	dNORTH (m)	dAHD (m)	dOSBG84 (gu)	MGA51EAST	MGA51NORTH	DATE	AHD	TIME	OBSG84 (gu)	METER_SN
2005602626	-0.349	1.525	-0.162	-0.230	351910.330	7662088.089	15/09/2005	260.112	14:57:36	9786171.910	711410
2005602650	0.484	-0.192	-0.079	-0.260	357005.043	7647894.062	17/09/2005	246.639	08:04:59	9786293.200	711410
2005602673	-2.972	-2.054	-0.078	-0.080	367106.782	7619759.291	17/09/2005	255.653	07:01:59	9786594.150	711410
2005602713	2.182	1.844	-0.069	-0.200	353811.805	7649464.517	17/09/2005	246.560	16:14:36	9786429.500	711410
2005602736	0.040	-0.050	0.124	-0.310	329775.895	7627481.742	17/09/2005	314.393	11:08:53	9786270.970	711410
2005602746	1.265	1.368	-0.056	0.490	339836.847	7607225.253	17/09/2005	322.056	12:51:26	9786250.900	711410
2005602771	-0.038	-0.034	-0.148	-0.150	338737.660	7617435.113	17/09/2005	301.045	14:58:30	9786343.100	711410
2005602791	0.270	0.280	0.163	-0.150	350820.448	7576942.001	19/09/2005	368.438	08:31:36	9786381.940	711410
2005602817	-0.326	0.018	-0.144	-0.360	340786.579	7634256.688	18/09/2005	275.901	09:27:03	9786459.770	711410
2005602836	-0.050	0.021	-0.087	0.013	355721.521	7636778.247	18/09/2005	246.434	07:20:26	9786591.590	711410
2005602836	0.241	0.111	0.111	0.033	355721.812	7636778.337	18/09/2005	246.632	08:50:02	9786591.610	711410
2005602856	-0.035	0.098	0.186	0.250	360122.651	7617088.110	18/09/2005	266.773	14:17:25	9786584.400	711410
2005602923	-0.705	0.834	0.098	0.470	345758.721	7619957.684	18/09/2005	284.272	13:28:25	9786438.520	711410
2005602974	0.459	0.940	-0.034	0.000	362709.876	7610120.457	18/09/2005	272.087	15:37:34	9786568.430	711410
2005602981	-0.017	0.294	-0.033	0.410	361155.761	7606967.861	19/09/2005	276.059	07:15:08	9786581.660	711410
2005603026	0.134	0.118	-0.149	-0.260	376285.111	7601733.379	19/09/2005	277.149	10:49:40	9786652.600	711410
2005603041	-0.312	0.213	-0.180	0.020	348706.251	7597148.168	19/09/2005	341.483	09:58:50	9786364.900	711410
2005603064	-0.197	1.297	0.031	0.530	357128.531	7573600.011	19/09/2005	335.649	14:25:29	9786487.310	711410
2005603077	-0.270	-0.155	0.088	0.570	359083.999	7598231.873	19/09/2005	290.355	13:29:35	9786534.520	711410
2005603104	-0.100	0.106	0.009	0.080	395356.424	7600727.867	19/09/2005	278.340	17:09:01	9786587.410	711410
2005603114	-3.283	-0.473	-0.048	0.140	373384.088	7595335.343	19/09/2005	280.060	16:20:41	9786663.410	711410
2005603142	0.128	0.157	0.065	-0.180	363595.169	7570647.700	20/09/2005	321.010	07:36:48	9786555.140	711410
2005603167	-0.006	0.193	0.056	-0.100	371743.315	7592112.688	20/09/2005	287.873	06:54:01	9786648.260	711410
2005603193	1.491	-0.657	0.002	-0.370	382860.265	7590623.298	20/09/2005	287.488	09:55:26	9786685.910	711410
2005603268	0.159	0.006	-0.196	-0.110	397808.056	7593691.261	28/09/2005	286.436	05:50:00	9786627.090	711410
2005603283	-0.448	0.076	0.100	-0.010	436390.180	7604763.185	20/09/2005	251.424	16:30:09	9786840.760	711410
2005603297	-0.116	0.289	-0.141	-0.520	463283.197	7603839.637	20/09/2005	262.929	15:30:57	9786817.280	711410
2005603309	-0.042	-0.157	-0.049	0.082	470220.794	7577088.389	21/09/2005	242.492	08:46:14	9786984.350	711410
2005603309	0.041	0.016	0.104	0.383	470220.877	7577088.562	21/09/2005	242.645	11:35:39	9786984.650	711410
2005603309	0.024	0.093	-0.051	-0.328	470220.861	7577088.639	30/09/2005	242.491	11:13:58	9786983.940	711410
2005603325	-0.223	-0.154	0.092	0.500	453644.926	7608344.695	21/09/2005	248.361	07:41:52	9786860.430	711410
2005603336	-0.079	0.236	-0.007	-0.120	426976.837	7601323.857	21/09/2005	266.155	06:51:51	9786795.370	711410
2005603351	-1.923	-0.221	0.047	0.110	430091.409	7599907.990	25/09/2005	268.205	13:15:53	9786874.480	711410
2005603366	-0.062	0.002	0.173	0.190	459403.238	7599877.473	25/09/2005	246.175	14:27:25	9786950.760	711410
2005603381	0.141	0.007	-0.017	-0.460	476809.384	7566190.733	21/09/2005	252.609	11:15:30	9787020.150	711410
2005603411	-0.475	-0.166	-0.037	-0.890	473513.403	7567731.147	26/09/2005	248.410	14:39:51	9787030.760	711410
2005603419	-0.162	0.297	0.062	0.020	362050.597	7538181.411	24/09/2005	364.226	07:00:56	9786414.060	711410
2005603454	0.165	-0.167	0.008	-0.070	386380.191	7477724.695	24/09/2005	430.033	08:48:51	9786909.480	711410

