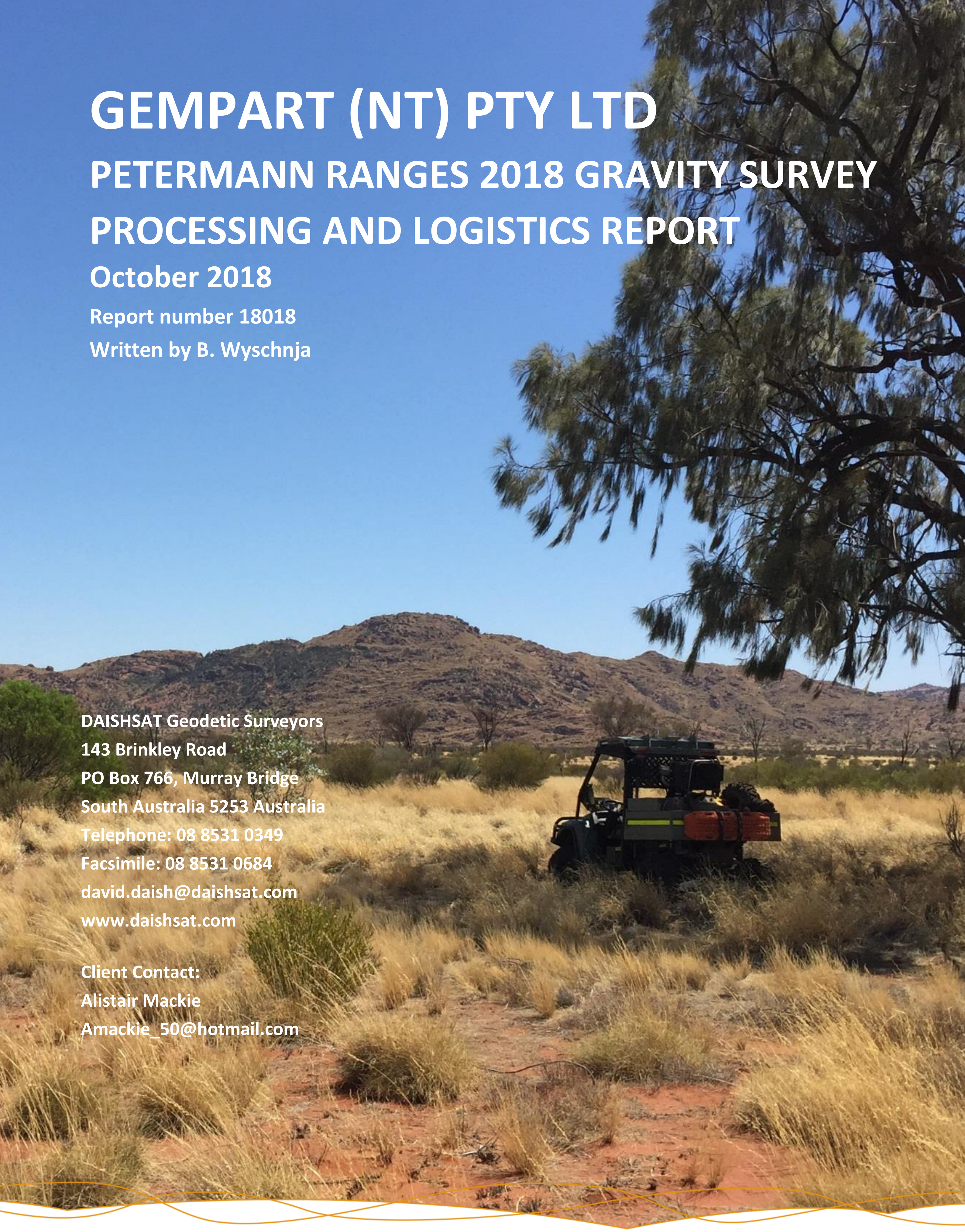

GEMPART (NT) PTY LTD

PETERMANN RANGES 2018 GRAVITY SURVEY PROCESSING AND LOGISTICS REPORT

October 2018

Report number 18018

Written by B. Wyschnja

DAISHSAT Geodetic Surveyors
143 Brinkley Road
PO Box 766, Murray Bridge
South Australia 5253 Australia
Telephone: 08 8531 0349
Facsimile: 08 8531 0684
david.daish@daishsat.com
www.daishsat.com

Client Contact:
Alistair Mackie
Amackie_50@hotmail.com

DAISHSAT GEODETIC SURVEYORS

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1.0 INTRODUCTION

Daishsat Geodetic Surveyors successfully carried out a precision ground gravity survey during October 2018 for Gempart (NT) Pty Ltd, with a total of 1,005 new gravity stations surveyed in the south western corner of the Northern Territory.

Scintrex CG-5 Autograv gravity meters were used for gravity data acquisition and base station control. Leica GX1230 differential GNSS receivers were used for gravity station positional acquisition. All gravity and GNSS data were acquired using Daishsat ATV methods.

The survey was conducted using two ATV crews and was completed safely, on time and within contract specifications.

Photo 1 – A Daishsat DATV, a highly modified all-terrain vehicle

2.0 SURVEY OVERVIEW

The gravity survey was conducted on Gempart (NT) Pty Ltd's exploration lease 31383. This was located on the Central Land Council's area of the Northern Territory, near the borders of South Australia and Western Australia (known as Surveyor Generals Corner).

The survey consisted of one area with gravity stations spaced 500m along 500m spaced lines running east-west. During the survey it was decided by Gempart (NT) Pty Ltd to infill 3 areas of interest at 250m spaced stations.

The terrain encountered in the survey area was generally flat, with grasslands and sand dunes. There were some low-lying hills that abutted the southern extents of the survey, near the defunct Claude Hills mine site.

The survey was reasonably remote, with crews obtaining fuel and supplies before heading into site. Additional fuel during the survey was obtained from Pipalyatjara to the south (as Wingellina did not have fuel available at the time). The crews were fully self-supporting, conducting vehicle and equipment maintenance as required and on site during the duration of the project.