STATION	dEAST (m)	dNORTH (m)	dAHD (m)	dOSBG84 (gu)	MGA51EAST	MGA51NORTH	DATE	AHD	TIME	OBSG84 (gu)	METER_SN
2005603469	0.019	-0.054	0.090	-0.210	373644.472	7513214.124	24/09/2005	390.214	07:43:13	9786627.490	711410
2005603470	1.532	-1.521	0.114	0.074	383895.277	7563597.473	25/09/2005	323.238	11:23:00	9786604.890	711410
2005603470	-3.128	4.750	-0.033	-0.586	383890.617	7563603.744	26/09/2005	323.091	06:05:07	9786604.230	711410
2005603470	2.912	-1.047	-0.004	0.004	383896.657	7563597.947	27/09/2005	323.120	06:00:42	9786604.820	711410
2005603470	-3.410	-1.408	-0.042	0.314	383890.335	7563597.586	05/10/2005	323.082	06:07:09	9786605.130	711410
2005603473	-0.445	1.365	0.082	-0.070	377587.968	7546405.956	24/09/2005	368.543	11:41:27	9786453.280	711410
2005603494	-0.194	1.300	-0.160	0.730	378543.980	7506898.521	24/09/2005	397.345	10:24:33	9786692.320	711410
2005603551	-1.971	-1.445	-0.079	-0.500	372616.096	7531377.463	25/09/2005	385.618	10:33:52	9786546.230	711410
2005603566	-0.174	-0.162	0.095	0.070	387468.547	7496697.641	25/09/2005	404.430	09:36:13	9786787.220	711410
2005603585	-0.201	0.273	-0.040	-0.520	412382.181	7479323.223	05/10/2005	370.212	07:59:05	9786923.380	711410
2005603597	0.028	0.207	-0.011	0.370	393176.982	7488433.196	26/09/2005	386.335	08:10:16	9786911.920	711410
2005603615	0.127	-0.195	-0.016	0.020	376350.382	7527492.701	26/09/2005	408.866	06:51:11	9786547.510	711410
2005603624	0.080	-0.283	-0.097	-0.840	381680.331	7542428.415	26/09/2005	390.619	06:19:58	9786405.280	711410
2005603637	-0.221	-0.212	0.071	-0.090	430958.956	7597521.287	25/09/2005	271.526	17:06:01	9786854.230	711410
2005603669	0.315	0.037	0.047	0.060	453300.442	7586989.904	25/09/2005	244.974	16:20:33	9786985.350	711410
2005603691	-2.123	2.714	-0.118	-0.520	442177.063	7588259.313	26/09/2005	247.638	13:28:32	9786915.780	711410
2005603707	0.185	0.541	-0.050	0.120	410683.110	7587513.620	27/09/2005	325.698	12:14:27	9786699.020	711410
2005603707	0.173	0.589	0.047	-0.010	410683.098	7587513.668	27/09/2005	325.795	17:30:09	9786698.890	711410
2005603707	-0.256	-1.385	-0.082	-0.060	410682.669	7587511.694	02/10/2005	325.666	17:06:02	9786698.840	711410
2005603737	0.101	-1.210	0.094	0.080	394813.037	7491467.447	26/09/2005	392.496	09:33:00	9786874.880	711410
2005603759	-0.024	-0.042	-0.048	-0.370	396287.081	7494819.989	27/09/2005	407.820	07:58:30	9786814.920	711410
2005603786	-0.002	-0.245	0.040	-0.140	420987.773	7588708.388	26/09/2005	297.136	17:32:47	9786637.300	711410
2005603803	0.056	0.095	-0.119	-0.100	450381.023	7580519.896	26/09/2005	244.527	16:31:43	9787038.670	711410
2005603824	1.162	-0.487	0.071	0.290	477268.331	7550180.726	29/09/2005	250.114	07:49:46	9787291.360	711410
2005603835	-0.128	0.111	0.198	-0.410	464831.455	7569807.484	27/09/2005	248.682	14:16:38	9787175.770	711410
2005603857	0.560	0.187	0.067	0.060	429637.031	7586410.472	27/09/2005	273.714	12:48:42	9786722.250	711410
2005603887	0.182	0.203	0.147	0.410	395275.871	7504975.612	27/09/2005	440.682	09:34:41	9786708.950	711410
2005603901	2.127	0.555	0.105	0.420	415557.121	7485780.325	05/10/2005	391.230	08:59:52	9786856.530	711410
2005603912	-0.059	0.139	-0.199	-0.790	400941.072	7496423.209	28/09/2005	404.650	09:40:35	9786775.220	711410
2005603934	-0.131	0.078	-0.102	-0.260	385461.357	7546478.995	28/09/2005	438.859	08:05:02	9786341.940	711410
2005603941	-1.343	-0.698	-0.079	0.510	389247.307	7558566.393	28/09/2005	346.588	07:29:37	9786538.510	711410
2005603951	-0.005	-0.480	0.056	0.120	430500.169	7584116.246	27/09/2005	279.133	16:53:43	9786724.100	711410
2005603965	0.097	0.221	-0.062	0.370	455237.558	7574370.811	27/09/2005	250.245	15:48:34	9787122.140	711410
2005603980	0.381	0.250	0.083	0.690	470138.781	7547826.306	28/09/2005	256.205	14:56:30	9787323.660	711410
2005603998	-0.134	0.033	-0.076	0.720	445851.929	7571141.802	28/09/2005	261.446	13:53:17	9787116.980	711410
2005604033	-0.070	0.485	0.120	0.220	398594.180	7562019.150	28/09/2005	325.887	11:50:53	9786744.410	711410
2005604050	1.179	0.912	-0.002	0.140	392117.467	7535710.658	28/09/2005	487.733	11:01:28	9786316.790	711410
2005604060	3.543	-0.342	-0.025	0.170	397424.631	7513730.827	28/09/2005	423.806	10:30:39	9786695.850	711410

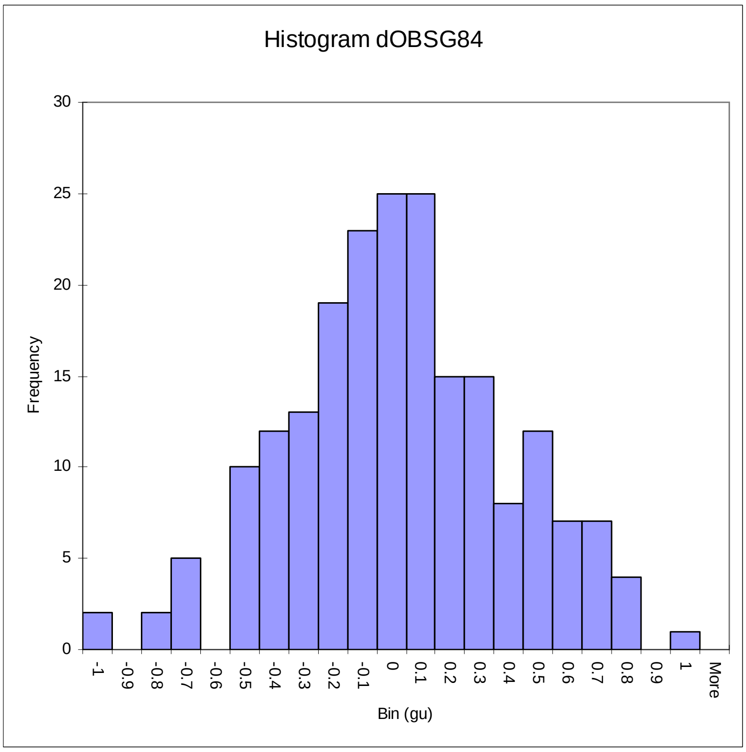
STATION	dEAST (m)	dNORTH (m)	dAHD (m)	dOSBG84 (gu)	MGA51EAST	MGA51NORTH	DATE	AHD	TIME	OBSG84 (gu)	METER_SN
2005604076	-1.412	0.280	0.201	0.500	403970.591	7502885.353	05/10/2005	413.129	07:24:47	9786763.650	711410
2005604118	0.478	-0.817	0.081	-0.080	439481.785	7574168.570	28/09/2005	269.205	16:20:28	9787012.040	711410
2005604129	0.121	-0.169	-0.043	-0.350	454712.505	7561048.287	28/09/2005	257.590	15:40:59	9787297.100	711410
2005604149	-0.204	1.034	-0.077	-0.130	453235.353	7557713.649	29/09/2005	261.046	06:53:47	9787253.220	711410
2005604166	-1.216	-2.622	0.026	-0.150	428259.186	7575438.402	29/09/2005	296.463	17:00:18	9786855.050	711410
2005604184	-0.086	0.012	0.049	0.680	441366.837	7561361.573	29/09/2005	278.523	10:35:11	9787146.170	711410
2005604200	-0.175	0.088	-0.185	0.090	463786.007	7542938.004	29/09/2005	271.235	09:37:59	9787194.320	711410
2005604261	-0.103	0.175	0.012	-0.060	440675.549	7555915.640	29/09/2005	280.554	13:53:34	9787122.770	711410
2005604261	-0.301	-0.095	0.020	0.250	440675.351	7555915.370	29/09/2005	280.562	14:59:35	9787123.080	711410
2005604283	0.444	-0.087	0.022	-0.100	448952.623	7540245.650	29/09/2005	283.295	14:18:42	9787038.170	711410
2005604283	0.423	0.204	0.052	0.220	448952.602	7540245.941	30/09/2005	283.325	07:55:24	9787038.490	711410
2005604299	0.769	0.514	0.084	-0.010	442532.993	7543344.828	29/09/2005	285.176	15:45:14	9787033.200	711410
2005604319	-0.705	0.217	0.094	-0.060	439583.232	7536855.991	30/09/2005	293.994	07:23:48	9787090.700	711410
2005604336	0.771	-0.884	-0.005	0.170	423655.472	7573621.142	01/10/2005	313.974	16:50:07	9786840.420	711410
2005604336	-0.512	0.529	0.000	-0.480	423654.189	7573622.555	02/10/2005	313.979	06:04:10	9786839.770	711410
2005604353	0.146	-0.032	-0.035	-0.020	438031.818	7533652.161	01/10/2005	308.103	10:30:31	9787094.100	711410
2005604353	0.153	-0.088	-0.066	0.340	438031.825	7533652.105	02/10/2005	308.072	06:58:48	9787094.460	711410
2005604364	-0.079	0.193	0.031	0.250	460843.384	7536563.685	30/09/2005	278.800	09:07:54	9787073.160	711410
2005604364	-0.004	0.003	-0.062	-0.430	460843.459	7536563.495	01/10/2005	278.707	06:44:06	9787072.480	711410
2005604399	0.210	-0.082	-0.164	0.230	477859.725	7526717.379	30/09/2005	274.822	12:33:39	9787191.260	711410
2005604415	0.178	-0.003	0.044	-0.090	481891.701	7522706.887	30/09/2005	269.791	14:46:12	9787248.020	711410
2005604466	-0.233	-0.114	-0.021	0.140	481034.318	7517431.679	01/10/2005	276.421	07:51:48	9787286.490	711410
2005604485	0.049	-0.282	0.121	0.180	450686.039	7535688.228	01/10/2005	292.387	09:56:37	9787068.010	711410
2005604500	-0.256	0.327	-0.125	-0.140	463145.392	7516092.755	01/10/2005	297.006	09:17:54	9787288.620	711410
2005604515	0.406	0.102	0.170	0.560	481523.343	7501467.442	01/10/2005	299.411	14:21:39	9787372.560	711410
2005604528	0.351	-0.203	0.050	0.120	461548.922	7513042.058	01/10/2005	301.620	13:37:54	9787316.400	711410
2005604554	-0.024	0.179	-0.109	-0.180	428186.788	7546059.031	02/10/2005	313.208	06:47:43	9787014.500	711410
2005604554	-0.132	0.199	0.043	0.020	428186.680	7546059.051	02/10/2005	313.360	10:21:59	9787014.700	711410
2005604563	0.259	0.052	-0.044	0.580	435853.961	7524838.905	02/10/2005	330.806	10:09:34	9787194.360	711410
2005604582	-0.083	-0.828	-0.172	-0.130	466871.836	7512076.455	01/10/2005	300.220	15:34:11	9787300.330	711410
2005604604	-0.206	0.609	-0.069	-0.060	472192.734	7498121.364	02/10/2005	314.175	08:31:30	9787337.210	711410
2005604621	-0.027	-0.110	0.133	-0.530	451712.701	7525238.968	02/10/2005	301.329	07:15:54	9787244.480	711410
2005604647	-0.621	-0.373	0.046	-0.190	459234.251	7504075.655	02/10/2005	316.780	08:57:53	9787348.880	711410
2005604672	-0.193	-0.417	-0.191	-0.060	446986.509	7523585.769	02/10/2005	307.614	13:29:20	9787236.320	711410
2005604688	0.299	-0.273	0.051	-0.120	417509.383	7568753.967	02/10/2005	334.268	16:33:47	9786918.470	711410
2005604724	-6.837	-4.846	0.106	0.690	448299.330	7497514.491	03/10/2005	359.876	07:55:40	9787143.770	711410
2005604780	-0.821	-0.920	0.067	0.247	420317.907	7545956.788	03/10/2005	340.661	10:42:56	9786855.500	711410
2005604780	-0.639	-0.489	-0.033	-0.493	420318.089	7545957.219	03/10/2005	340.561	12:30:05	9786854.760	711410