Photo 2 – Typical terrain found in the survey area

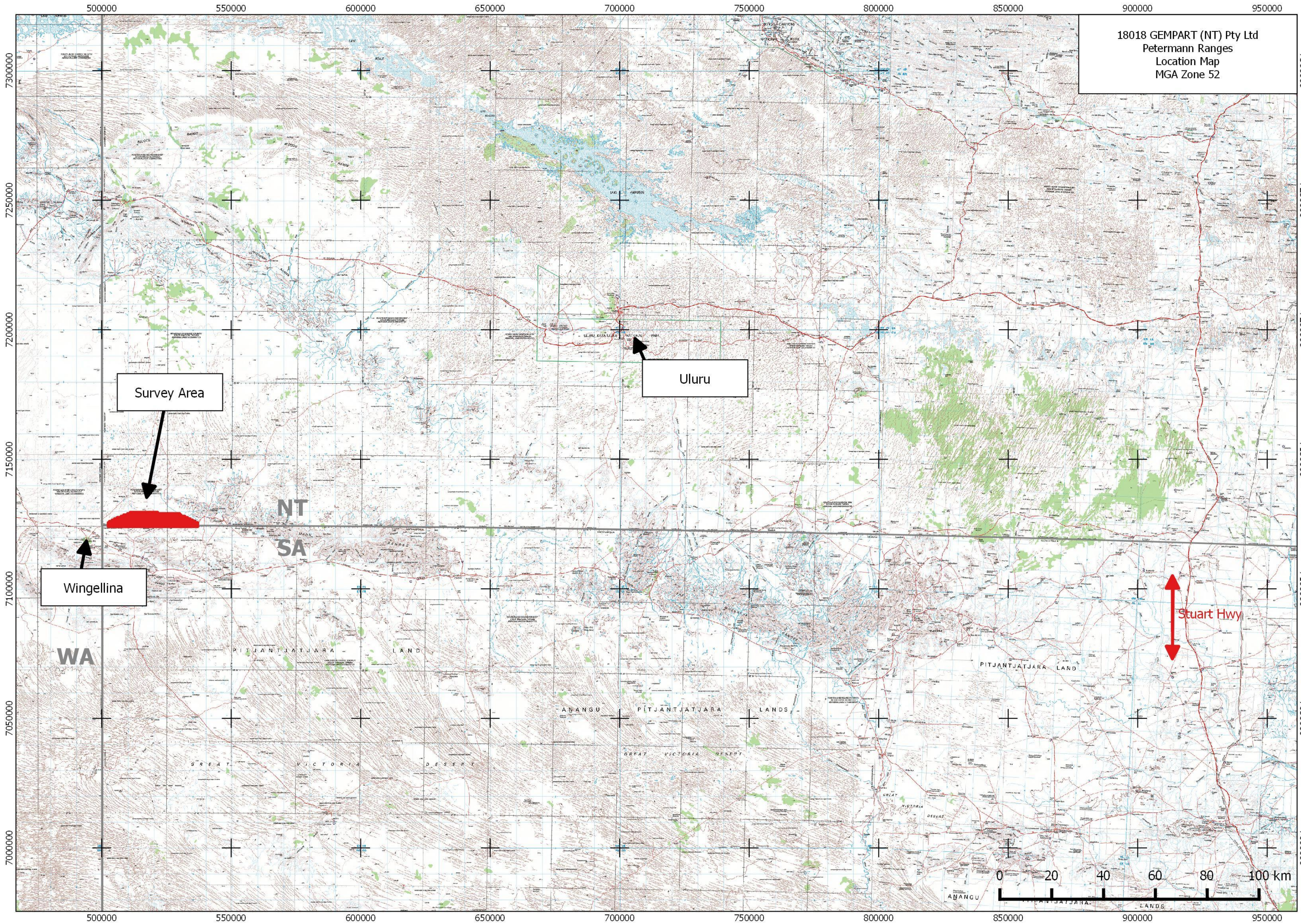


Figure 1 – Survey Location

3.0 PERSONNEL AND EQUIPMENT

3.1 Personnel

Gravity surveying, final data reduction, image processing and reporting was conducted by Daishsat Surveyors and Geophysicists. A full description of the personnel involved in the survey is listed in Appendix C – Survey information.

Photo 3 – Daishsat ground gravity crews with their acquisition equipment

3.2 Survey equipment

Surveying equipment utilised on this survey included:

- Scintrex CG-5 Gravity meters
- Leica System GX1230 dual frequency DGNSS receivers
- Garmin vehicle-mounted GNSS receivers for navigation
- Notebooks for data processing and backup

3.3 Vehicles

Toyota Landcruisers were used for transport to and from site with heavily customised John-Deere Gator 4WD all-terrain vehicles (ATV's) used to acquire gravity stations.

The Landcruisers are fitted with a range of safety equipment including:

- Dual fuel tanks
- Spare tyres, tubes and tyre repair kit
- Satellite phone and UHF Radios
- Garmin inReach satellite tracking device
- Self-recovery equipment including winch and snatch straps

- Tools and spares to enable field repairs as necessary
- Survival kit with EPIRB emergency locator beacon
- First Aid kits

The Daishsat ATV's used were equipped with the following survey and safety equipment:

- Garmin inReach satellite tracking device
- 10L jerry can of spare fuel
- Spare tyres, tubes and tyre repair kit
- Satellite phone and UHF Radio
- Personal First Aid Kit
- Self-recovery equipment including winch, snatch straps
- Tools and spares to enable field repairs as necessary
- Survival kit with EPIRB emergency locator beacon

3.4 Accommodation

To minimise daily travel times, crews set up a fly camp as close to the survey area as possible.

Our fly camps consist of a small tent and swag for each person, and a small area for the vehicles and ATV's. All equipment and rubbish were removed upon demobilisation from site, causing minimal impact on the surrounding environment.

3.5 Communications

The survey crews were equipped with hand-held Iridium satellite phones, vehicle-mounted UHF radios and Garmin inReach satellite tracking and messaging devices. The inReach system allows for real time monitoring of the crews' location (whether in a vehicle or on foot) via a web interface, and two-way messaging between the office and other crews onsite. Scheduled daily communication and data exchanges with the Murray Bridge office were ongoing for the duration of the job and this enabled survey updates and interim data to be reported to the client on a regular basis.

Photo 4 – Fly camp site in the Petermann Ranges

4.0 GNSS SURVEYING AND PROCESSING

4.1 Set out and surveying of the grid

Set out of the survey grid was done concurrently with the gravity data acquisition using Leica GX1230 dual-frequency GNSS units operating in autonomous mode. Where possible, the readings were taken as close as possible to the nominated coordinates. Some stations were moved from their nominated coordinates for various reasons including inaccessible trees and scrub, topographical features that could introduce severe local gravity terrain effects and other topographical issues making access to the station difficult or unsafe. Raw kinematic GNSS data was logged by a Leica GX1230 receiver during the gravity observations to determine the precise location of the GNSS antenna. Repeat gravity stations were strategically placed throughout the survey to monitor and control gravity meter performance and positional accuracy.

4.2 Survey datum and control

A new GNSS base station (with gravity base located coincident), numbered 1537, was established for use in the survey.

A typical Daishsat base station consists of a star picket witness post with an affixed Daishsat plaque along with a short star picket driven to refusal about 10cm above ground level and emplaced about 30cm to the left of the witness post. All bases are photographed to create a permanent record that will ensure accurate access to this site as a future resource.

Further base station information is described in Appendix D – Base station location and information.

Photo 5 – Base 1537 used for the survey

Coordinates for base station 1537 have been calculated using three days' worth of static GNSS data connected to Australian based IGS (International GNSS Service, formerly the International GPS Service) stations using Geoscience Australia's online GNSS processing system, AUSPOS. The base positions obtained from AUSPOS usually show final accuracy standard deviations (SD) of better than 5mm obtained for x, y and z, and can be considered first order.

4.3 Processing of the position and level data

Raw kinematic GNSS data were logged at 5 second intervals on the Leica GX1230 GNSS receiver and static GNSS data was logged at 5 second intervals on a Leica GX1230 GNSS receiver set up on the GNSS base station. Surveys are planned such that base to rover baseline lengths are kept as short as possible to maintain reliable and accurate positional resolution. At times additional GNSS receivers are placed in the field at temporary unmarked locations to shorten the baseline lengths.

At the end of each day all raw GNSS data was downloaded onto a laptop, compressed and transferred to the Daishsat FTP site. The data was processed using Waypoint's (Novatel) GrafNav GNNS post-processing software to produce positions accurate to within a couple centimetres for the antenna location at every 5 second epoch.

Photo 6 – A Leica GX1230 GNSS receiver set up over base 1537 with a redundant base set up nearby

4.4 Quality control of the position and level data

The GNSS data was processed using Waypoint's (Novatel) GrafNav GNNS post-processing software. This software has many tools and applications that assist our Surveyors and Geophysicists processing and analysing the data to ensure quality positional data is reliably and consistently obtained for all gravity stations throughout the project. Experience is required in structuring the field observations to collect reliable and accurate data in different conditions. Trees, scrub, long baseline lengths, different satellite windows and other factors can affect the GNSS observations and these need to be taken into account when planning and processing a survey. Repeat analysis on the survey data had demonstrated that accurate and reliable positional data has been collected and processed for this project.

5.0 GRAVITY ACQUISITION AND PROCESSING

5.1 Gravity data acquisition

Scintrex CG-5 Autograv gravity meters were used exclusively for the field acquisition. For each gravity observation the CG-5 gravity meter was carefully placed on its tripod and levelled, restricting the vertical and horizontal levels to 5 arc seconds. Once the meter was level, two gravity observations of 20-second stacking time were read and recorded. The instrument was monitored for any seismic or instrumental noise and the X/Y tilts, temperature and tolerance between readings was monitored during the reading by the Surveyor. The tolerance between readings is set at 0.030 of a dial reading and any readings falling outside of this were re-read. Field readings were also manually recorded by the field crews in Daishsat gravity field books along with any observations that may affect the reading.

During the day the field crews monitored any internal repeat gravity stations collected for abnormal drift and tares as well as the drift closure at the end of the day. If the meter received a bump or knock the previous station was revisited in order to detect if a tare had occurred.

5.2 Gravity base stations

The gravity base used for this survey was located coincident with the new GNSS base station, numbered 1537, as described in section 4.2. Gravity base 1537 was tied with multiple loops to one of Daishsat's existing gravity bases, 20086000319 at Wingellina, which was previously tied to the AFGN station at Warburton Roadhouse in 2008. These base stations are described further in Appendix D – Base station location and information.

When in the field during field acquisition, a base station reading was taken in the morning before surveying commenced, and after the last field observation of the day. When taking a base station reading, the observed gravity values were stacked over 120 seconds to ensure accuracy. Observations were repeated until the readings repeated to 0.010 of a dial reading or less.

5.3 Gravity data processing

At the end of each day the raw gravity data was downloaded from the CG-5 instruments onto a laptop where preliminary quality control was carried out. Any erroneous station numbers were corrected and readings that fell outside of tolerance were removed. Once this was done Daishsat's in-house software was used to average the two 20-second readings for each gravity station, remove the Scintrex Earth Tide Correction and assign each gravity station reading an easting and northing co-ordinate and a ellipsoidal elevation. Geosoft GRAVRED software was then used to perform gravity reductions to produce a set of observed gravity values that can be used for gridding, imaging and further analysis.

The following corrections were applied to the raw gravity data using Geosoft's GRAVRED software:

Instrument Scale Factor (SF): This correction is applied to correct each raw gravity reading (in dial units) to a relative gravity unit value based on the meter calibration.

$$\mathbf{R_{SF} = r_d \times SF}$$

Where:

R_{SF} = scale factor corrected reading in milliGals

r_d = raw gravity meter reading in dial units

SF = instrument scale factor (dial units/milliGal)

Earth Tide Correction (ETC): This correction is applied to correct for regular variations in the Earth's gravitational field due to changes in the relative position of the moon and sun. The Scintrex calculated ETC was removed and a new ETC was calculated using Geosoft Formulae.

$$\mathbf{r_{ETC} = r_{SF} + ETC}$$

Where:

r_{ETC} Earth Tide Corrected reading in milliGals

r_{SF} Scale Factor Corrected reading in milliGals

ETC Earth Tide Correction (ETC) in milliGals

Instrument Drift Correction (IDC): This correction is applied to compensate for the daily changes in the gravity meter due to mechanical stresses and strains encountered during surveying. The extension and contraction of the gravity meter spring with slight variations in temperature (obeying Hooke's Law) are the major cause of drift. The drift is assumed to be linear and is calculated by measuring the difference between the last and first base readings.

$$\mathbf{ID} = \frac{r_{B2} - r_{B1}}{t_{B2} - t_{B1}}$$

Where:

ID Instrument Drift in milliGals/hour

r_{B2} 2nd Gravity Base reading in milliGals

r_{B1} 1st Gravity Base reading in milliGals

t_{B2} Time of 2nd Gravity Base reading

t_{B2} Time of 1st Gravity Base reading

Observed Gravity (G_{OBS}): The preceding corrections are applied to each of the raw gravity readings to calculate the earth's relative gravitational attraction at each of the field gravity stations. Absolute gravity values are determined relative to a known Observed gravity value at each base. Observed Gravity values were calculated for both the ISOGAL84 and AAGD07 gravity datum's.

$$G_{BOS} = G_{B1} + (r_{ETC} - r_{B1}) - (t - t_{B1}) \times ID$$

Where:

G_{B1}	Gravity Base Observed Gravity in milliGals
r_{ETC}	Earth Tide Corrected reading in milliGals
r_{B1}	Gravity Base reading in milliGals
t	Time of field reading
t_{B1}	Time of Gravity Base reading
ID	Instrument Drift in milliGals/hour

Once Observed Gravity values were produced, an Excel spreadsheet was used to calculate Infinite Slab Bouguer Anomaly and Spherical Cap Bouguer Anomaly for each gravity station.

The following corrections were applied to produce Infinite Slab Geoidal Bouguer Anomaly values:

Theoretical Gravity (G_{T67}): As the Earth is not a perfect sphere, with the polar radius being smaller than the equatorial radius, gravity values vary with latitude. This is due to the differences in the distance from the centre of the Earth's mass and differences in centrifugal accelerations at varying latitudes. The theoretical value of gravity was calculated using the 1967 variant of the International Gravity Formula and used to latitude correct the observed gravity.

$$G_{T67} = 978031.8456 \times (1 + 0.005278895 \times \sin^2\phi + 0.000023462 \times \sin^4\phi)$$

Where:

ϕ	GDA94 latitude in decimal degrees

Infinite Slab Free-Air Correction (ISFAC): 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.

$$ISFAC = (0.3087691 - 0.0004398 \times \sin^2\phi) \times h_{AHD} - 0.0000001442 \times h_{AHD}^2$$

Where:

h_{AHD}	Height of the gravity meter above the Geoid (Ausgeoid09) in meters

Infinite Slab Bouguer Correction (ISBC): 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 t/m^3 was used in the correction to represent solid earth.

$$ISBC = 0.04191 \times \rho \times h_{AHD}$$

Where:

P	Earth density in gm/cc
h_{AHD}	Height of the gravity meter above the Geoid (Ausgeoid09) in meters

Infinite Slab Free Air Anomaly (ISFAA): This is obtained by applying the Infinite Slab Free Air Correction (ISFAC) to the Observed Gravity reading.

$$\mathbf{ISAA = G_{OBSG} - G_{T67} + ISFAC}$$

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

$$\mathbf{ISBA = G_{OBSG} - G_{T67} + ISFAC - ISBC}$$

The following corrections were applied to produce Spherical Cap Ellipsoidal Bouguer Anomaly values:

Theoretical Gravity (G_{T80}): The theoretical gravity value for each gravity station was calculated using the closed form of the 1980 International Gravity Formula (Moritz, 1980) and used to latitude correct the observed gravity.