STATION	dEAST (m)	dNORTH (m)	dAHD (m)	dOSBG84 (gu)	MGA51EAST	MGA51NORTH	DATE	AHD	TIME	OBSG84 (gu)	METER_SN
2005604837	0.317	-0.447	-0.150	-0.300	436958.339	7506772.950	03/10/2005	338.041	13:44:10	9787163.560	711410
2005604840	-0.034	-0.116	-0.055	-0.380	429829.620	7512028.645	03/10/2005	357.363	13:31:50	9787055.820	711410
2005604854	0.279	0.381	-0.014	0.110	413417.893	7564702.245	03/10/2005	351.545	11:58:17	9786865.150	711410
2005604856	-0.023	0.159	-0.031	-0.380	404785.178	7574837.247	04/10/2005	316.399	17:19:07	9786852.600	711410
2005604866	1.113	-0.398	0.064	-0.240	418018.301	7544960.119	03/10/2005	374.032	16:00:36	9786726.650	711410
2005604881	-0.611	0.482	0.043	-0.020	427463.072	7511228.876	03/10/2005	424.612	15:07:36	9786862.250	711410
2005604881	0.034	0.145	0.045	0.160	427463.717	7511228.539	04/10/2005	424.614	08:18:45	9786862.430	711410
2005604886	0.144	-0.312	-0.035	-0.157	436447.766	7501202.776	03/10/2005	339.265	14:49:52	9787127.110	711410
2005604886	-0.854	-0.159	0.036	0.283	436446.768	7501202.929	04/10/2005	339.336	08:42:47	9787127.550	711410
2005604914	2.436	1.295	-0.097	0.210	416688.042	7533579.609	04/10/2005	450.653	07:28:04	9786635.970	711410
2005604935	-0.047	0.112	0.058	-0.267	408399.280	7578873.512	04/10/2005	332.504	06:06:18	9786762.850	711410
2005604935	0.084	-0.148	-0.052	0.113	408399.411	7578873.252	04/10/2005	332.394	11:30:37	9786763.230	711410
2005604956	1.777	0.694	-0.097	0.910	412551.349	7545738.984	04/10/2005	428.128	11:01:22	9786552.670	711410
2005605004	-1.912	0.949	-0.115	-0.070	417739.663	7515786.027	04/10/2005	461.092	13:17:22	9786596.640	711410
2005605038	-0.091	0.004	-0.092	-0.320	413847.466	7519711.120	04/10/2005	394.700	16:11:34	9786685.720	711410
2005605175	0.082	-0.731	0.158	-0.170	405193.272	7528579.887	05/10/2005	373.803	13:39:51	9786750.470	711410

Histogram dAHD



Histogram dOBSG84



Summary Statistics

	dAHD (m)	*dOBSG (gu)*
Mean	-0.01	-0.02
Standard Error	0.01	0.03
Median	-0.02	-0.06
Mode	-0.04	-0.06
Standard Deviation	0.10	0.37
Sample Variance	0.01	0.14
Kurtosis	-0.74	-0.07
Skewness	0.10	0.00
Range	0.40	1.94
Minimum	-0.20	-1.03
Maximum	0.20	0.91
Sum	-1.81	-4.95
Count	205	205

APPENDIX C

Survey Metadata/Specifications

SURVEY NAME PATERSON 200560
START DATE 01/09/05
END DATE 06/10/05
OPERATORS GEOSCIENCE AUSTRALIA
CONTRACTOR DAISHSAT JOB05003
PROCESSOR DAISHSAT/LR MATHEWS
SOFTWARE GEOSOFT/CHRISDBF/ERMAPPER/INHOUSE
VESSEL BELL-47 HELICOPTER
GEODETIC DATUM GDA94
PROJECTION SUTM51/MGA51
HORIZONTAL ACCURACY 0.05M
LOCATION METHOD AUTONOMOUS GPS
GRAVITY STATION SPACING MIN 2500M
GRAVITY STATION SPACING MAX 2500M
NUMBER OF NEW STATIONS 4236
ELEVATION ACCURACY 0.1M
GRAVITY ACCURACY 0.370GU
TERRAIN CORRECTION RASTERTC
LAYOUT CELL CENTRE
EQUIPMENT 1*LEICA GPS500, 2*ASHTECH Z12, CG3 SN 408275,711410, CG5 24921, LR SN G80, G711
OBSERVERS DAVID DAISH, GRANT COOPES, ALAN COWIE, MATT INGALL
BASE TIE NEWMAN AFGN 9893.1602
GPS TIE AUSPOS CONNECTIONS OVER MULTIPLE DAYS

APPENDIX D

Base Station Information

GPS/Gravity Base 2005600006 – Rocky Ridge

MGA94

EASTING (m)	404 763.200
NORTHING (m)	7 607 182.520
ZONE (UTM)	51 South
HEIGHT (AHD, m)	289.262

GDA94

LATITUDE (DMS)	21 38 9.5124 S
LONGITUDE (DMS)	122 4 46.9504 E
GDAHT (m)	294.509
N (AUSGEOID98, m)	5.247

OBSERVED GRAVITY

9786619.088 gu ISOGAL84

SURVEYED BY

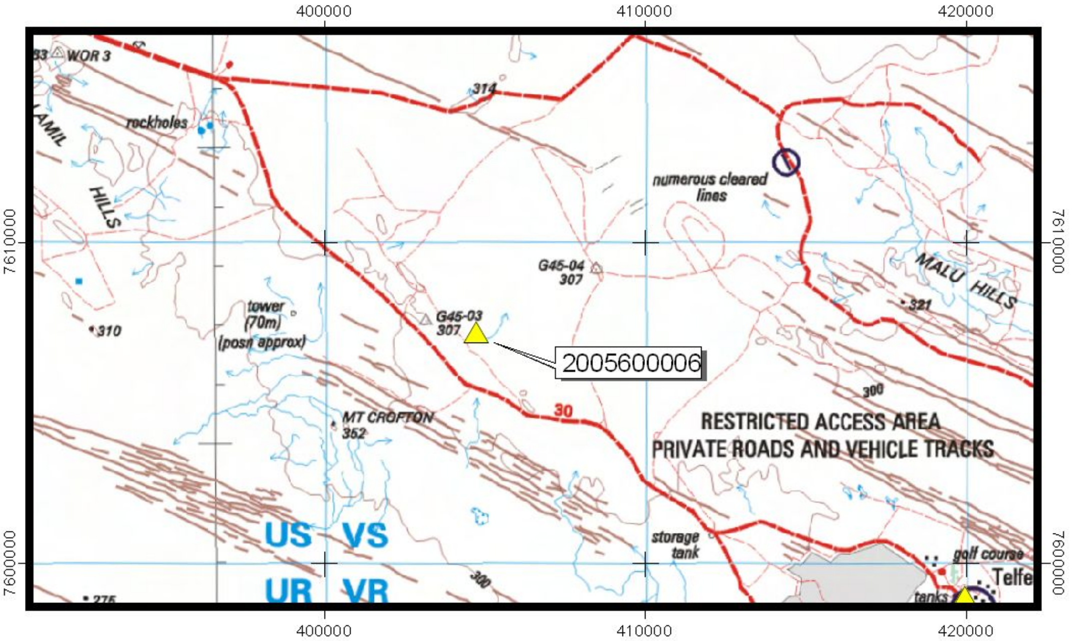
GPS - Daishsat using a multiple static sessions and the AUSPOS online GPS Processing system. Expected accuracy of station coordinates better than 0.005m.

Gravity – ABABA ties to primary base station 2005600106 at Telfer using two gravity meters. Expected accuracy better than 0.1gu.

MISCELLANEOUS DETAILS

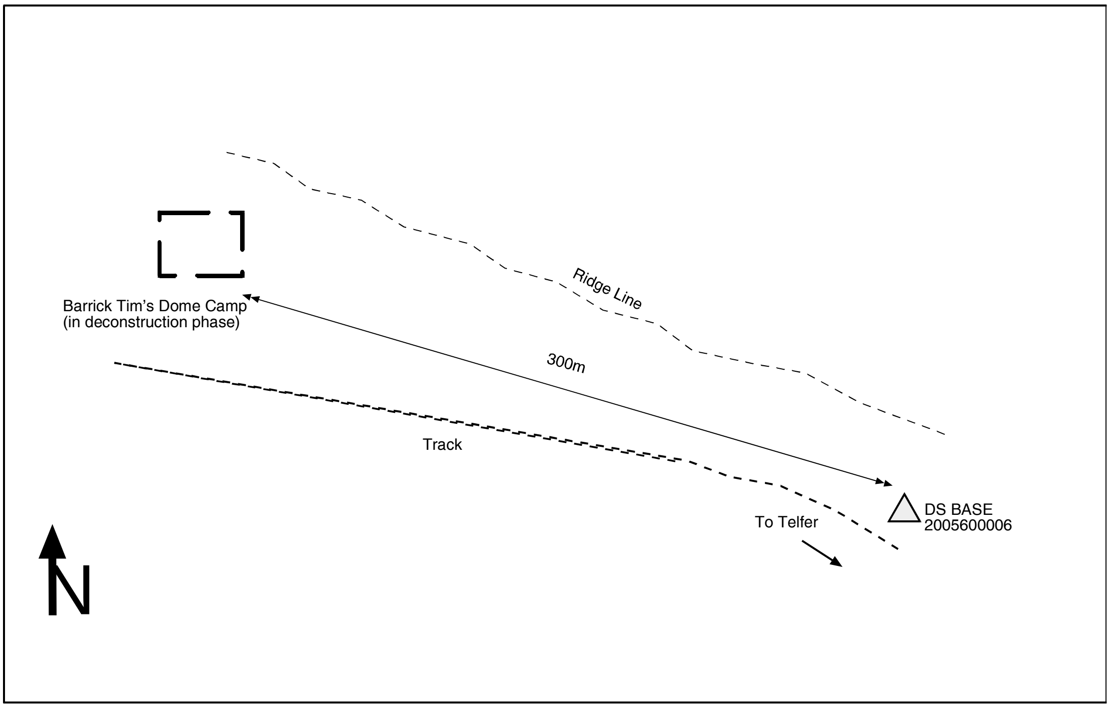
This station consists of a small star picket protruding approximately 150mm above ground level, and is witnessed by a large star picket with a Daishsat Witness Plate attached ~ 0.3m to the right The gravity station consists of a hexagonal shaped concrete monument opposite the star picket.

The station is located to the north of the haul road leading into the Telfer Gold Mine. 15km from the Telfer security gate along the haul road, an old Barrack exploration track heads to the North. This track then heads North-east for 2.5km. Located approximately 350m east of Tim's Dome Barrick Exploration Camp in a small gibber plain. The station can be accessed by taking the Barrack exploration track off to the left, when inbound (15km from) to the Telfer Mine. Following this track to the North-East will lead to a N-S ridge line, with the base station on the eastern side of this ridge.



Location Map

Base Station Photograph



Locality Sketch (not to scale)

GPS/Gravity Base 20056000106 – Telfer AS

MGA94

EASTING (m)	419 985.830
NORTHING (m)	7 598 963.626
ZONE (UTM)	51 South
HEIGHT (AHD, m)	294.213

GDA94

LATITUDE (DMS)	21 42 39.5126 S
LONGITUDE (DMS)	122 13 35.0447 E
GDAHT (m)	270.260
N (AUSGEOID98, m)	-23.953

OBSERVED GRAVITY

9786676.348 gu ISOGAL84

SURVEYED BY

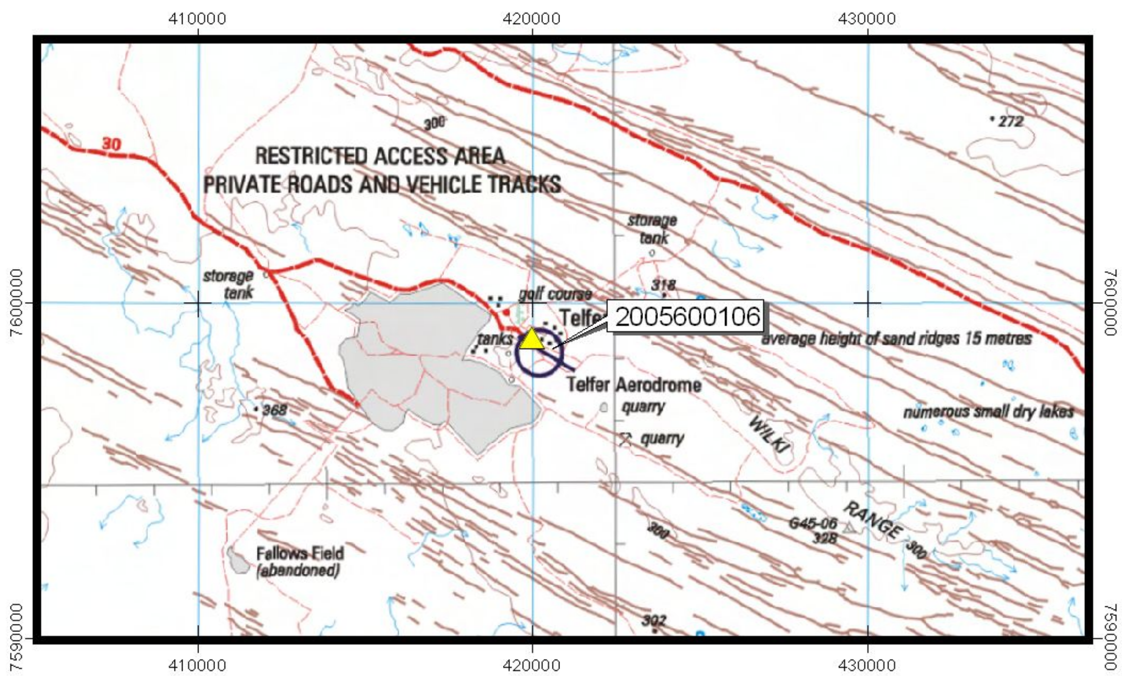
GPS - Daishsat using a single kinematic occupation. Coordinates for location only, coordinates not for geodetic use. Expected accuracy of station coordinates better than 0.2m.