$$G_{T80} = 978032.67715 \times ((1+0.001931851353 \times \sin^2\phi)/\sqrt{}(1 - 0.00669438002290 \times \sin^2\phi))$$

Where:

ϕ GDA94 latitude in decimal degrees

Atmospheric Correction (AC): This correction removes the effect of the change in mass of the atmosphere above the ellipsoid by shifting it vertically into the interior of the geoid.

$$AC = 0.874 - 0.000099 \times h_{ELL} + 0.00000000356 \times h_{ELL}^2$$

Where:

h_{ELL} Height of the gravity meter above the ellipsoid (GRS80) in meters

Ellipsoidal Free-Air Correction (EFAC): 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. The free air correction was calculated using GRS80 ellipsoidal heights and the second order approximation equation (Heiskanen and Mortiz, 1969):

$$EFAC = -1 \times (0.3087691 - 0.0004398 \times \sin^2\theta) \times h_{ELL} + (7.2125 \times 10^{-7}) \times h_{ELL}^2$$

where:

h_{ELL} Height of the gravity meter above the ellipsoid (GRS80) in meters

ϕ GDA94 latitude in decimal degrees

Spherical Cap Bouguer Correction (SCBC): This correction accounts for the attraction of material between the station and datum plane that is ignored in the free-air calculation. The Bouguer correction uses the closed form equation for the gravity effect of a spherical cap of radius 166.7 km based on a spherical Earth with a mean radius of 6,371.0087714 km, height relative to the GRS80 ellipsoid, and an earth density of 2.67 t/m^3 was used in the correction to represent solid earth.

$$\mathbf{SCBC = 2 \times \pi \times (6.67428 \times 10^{-11}) \times \rho \times ((1 + \mu) \times h - \lambda \times R)}$$

Where:

π pi

ρ Earth density in gm/cc

h height of the gravity meter above the GDA94 ellipsoid in meters

μ & λ are dimensionless coefficients with following definitions

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

where:

$\eta = h/R$

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

where:

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

$f = \cos\alpha$; Please Note this "f" is NOT the same as the parameter "f" in Free Air Correction above.

$k = \sin^2\alpha$;

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

$\delta = R_o / R$;

$m = -3*\sin^2\alpha\cos\alpha = -3*k*f$ *Note "m" is NOT the same as the parameter "m" in Free Air Correction above.

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

$\alpha = S/R_o$, with S = Bullard B Surface radius = 166.735 km.

Ellipsoidal Free Air Anomaly (EFAA): This is obtained by applying the Atmospheric Correction (AC) and Ellipsoidal Free Air Correction (FAC) to the observed gravity reading.

$$\mathbf{EFAA = G_{OBS} - (G_{T80} - AC) - EFAC}$$

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

$$\mathbf{SCBA = EFAA - SCBC}$$

5.4 Gravity meter calibrations and scale factors

All the company gravity meters undergo regular calibrations over the Kensington to Norton Summit calibration range in Adelaide. Meters are also calibrated upon return from repair by the manufacturer (Scintrex in Canada).

Along with calibrations we also conduct regular tilt tests, sensor drift calibrations and temperature adjustments in our technical workshops in Murray Bridge.

The gravity meters used on the survey along with their most recent calibration factors are described in Appendix C – Survey information.

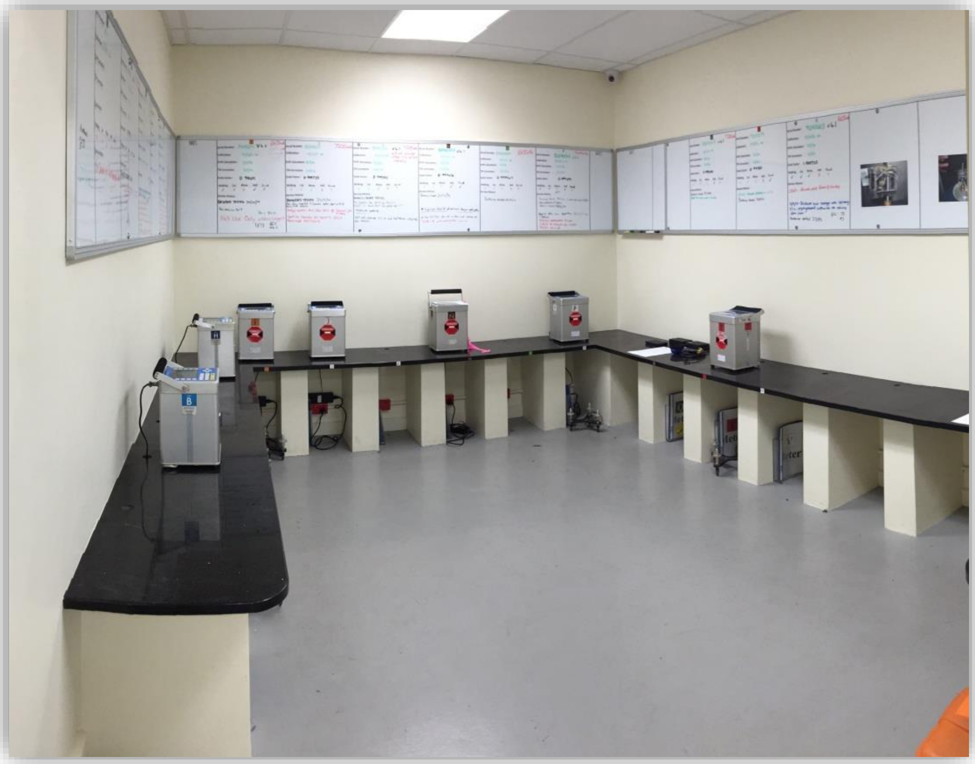


Photo 7 – Daishsat's gravity calibration room

5.5 Quality control of the processed gravity data

Following the reduction of the gravity data, quality control was carried out to check the repeatability of the positional and gravity observations.

The elevation and gravity data were gridded at 1/5th the line spacing using ChrisDBF to produce ERMapper compatible grid files of the AHD Elevation and Infinite Slab Bouguer Anomaly. A Remove Regional filter (using a First Order Polynomial) and a First Vertical Derivative Filter were both applied to the Infinite Slab Bouguer Anomaly grid to produce a Residual Anomaly grid and a First Vertical Derivative grid respectively. These grids were imaged using Oasis Montaj where they were checked for any anomalous points. A plot of the acquired gravity stations was regularly monitored to make sure no stations were missed.

Photo 8 – A Surveyor levelling a Scintrex CG5 gravity meter

6.0 RESULTS

Raw and processed GNSS and gravity data are contained on a USB drive as Appendix E. A hardcopy plot of station locations and gridded data images are contained in Appendix A.

6.1 Stations surveyed and survey progress

In total 1,005 new gravity stations were acquired during the project and of these, 82 (8.2%) were revisited for survey quality control.

Each crew averaged an individual production rate of over 55 stations per day, completing the survey in 18 crew days (on site for 9 days). Time was lost on some days due to rain and thunderstorms.