Gravity – ABABA ties meters to the Newman AFGN station 9893.1602 with three meters. Expected accuracy better than 0.1gu.

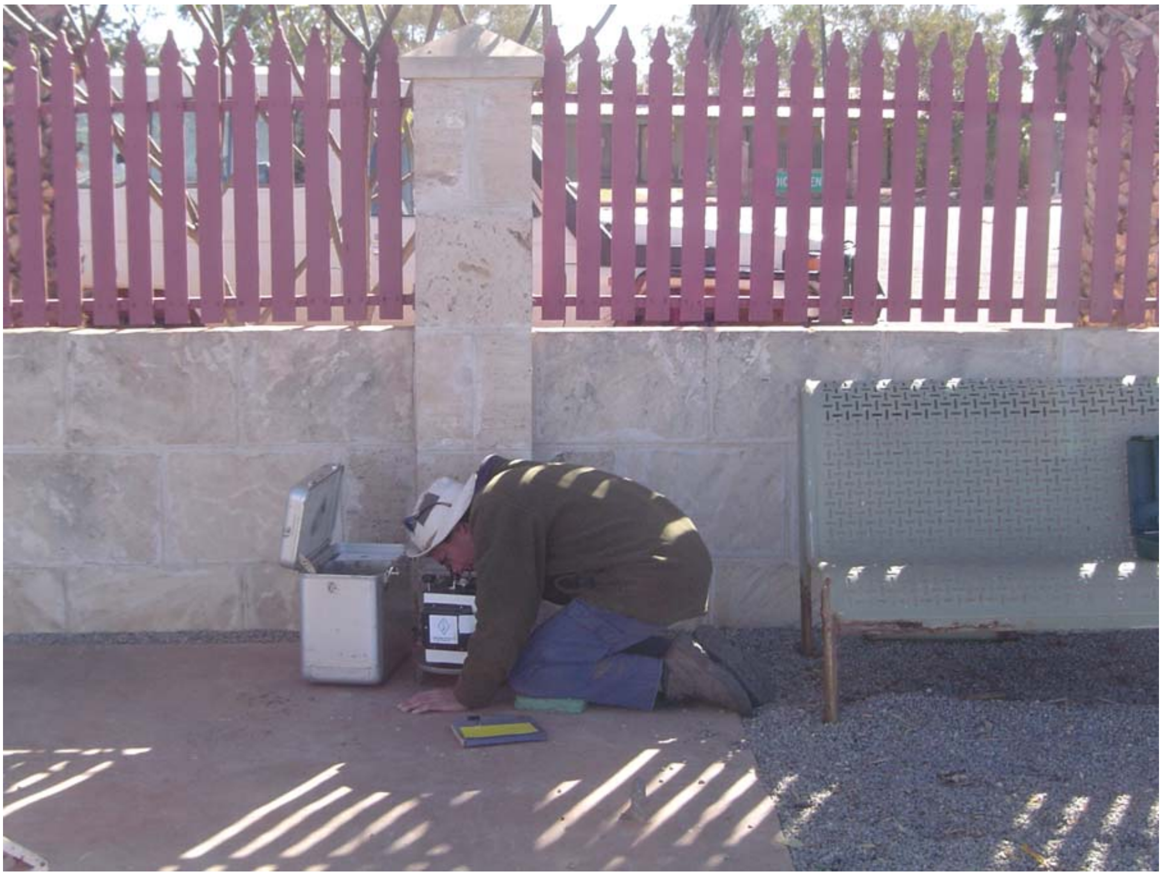
MISCELLANEOUS DETAILS

The base at Telfer Airport is located on a large concrete slab which is used to store the portable aircraft stairs on the side of the runway apron. It is marked by three drill holes in a triangle, approximately 200mm from the base of a sandstone wall pillar which separates the apron from the car park. The station sits 450mm to the east of the edge of the slab. A steel bench chair sits just west of the station. Access is through the gate leading onto the apron.

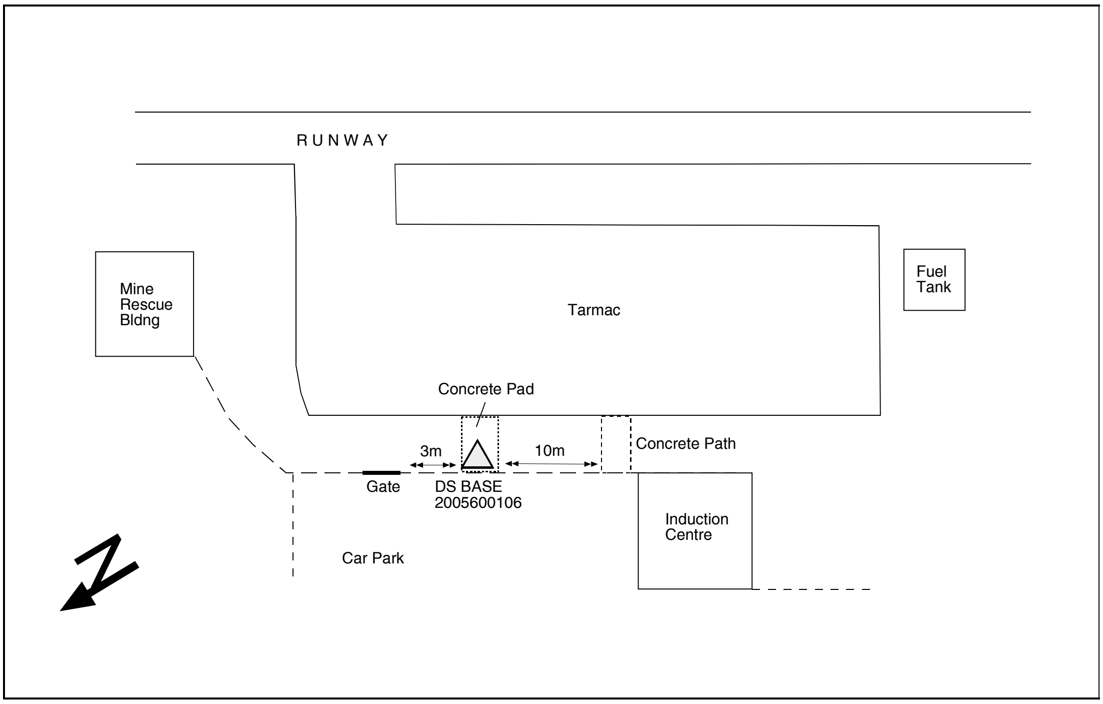
Note to access the Telfer Airstrip, a short induction is required and this can be gained from the Telfer gatehouse.



Location Map



Base Station Photograph



Locality Sketch (not to scale)

GPS Gravity Base 20056000101 – Yeneena Camp

MGA94

EASTING	384 402.755
NORTHING	7 563 620.695
ZONE	51
HEIGHT (AHD)	322.709

GDA94

LATITUDE	22 01 41.7534 S
LONGITUDE	121 52 47.7386 E
GDAHT	325.906

OBSERVED GRAVITY

9786602.290 gu ISOGAL84

SURVEYED BY

GPS - Daishsat using multiple static sessions and the AUSPOS online GPS Processing system. Expected accuracy of station coordinates better than 0.005m.

Gravity base tied to Daishsat Telfer base 20056000106 using an ABABA loop with one gravity meter.

MISCELLANEOUS DETAILS

This base is located within the Yeneena Exploration Camp. The station is marked by a steel star picket driven into the ground with about 20cm protruding; a centre punch marks the point. The station is witnessed with a 1.5m steel picket and Daishsat plaque located approximately 30cm south. Access to the camp is via unsealed road from Telfer mine.