6.2 Data repeatability

Analysis of the repeat data shows that measurement repeatability was excellent for both GNSS and Gravity observations. An analysis of the survey data is included in Appendix B. Based on the repeat data, one can assume the following typical accuracies for the observables:

Gravity standard deviation (SD) of repeats:	SD < 0.024 mGal
Height standard deviation (SD) of repeats:	SD < 0.036 m

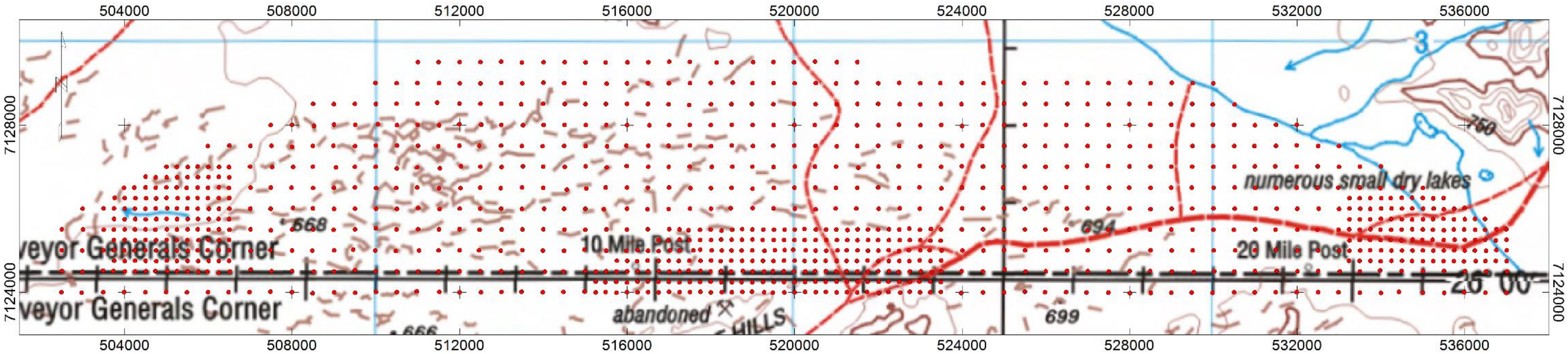
7.0 CONCLUSION

Daishsat Geodetic Surveyors successfully carried out a precision ground gravity survey during October 2018 for Gempart (NT) Pty Ltd.

The survey was conducted safely, without incident and with minimal environmental impacts. Final results have been demonstrated to be accurate, reliable and conducted to the highest standards with modern calibrated acquisition equipment, professional experienced staff, proven acquisition techniques and quality control procedures.

Appendix A

Station location plot and gridded data images



Scale 1:101650

2500 0 2500 5000

(meters)

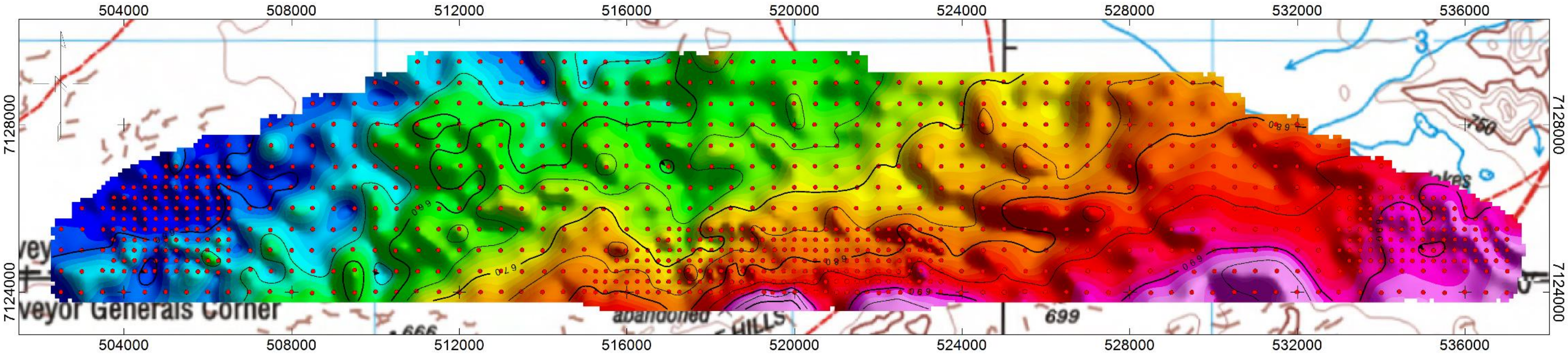
GDA94 / Map Grid of Australia zone 52

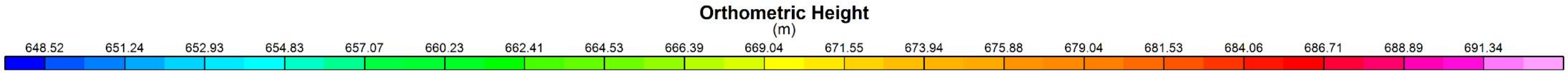
Red Dots = Surveyed stations

Gempart (NT) Pty Ltd

Petermann Ranges 2018 Gravity Survey
Station Location Plot
1,005 stations surveyed

Survey by Daishsat Geodetic Surveyors





Red Dots = Surveyed stations

Grid Cell Size - 100m
Scan Distance - 750m
Histogram Equalisation
Contour Interval - 5m
Northeast Sunshaded

Scale 1:101650

2500 0 2500 5000

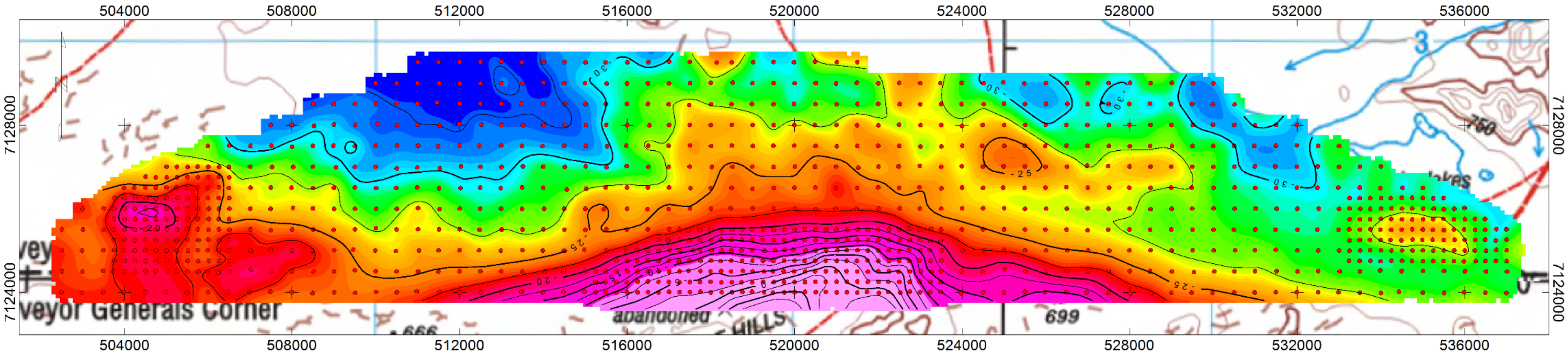
(meters)

GDA94 / Map Grid of Australia zone 52

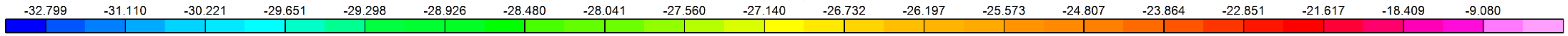
Gempart (NT) Pty Ltd

Petermann Ranges 2018 Gravity Survey
Orthometric Height
AHD (AusGeoid09)

Survey by Daishsat Geodetic Surveyors



Bouguer Anomaly
(mGal)



Red Dots = Surveyed stations

Gravity Datum - Isogal84
Grid Cell Size - 100m
Scan Distance - 750m
Histogram Equalisation
Contour Interval - 2.5mGal

Scale 1:101650

2500 0 2500 5000

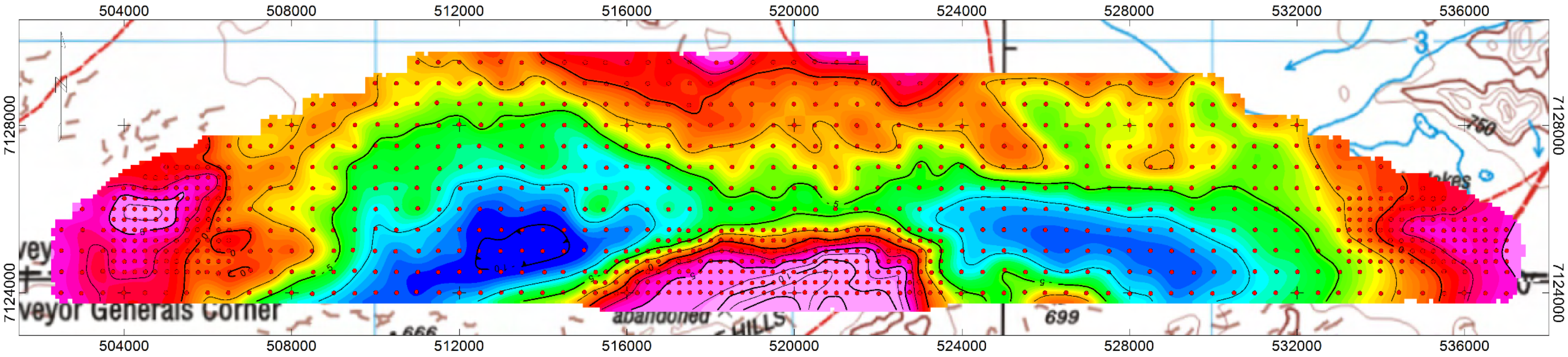
(meters)

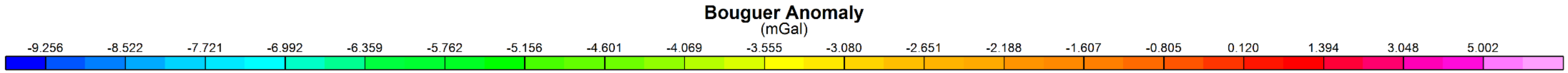
GDA94 / Map Grid of Australia zone 52

Gempart (NT) Pty Ltd

Petermann Ranges 2018 Gravity Survey
Infinite Slab Bouguer Anomaly
Density = 2.67 gm/cc

Survey by Daishsat Geodetic Surveyors





Red Dots = Surveyed stations

Gravity Datum - Isogal84
Grid Cell Size - 100m
Scan Distance - 750m
Histogram Equalisation
Contour Interval - 2.5mGal

Scale 1:101650

2500 0 2500 5000

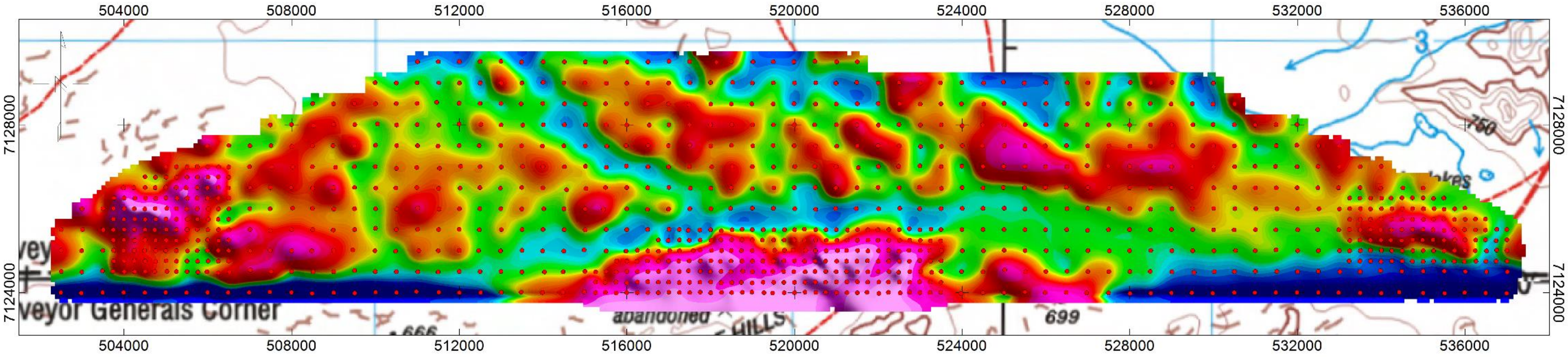
(meters)

GDA94 / Map Grid of Australia zone 52

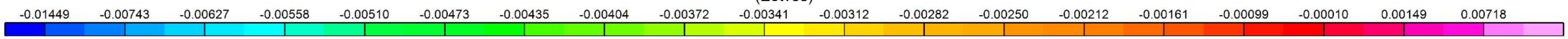
Gempart (NT) Pty Ltd

Petermann Ranges 2018 Gravity Survey
Residual Gravity
Density = 2.67 gm/cc

Survey by Daishsat Geodetic Surveyors



Vertical Derivative
(Eotvos)



Red Dots = Surveyed stations

Gravity Datum - Isogal84
Grid Cell Size - 100m
Scan Distance - 750m
Histogram Equalisation
Northeast Sunshaded

Scale 1:101650

GDA94 / Map Grid of Australia zone 52

Gempart (NT) Pty Ltd

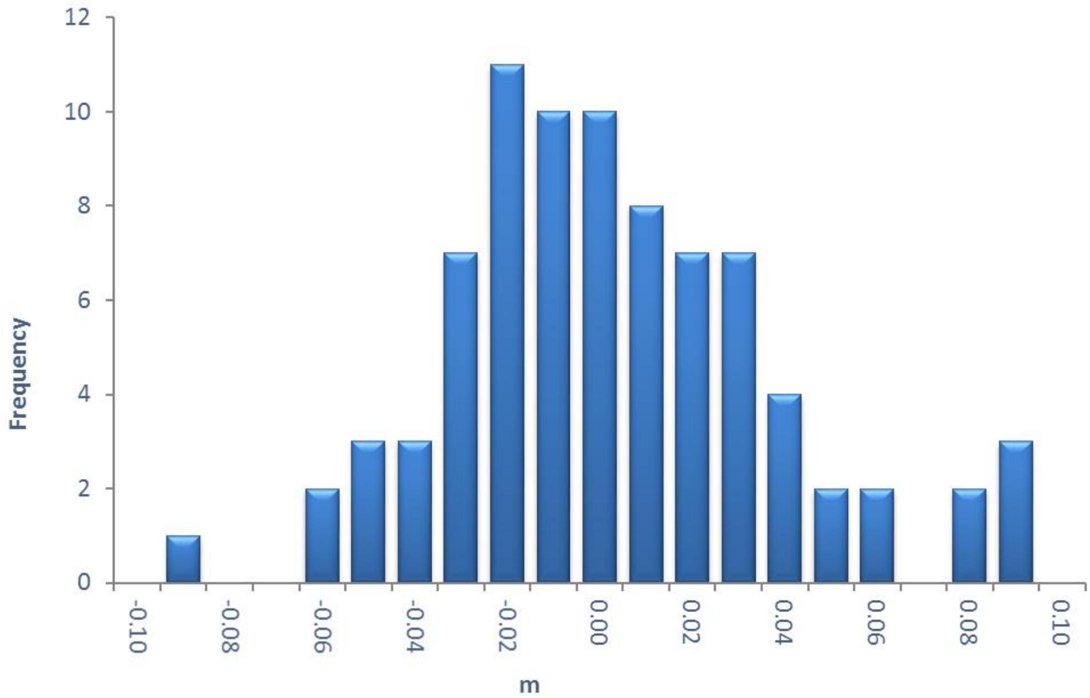
Petermann Ranges 2018 Gravity Survey
1st Vertical Derivative of Infinite Slab Bouguer Anomaly
Density = 2.67 gm/cc