Photo of GPS Gravity Base 20056000101 with distinguishing features in background

Gravity Base 102 – Field Base (West)

MGA94

EASTING	365 931.248
NORTHING	7 557 812.753
ZONE	51
HEIGHT (AHD)	333.708

GDA94

LATITUDE	22 4 45.847070 S
LONGITUDE	121 42 1.80834314 E
GDAHT	336.029

OBSERVED GRAVITY

9786579.100 gu ISOGAL84

SURVEYED BY

GPS - Daishsat using multiple kinematic sessions during field occupations. Field station only, coordinates not for geodetic use. Accuracy better than 0.2m x,y,z.

Gravity base tied to Yeneena base 20056000106 with multiple field occupations with two gravity meters.

MISCELLANEOUS DETAILS

This base is located west of the Yeneena Exploration Camp, approximately 4km west off the main track. The station is marked by a steel star picket driven into the ground with about 20cm protruding; a centre punch marks the point. The station is witnessed with a 1.5m steel picket and Daishsat plaque located approximately 30cm east.

Photo of Gravity base 20056000102 with distinguishing features in background.

Gravity Base 103 – Field Base (North)

MGA94

EASTING	385 769.826
NORTHING	7 573 777.765
ZONE	51
HEIGHT (AHD)	326.743

GDA94

LATITUDE	21 56 11.785551 S
LONGITUDE	121 53 37.978171 E
GDAHT	330.367

OBSERVED GRAVITY

97866264.300 gu ISOGAL84

SURVEYED BY

GPS - Daishsat using multiple kinematic sessions during field occupations. Field station only, coordinates not for geodetic use. Accuracy better than 0.2m x,y,z.

Gravity base tied to Yeneena base 20056000106 with multiple field occupations with two gravity meters.

MISCELLANEOUS DETAILS

This base is located on a hill approximately 11km to the north of the Yeneena Exploration Camp, approximately 200m east off the main track from Goosewhacker to the Rudall Track. The station is marked by a steel star picket driven into the ground with about 20cm protruding; a centre punch marks the point. The station is witnessed with a 1.5m steel picket and Daishsat plaque located approximately 30cm east.

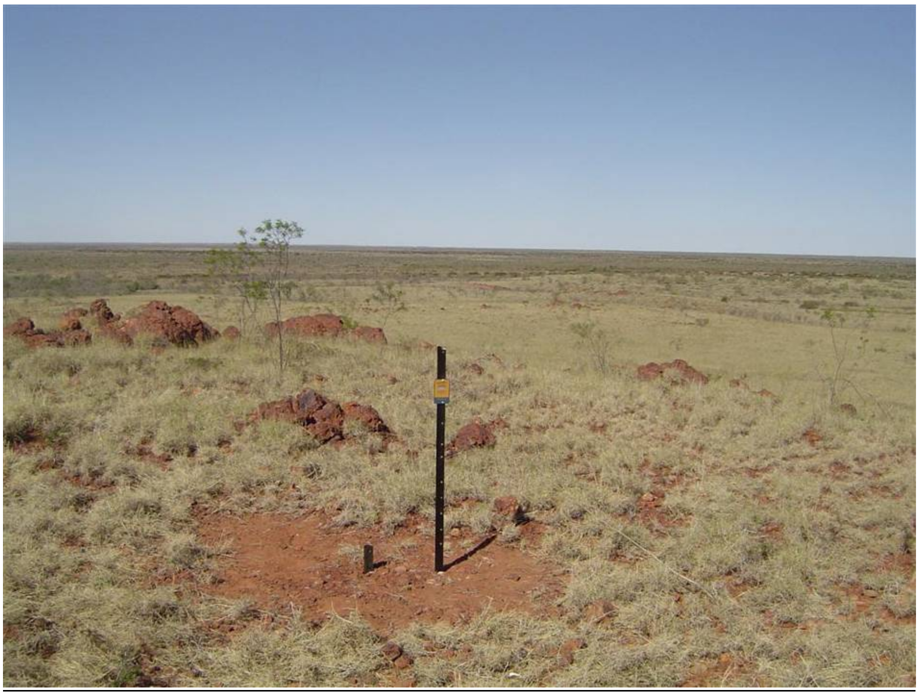


Photo of Gravity base 20056000103 with distinguishing features in background.

APPENDIX E

Data Formats

Data formats

- Raw field data supplied in .RAW Geosoft format. The files contain the dial reading in milliGals, as well as the GPS data in MGA51 coordinates, with heights expressed as AHD. Each file contains the acquisition date and meter serial number. Base station readings are flagged with a – sign.

```
Job:5003.   Line:0.      Oper:1.      CG3#:711410.
dt=2005/09/11 gm=-8.
     Stn           X            Y     Time      Rdng    In_Ht     Elev
      -6   404798.037  7607146.724 05:52:32  3332.571      0.0  289.343
       6   404798.029  7607146.729 05:53:48  3332.580      0.0  289.354
    1898   407399.364  7618259.266 06:07:03  3335.480      0.0  273.302
    1899   406618.296  7620572.161 06:10:34  3337.607      0.0  265.964
    1900   405869.422  7622980.587 06:13:46  3342.397      0.0  252.764
    1901   404753.576  7625445.519 06:17:59  3340.430      0.0  252.182
    1902   404037.137  7627787.674 06:21:23  3338.994      0.0  244.759
    1903   403264.682  7630097.029 06:24:37  3342.797      0.0  239.566
    1904   402404.225  7632395.356 06:27:41  3342.055      0.0  236.576
    1905   401444.797  7634845.331 06:30:59  3342.334      0.0  239.710
    1906   400852.661  7637336.346 06:34:07  3341.872      0.0  237.182
    1907   401079.321  7640020.126 06:37:53  3339.094      0.0  236.746
    1829   404597.207  7641368.797 06:42:10  3332.689      0.0  235.839
```

- Calibration data are presented as RAW files, as well as in a processed form in MS Excel format.

- GPS data supplied as RAW Ashtech Z12 carrier phase data in "b-files".

- Terrain correction data are presented as RASTERTC output, in comma delimited format. Note, all data are output in **milliGals**. Data headings are self explanatory.

- Final data supplied in a format specified by GA. See overleaf.