Survey by Daishsat Geodetic Surveyors

Appendix B

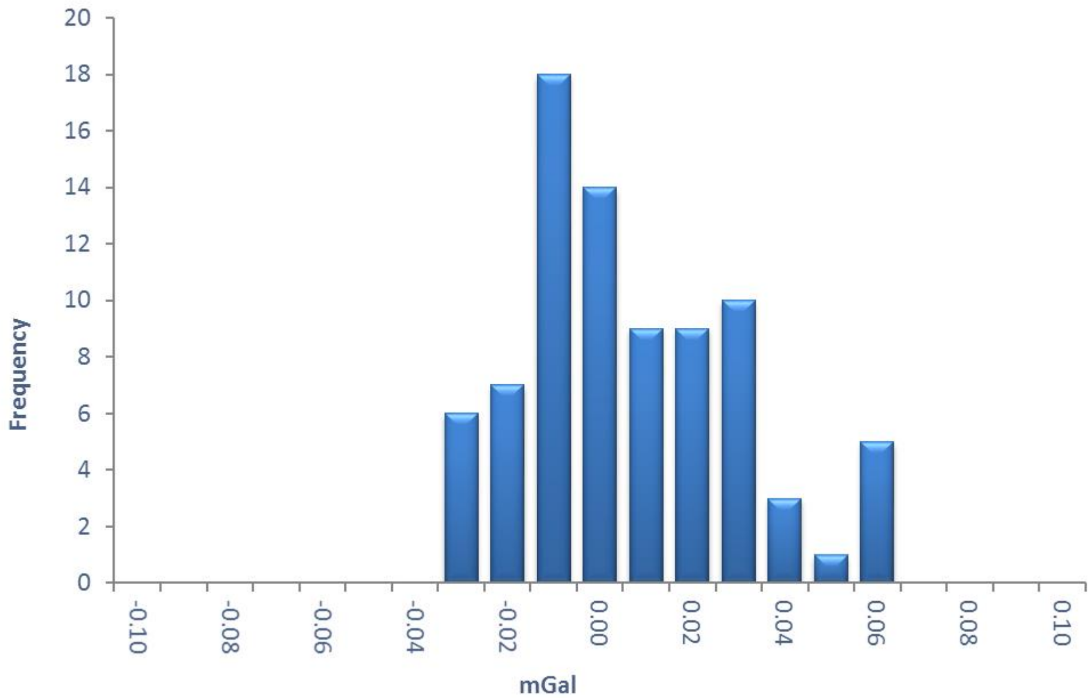
Repeat tabulation and analysis

Histogram of height repeats



Height standard deviation (SD) of repeats: 0.036 m

Histogram of gravity repeats



Gravity standard deviation (SD) of repeats: 0.024 mGal

Appendix C

Survey information

18018 GEMPART (NT) Pty Ltd - Petermann Ranges			
Survey Details			
Survey date	19/10/18 - 27/10/18		
Surveyors / Personnel	Hayden Harris / Lea Hodge		
Processors	Harley Jones / Ben Wyschnja		
Techniques employed	Post processed DATV gravity		
GPS receiver types used	Leica GRX1230		
Number of new points acquired	1,005		
Number of repeats on new points	82 (8.2 %)		
Station / line spacing	500m x 500m (with 250m infill in 3 areas)		
Height observation accuracy (SD)	0.036 m		
Gravity observation accuracy (SD)	0.024 mGal		
GPS / Gravity bases used	Daishsat Base 1537		
Gravity Meters			
Meter Serial	**Meter Letter**	**Scale Factor**	**Date & State of Calibration**
CG5 - 80340364	J	1.000599	10/10/2018 SA
CG5 - 80440373	N	1.000351	10/10/2018 SA

Appendix D

Base station locations and information

GPS/Gravity 1537 - Claude Hills

FINAL AUSPOS CO-ORDINATES

MGA94 / AHD		GDA94 / GRS80	
EASTING (m)	518261.41	LATITUDE (DMS)	26° 0' 29.00879" S
NORTHING (m)	7123411.04	LONGITUDE (DMS)	129° 10' 56.94478" E
ZONE (UTM, South)	52	ELL HT (m)	708.09
ORTHO HT (AHD, m)	703.83		
N (AUSGEOID09, m)	4.26		

CONTROL DETAILS

Observed Gravity ISOGAL84 (mGal)		Observed Gravity AAGD07 (mGal)	
Calculated ObsG	978889.170	Calculated ObsG	978889.092

Gravity Control	GPS Control
GRAVITY – Daishsat using multiple B-A-B loops to nearby existing Daishsat base 2008600319, which has previously been tied to the AFGN stations at Warburton.	**GPS** – Daishsat using multiple static sessions and the AUSPOS online GPS processing system. Expected accuracy of station coordinates better than 0.005m.

MISCELLANEOUS DETAILS

Est. Date:	19/10/2018	Established By:	Hayden Harris	Survey:	18018

DESCRIPTION AND ACCESS

This base station consists of a small star picket protruding from the ground and is witnessed by a Daishsat survey plaque, placed on a large star picket ~ 0.3m to the right. The base is approximatley 25km north east of the Wingellina Community. From the SA / WA border on the Gunbarrel Highway, next to the border signage (Z52J, 0500075e, 7118750n), there is a track which heads north. Zero the odometer (0.0km) and follow the track north / north east and after 19.9km, turn left and continue down a small track for 1.1km (21.0km) where you will come to Base 1537 approximatley 15m off to the right side of the track. Across the other side of the track from the base is a pile of copper ore from an old mine and some old rusty barrels full of rocks.