/ PROJECT 1-7 Length = 6 Decimal places = 0 Null Value = -99 Units = None Desc = GA Project Name I6
/ STATION 8-18 Length = 10 Decimal places = 0 Null Value = -99 Units = None Desc = GA Station Number I10
/ GDA94_LATITUDE_DD 19-31 Length = 12 Decimal places = 6 Null Value = -99 Units = Decimal Degrees Desc = Latitude GDA94 F12.6
/ GDA94_LONGITUDE_DD 32-44 Length = 12 Decimal places = 6 Null Value = -99 Units = Decimal Degrees Desc = Longitude GDA94 F12.6
/ MGA94_EAST_M 45-53 Length = 8 Decimal places = 1 Null Value = -99 Units = Metres Desc = Easting MGA94 F8.1
/ MGA94_NORTH_M 54-63 Length = 9 Decimal places = 1 Null Value = -99 Units = Metres Desc = Northing MGA94 F9.1
/ N_AUSGEOID98_M 64-72 Length = 8 Decimal places = 3 Null Value = -99 Units = Metres Desc = Geoid-Ellipsoid Separation using AUSGEOID98 F8.3
/ ELEVATION_GROUND_MAHD 73-81 Length = 8 Decimal places = 3 Null Value = -99 Units = Metres Desc = Station Elevation at Ground Level AHD F8.3
/ OBS84_GU 82-93 Length = 11 Decimal places = 3 Null Value = -99 Units = Gravity Units (micrometre/sec^2) Desc = Station Observed Gravity F11.3
/ HT_GRAVITY_METER_MAHD 94-102 Length = 8 Decimal places = 3 Null Value = -99 Units=Metres Desc = Station Height of Gravity Meter F8.3
/ INNER_TC_GU 103-109 Length = 6 Decimal places = 2 Null Value = -99 Units = Gravity Units (micrometre/sec^2) Desc = Inner Zone (<300m)) Terrain Correction F6.2
/ QF_INNER_TC_GU 110-113 Length = 3 Decimal places = 0 Null Value = -99 Units = None Desc = Quality Factor of Inner Zone Terrain Correction I3
/ ERROR_INNER_TC_GU 114-126 Length = 12 Decimal places = 10 Null Value = -99 Units = Gravity Units (micrometre/sec^2) Desc = Error in Inner Zone Terrain Correction F12.10
/ OUTER_TC_GU 127-133 Length = 6 Decimal places = 2 Null Value = -99 Units = Gravity Units (micrometre/sec^2) Desc = Outer Zone (300m-20000m) Terrain Correction F6.2
/ QF_OUTER_TC 134-137 Length = 3 Decimal places = 0 Null Value = -99 Units = None Desc = Quality Factor of Outer Zone Terrain Correction I3
/ TOTAL_TC_GU 138-144 Length = 6 Decimal places = 2 Null Value = -99 Units = Gravity Units (micrometre/sec^2) Desc = Total Terrain Correction Applied (Inner + Outer) F6.2
/ FAA_GU 145-154 Length = 9 Decimal places = 2 Null Value = -99 Units = Gravity Units (micrometre/sec^2) Desc = Free Air Anomaly F9.2
/ BA_GU 155-164 Length = 9 Decimal places = 2 Null Value = -99 Units = Gravity Units (micrometre/sec^2) Desc = Simple Bouguer Anomaly for a density of 2.6 tm^-3 F9.2
/ COMPLETE_BA_GU 165-174 Length = 9 Decimal places = 2 Null Value = -99 Units = Gravity Units (micrometre/sec^2) Desc = Complete Bouguer Anomaly for a density of 2.6 tm^-3 F9.2
/ HORIZONTAL_DIFF_M 175-183 Length = 8 Decimal places = 2 Null Value = -99 Units = Metres Desc = Horizontal Offset from pre-planned station F8.2
/ GRAVITY_BASE_REF 184-194 Length = 10 Decimal places = 0 Null Value = -99 Units = None Desc = Gravity base station referenced to I10
/ GPS_BASE_REF 195-205 Length = 10 Decimal places = 0 Null Value = -99 Units = None Desc = GPS base station referenced to I10
/ TIME 206-214 Length = 8 Decimal places = 0 Null Value = -99 Units = None Desc = Time of gravity observation NA
/ DATE 215-223 Length = 8 Decimal places = 0 Null Value = -99 Units = None Desc = Date of gravity observation NA
/ MGAZONE 224-227 Length = 3 Decimal places = 0 Null Value = -99 Units = None Desc = MGA Zone Number I3
/ GMTYPEGMSN 228-258 Length = 30 Decimal places = 0 Null Value = -99 Units = None Desc = Gravity Meter Type A30
/ STATION_DESC 259-289 Length = 30 Decimal places = 0 Null Value = -99 Units = None Desc = Description of station

APPENDIX F
Calibration Data

Calibration Data

2001 **Kensington Garden Station, SA 2001.9108**
208 **Norton Summit Station, SA 6091.0208**
1 **Mundaring Weir, WA 8909.0317**
2 **Mt Gungin, WA 7391.0217**

CALIBRATION PRE-SURVEY

24291

Station	Date	Ht	Long	Lat	Time	Rdng	ETC	OBSG84 (mGals)	Closure (mGals)	Meter
-2001	*	*	*		14:41:28	2663.947	-0.037	979698.526	-0.001	24921
2001	12/05/2005	111.620	138.6515	-34.9216	14:43:39	2663.946	-0.037	979698.525	-0.001	24921
208	12/05/2005	455.380	138.7267	-34.9250	15:13:55	2595.472	-0.040	979630.048	-0.001	24921
-2001	12/05/2005	111.620	138.6515	-34.9216	15:39:14	2663.953	-0.044	979698.526	-0.001	24921
-2001	12/05/2005	111.620	138.6515	-34.9216	15:39:14	2663.953	-0.044	979698.526	0.017	24921
208	12/05/2005	455.380	138.7267	-34.9250	16:06:01	2595.513	-0.049	979630.072	0.017	24921
-2001	12/05/2005	111.620	138.6515	-34.9216	16:30:11	2663.979	-0.053	979698.526	0.017	24921
-2001	12/05/2005	111.620	138.6515	-34.9216	16:30:11	2663.979	-0.053	979698.526	-0.013	24921
208	12/05/2005	455.380	138.7267	-34.9250	16:58:25	2595.526	-0.059	979630.074	-0.013	24921
2001	12/05/2005	111.620	138.6515	-34.9216	17:22:18	2663.976	-0.063	979698.526	-0.013	24921
-2001	*	*	*		17:22:18	2663.976	-0.063	979698.526	-0.013	24921
						AVG OBSG gu		**9796300.647**		

G711

Station	Date	Ht	Long	Lat	Time	Rdng	ETC	OBSG84 (mGals)	Closure (mGals)	Meter
-2001	10/05/2005	111.620	138.6515	-34.9216	09:44:00	3222.870	-0.066	979698.526	0.010	G711.
208	10/05/2005	455.380	138.7267	-34.9250	10:20:00	3155.660	-0.055	979630.114	0.010	G711.
-2001	10/05/2005	111.620	138.6515	-34.9216	10:47:00	3222.860	-0.046	979698.526	0.010	G711.
-2001	10/05/2005	111.620	138.6515	-34.9216	10:47:00	3222.860	-0.046	979698.526	0.047	G711.
208	10/05/2005	455.380	138.7267	-34.9250	12:15:00	3155.630	-0.022	979630.077	0.047	G711.
-2001	10/05/2005	111.620	138.6515	-34.9216	12:49:00	3222.880	-0.019	979698.526	0.047	G711.
						AVG OBSG gu		**9796300.955**		

G80

Station	Date	Ht	Long	Lat	Time	Rdng	ETC	OBSG84 (mGals)	Closure (mGals)	Meter
-2001	10/05/2005	111.620	138.6515	-34.9216	09:34:00	3197.730	-0.069	979698.526	0.011	G80.
208	10/05/2005	455.380	138.7267	-34.9250	10:15:00	3132.110	-0.056	979630.088	0.011	G80.
-2001	10/05/2005	111.620	138.6515	-34.9216	10:41:00	3197.720	-0.048	979698.526	0.011	G80.
-2001	10/05/2005	111.620	138.6515	-34.9216	10:41:00	3197.720	-0.048	979698.526	0.039	G80.
208	10/05/2005	455.380	138.7267	-34.9250	12:22:00	3132.080	-0.021	979630.056	0.039	G80.
-2001	10/05/2005	111.620	138.6515	-34.9216	12:45:00	3197.730	-0.019	979698.526	0.039	G80.
						AVG OBSG gu		**9796300.720**		

711410

Station	Date	Ht	Long	Lat	Time	Rdng	ETC	OBSG84 (mGals)	Closure (mGals)	Meter
-2001	*	*	*		14:32:01	4273.804	-0.071	979698.526	-0.004	711410
2001	31/05/2005	111.620	138.6515	-34.9216	14:35:02	4273.804	-0.070	979698.527	-0.004	711410
208	31/05/2005	455.380	138.7267	-34.9250	14:58:25	4205.369	-0.064	979630.100	-0.004	711410
-2001	31/05/2005	111.620	138.6515	-34.9216	15:20:08	4273.787	-0.057	979698.526	-0.004	711410
-2001	31/05/2005	111.620	138.6515	-34.9216	15:20:08	4273.787	-0.057	979698.526	0.010	711410
208	31/05/2005	455.380	138.7267	-34.9250	15:49:10	4205.347	-0.046	979630.091	0.010	711410
-2001	31/05/2005	111.620	138.6515	-34.9216	16:09:10	4273.777	-0.038	979698.526	0.010	711410
-2001	31/05/2005	111.620	138.6515	-34.9216	16:09:10	4273.777	-0.038	979698.526	-0.004	711410
208	31/05/2005	455.380	138.7267	-34.9250	16:31:40	4205.332	-0.027	979630.094	-0.004	711410
2001	31/05/2005	111.620	138.6515	-34.9216	16:51:39	4273.754	-0.018	979698.527	-0.004	711410
-2001	*	*	*		16:51:39	4273.753	-0.018	979698.526	-0.004	711410
						AVG OBSG gu		**9796300.950**		

408275

Station	Date	Ht	Long	Lat	Time	Rdng	ETC	OBSG84 (mGals)	Closure (mGals)	Meter
-2001	*	*	*		14:41:12	4241.605	-0.036	979698.526	0.005	408275
2001	12/05/2005	111.620	138.6515	-34.9216	14:43:46	4241.605	-0.036	979698.526	0.005	408275
208	12/05/2005	455.380	138.7267	-34.9250	15:13:12	4173.185	-0.035	979630.103	0.005	408275
-2001	*	*	*		15:38:14	4241.611	-0.037	979698.526	0.005	408275
-2001	*	*	*		15:38:14	4241.611	-0.037	979698.526	-0.003	408275
208	12/05/2005	455.380	138.7267	-34.9250	16:04:22	4173.165	-0.039	979630.079	-0.003	408275
2001	12/05/2005	111.620	138.6515	-34.9216	16:56:13	4241.618	-0.047	979698.525	-0.003	408275
-2001	*	*	*		16:59:33	4241.619	-0.047	979698.526	-0.003	408275
						AVG OBSG gu		**9796300.910**		

CALIBRATION POST-SURVEY

408275

Station	Date	Ht	Long	Lat	Time	Rdng	ETC	OBSG84 (mGals)	Closure (mGals)	Meter
-2001	19/10/2005	111.620	138.6515	-34.9216	14:39:04	4281.353	0.118	979698.526	-0.008	408275
2001	19/10/2005	111.620	138.6515	-34.9216	14:41:28	4281.353	0.117	979698.525	-0.008	408275
208	19/10/2005	455.380	138.7267	-34.9250	15:12:10	4212.956	0.094	979630.109	-0.008	408275
208	19/10/2005	455.380	138.7267	-34.9250	15:13:22	4212.952	0.093	979630.104	-0.008	408275
2001	19/10/2005	111.620	138.6515	-34.9216	15:39:11	4281.390	0.072	979698.524	-0.008	408275
-2001	19/10/2005	111.620	138.6515	-34.9216	15:41:22	4281.394	0.070	979698.526	-0.008	408275
-2001	19/10/2005	111.620	138.6515	-34.9216	15:41:22	4281.394	0.070	979698.526	0.000	408275
208	19/10/2005	455.380	138.7267	-34.9250	15:57:12	4212.995	0.055	979630.113	0.000	408275
208	19/10/2005	455.380	138.7267	-34.9250	16:00:08	4213.002	0.053	979630.117	0.000	408275
2001	19/10/2005	111.620	138.6515	-34.9216	16:19:41	4281.424	0.036	979698.522	0.000	408275
-2001	19/10/2005	111.620	138.6515	-34.9216	16:22:01	4281.430	0.033	979698.526	0.000	408275
-2001	19/10/2005	111.620	138.6515	-34.9216	16:22:01	4281.430	0.033	979698.526	-0.006	408275
208	19/10/2005	455.380	138.7267	-34.9250	16:38:12	4213.036	0.019	979630.120	-0.006	408275
208	19/10/2005	455.380	138.7267	-34.9250	16:41:11	4213.034	0.016	979630.116	-0.006	408275
2001	19/10/2005	111.620	138.6515	-34.9216	17:01:11	4281.455	-0.001	979698.523	-0.006	408275
-2001	19/10/2005	111.620	138.6515	-34.9216	17:03:32	4281.460	-0.003	979698.526	-0.006	408275
						AVG OBSG gu		**9796301.132**		

711410

Station	Date	Ht	Long	Lat	Time	Rdng	ETC	OBSG84 (mGals)	Closure (mGals)	Meter
-1	20/10/2005	115.000	31.9550	116.1600	10:36:31	4111.830	-0.093	979453.240	-0.012	711410
2	20/10/2005	398.200	31.9880	116.1270	10:59:28	4057.514	-0.092	979398.932	-0.012	711410
-1	20/10/2005	115.000	31.9550	116.1600	11:19:45	4111.815	-0.090	979453.240	-0.012	711410
-1	20/10/2005	115.000	31.9550	116.1600	11:19:45	4111.815	-0.090	979453.240	-0.034	711410
2	20/10/2005	398.200	31.9880	116.1270	11:40:19	4057.481	-0.087	979398.926	-0.034	711410
-1	20/10/2005	115.000	31.9550	116.1600	12:00:38	4111.775	-0.084	979453.240	-0.034	711410
-1	20/10/2005	115.000	31.9550	116.1600	12:00:38	4111.775	-0.084	979453.240	-0.034	711410
2	20/10/2005	398.200	31.9880	116.1270	12:20:55	4057.443	-0.080	979398.927	-0.034	711410
-1	20/10/2005	115.000	31.9550	116.1600	12:46:17	4111.731	-0.074	979453.240	-0.034	711410
						AVG OBSG gu		**9793989.283**		

APPENDIX G
Earth Tide Correction Formulae Listing

```
input dLat (latitude)
input dLon (longitude)
input dDate (date)
*Date broken down into year, month and date
input dTime (time)

array pClndr[12]={0,31,59,90,120,151,181,212,243,273,304,334}
lYr=year
lMo=month
lDa=day

ny=(lYr-1900)
days=(dTime/24.0+lDa-1+pClndr[lMo-1])
lLeap=(ny/4)
if(lLeap/2=ny and lMo<3)then lLeap=lLeap-1
lDay=(ny*365+lLeap+lDa+pClndr[lMo-1])
dcent = (ny*365.0+lLeap+days+0.5)/36525)
dhrs = (ny*365.0+lLeap+days+0.5)*24.0)
ds = (dcent*8399.709299+4.720023434+(dcent*dcent)*4.40696e-5)
dp=(dcent*71.01800936+5.835124713-(dcent*dcent)*1.80545e-4-dcent*2.1817e-
7*(dcent*dcent)
dh=(dcent*628.3319509+4.88162792+(dcent*dcent)*5.27962e-6)
doln=(4.523588564-dcent*33.757153303+(dcent*dcent)*3.6749e-5)
dps=(dcent*0.03000526416+4.908229461+(dcent*dcent)*7.902463e-6)
des=(0.01675104-dcent*4.18e-5-(dcent*dcent)*1.26e-7)
dsoln=(sin(doln))
dci=(0.91369-cos(doln)*0.03569)
dsi=(sqrt(1.0-(dci*dci))
dsn=(dsoln*0.08968/dsi)
dcn=(sqrt(1.0-(dsn*dsn))
dtit=(dsoln*0.39798/(dsi*cos(doln)*dcn+1.0dsoln*0.91739*dsn))
det=(atan(dtit)*2.0)
if (det<0.0)then det=det+6.2831852)

dolm1=(ds-doln+det+sin(ds-dp)*0.10979944)
dolm=(dolm1+sin((ds-dp)*2.0)*0.003767474+sin(ds-dh*2.0+dp)*0.0154002+sin((ds-
dh)*2.0)*0.00769395)
dha=((dTime*15.0-180)*0.0174532925199+dLon/57.295779513)
dchi=(dha+dh-atan(dsn/dcn))
dal=(dLat/57.295779513)
dct=(sin(dal)*dsi*sin(dolm)+cos(dal)*((dci+1.0)*cos(dolm-dchi)+(1.0-
dci)*cos(dolm+dchi))/2.0)
dda=(cos(ds-dp)*0.14325+2.60144+cos((ds-dp)*2.0)*0.0078644+cos(ds-
dh*2.0+dp)*0.0200918+cos((ds-dh)*2.0)*0.0146006)
dr=(6.378388/sqrt((1.0-((cos(dal)*cos(dal))*0.00676902+1.0)
r_1=(dda)
r_2=(dct)
r_3=(dr)
r_4=(dda)
r_5=(dda*dda)
r_6=(dct)
dgm=(dr80.49049*dda*(r_1*r_1)*((r_2*r_2)*3.0-1.0)+(r_3*r_3)*7.4e-
4*(r_5*r_5)*dct*((r_6*r_6)*5.0-3.0))
dols=(dh+des*2.0*sin(dh-dps))
dchis=(dha+dh)
dds=((des*cos(dh-dps)+1.0)*0.668881/(1.0-(des*des)))
dcf=(sin(dal)*0.39798*sin(dols)+cos(dal)*(cos(dols-
dchis)*0.95869+cos(dols+dchis)*0.0413))
dgs=(dr*13.2916*((dcf*dcf)*3.0-1.0)*dds*(dds*dds))

dTide = (dgm + dgs) * 0.00116
```