Field Photo Of Base

GPS Gravity Base 2008600319 Wingellina

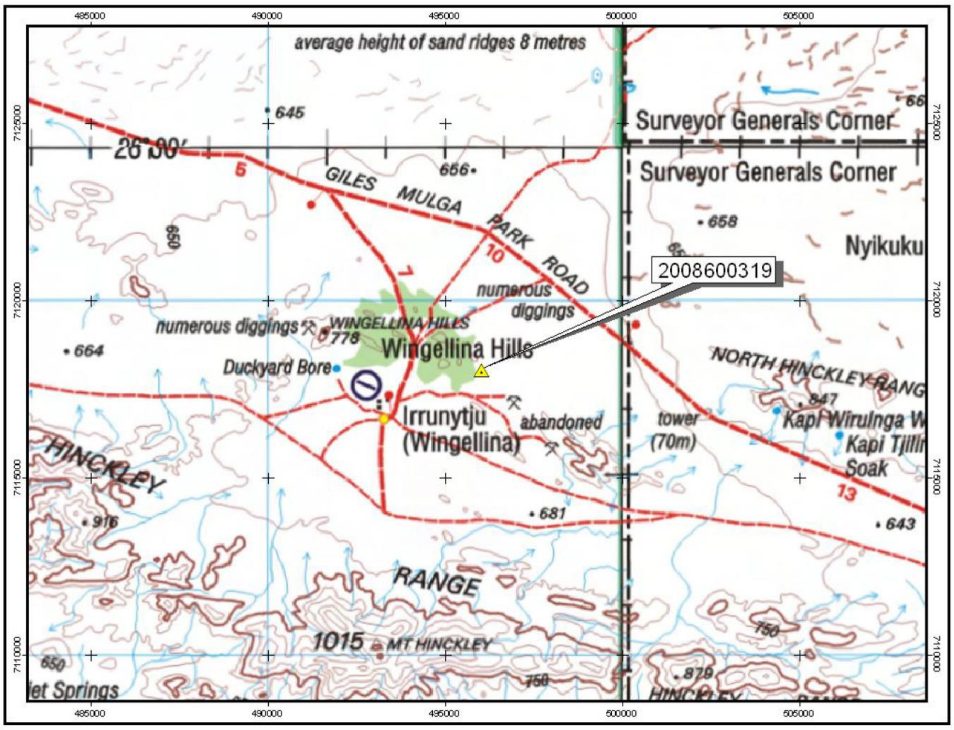
MGA94		GDA94	
EASTING (m)	496 023.420	LATITUDE (DMS)	26^{0} 03’ 24.2321” S
NORTHING (m)	7 118 032.914	LONGITUDE (DMS)	128^{0} 57’ 36.8854” E
ZONE (UTM)	52 S	GDAHT (m)	682.062
HEIGHT (AHD, m)	678.253	N (AUSGEOID98, m)	-3.809

OBSERVED GRAVITY	SURVEYED BY
9789135.440 μms^{-2}	GPS – Daishsat using a multiple static sessions and the AUSPOS online GPS Processing system. Expected accuracy of station coordinates better than 0.005m. Gravity – Daishsat using ABA ties with AFGN station 200890.9969 at the Warburton Airport. Expected accuracy better than 0.10 μms^{-2}.

MISCELLANEOUS DETAILS

This station consists of a small star picket protruding 0.05m out of the ground, and is witnessed by a larger star picket positioned 0.30m to the right. The circular concrete slab located beside the star pickets is the gravity base.

The Base is located at the Metals X Wingellina Exploration Camp. The Wingellina Aboriginal Community is located approximately 300km east of Warburton by road and the Exploration camp is 3km further east of the Community. Access to the base requires permission from the Metals X camp on (08) 8956 7158 with the base located 75m to the east of the site office.



Location Map

Appendix E

Data USB & Field header descriptions

(USB storage attached to back cover)

Daishsat CSV Data Columns - Infinite Slab Bouguer Anomaly		
Field Header	**Field Description**	**Units**
PROJECT	Contractor Project Number	
OPERATOR	Contractor Company Name	
SURVEY	Survey Name (eg. Angelo River)	
STATION	Unique Station ID	
LINE	Survey Line number (99 for Base readings)	
DIFF_EAST_m	Repeat Error for MGA Easting Observation	m
DIFF_NORTH_m	Repeat Error for MGA Northing Observation	m
DIFF_GDA94_m	Repeat Error for Ellipsoid Height (GDA94)	m
DIFF_OBSG84_mGal	Repeat Error for Observed Gravity (ISOGAL84)	mGal
RDNG_TYPE	Record observation type (Base, Field or Repeat)	
METER_MODEL	Model of Gravity Meter	
METER_SN	Serial Number of Gravity Meter	
EAST_MGA94_m	Easting (MGA Grid, GRS80, GDA94)	m
NORTH_MGA94_m	Northing (MGA Grid, GRS80, GDA94)	m
ZONE_UTM	UTM Zone Number	
LAT_GDA94_DD	Coordinate Latitude (Geodetic, GRS80, GDA94)	DD
LONG_GDA94_DD	Coordinate Longitude (Geodetic, GRS80, GDA94)	DD
HEIGHT_AHD09_m	Orthometric Height - Australian Height Datum AHD (AUSGEOID09)	m
N_AUSGEOID09_m	Geoid Ellipsoid separation N (AUSGEOID09)	m
DATE	Observation Date (DD/MM/YYYY)	
TIME	Observation Time (HH:MM:SS)	
DIAL_mGal	Gravity Dial Reading	mGal
SCALE	Scale Factor Applied to Dial Reading	
ETC_mGal	Earth Tide Correction (Longman)	mGal
OBSG84_mGal	Observed Gravity (ISOGAL84)	mGal
TG1967_mGal	Theoretical Gravity (1967 variant)	mGal
ISFAC_mGal	Infinite Slab Free Air Correction using Orthometric Height (AHD AUSGEOID09)	mGal
ISFAA_mGal	Infinite Slab Free Air Anomaly using Orthometric Height (AHD AUSGEOID09)	mGal
ISBC_267_mGal	Infinite Slab Bouguer Correction (2.67 t/m^3) using Orthometric Height (AHD AUSGEOID09)	mGal
ISBC_240_mGal	Infinite Slab Bouguer Correction (2.40 t/m^3) using Orthometric Height (AHD AUSGEOID09)	mGal
ISBC_220_mGal	Infinite Slab Bouguer Correction (2.20 t/m^3) using Orthometric Height (AHD AUSGEOID09)	mGal
ISBA_267_mGal	Infinite Slab Bouguer Anomaly (2.67 t/m^3) using Orthometric Height (AHD AUSGEOID09)	mGal
ISBA_240_mGal	Infinite Slab Bouguer Anomaly (2.40 t/m^3) using Orthometric Height (AHD AUSGEOID09)	mGal
ISBA_220_mGal	Infinite Slab Bouguer Anomaly (2.20 t/m^3) using Orthometric Height (AHD AUSGEOID09)	mGal
CLOSURE_mGal	Loop Closure	mGal
BASE_GRV	Gravity Base Station Name	

Daishsat CSV Data Columns - Spherical Cap Bouguer Anomaly		
Field Header	**Field Description**	**Units**
PROJECT	Contractor Project Number	
OPERATOR	Contractor Company Name	
SURVEY_NAME	Survey Name (eg. Angelo River)	
STATION	Unique Station ID	
LINE	Survey Line number (99 for Base readings)	
DIFF_EAST_m	Repeat Error for MGA Easting Observation	m
DIFF_NORTH_m	Repeat Error for MGA Northing Observation	m
DIFF_GDA94_m	Repeat Error for Ellipsoid Height (GDA94)	m
DIFF_OBSG84_mGal	Repeat Error for Observed Gravity (ISOGAL84)	mGal
RDNG_TYPE	Record observation type (Base, Field or Repeat)	
METER_MODEL	Model of Gravity Meter	
METER_SN	Serial Number of Gravity Meter	
EAST_MGA94_m	Easting (MGA Grid, GRS80, GDA94)	m
NORTH_MGA94_m	Northing (MGA Grid, GRS80, GDA94)	m
ZONE_UTM	UTM Zone Number	
LAT_GDA94_DD	Coordinate Latitude (Geodetic, GRS80, GDA94)	DD
LONG_GDA94_DD	Coordinate Longitude (Geodetic, GRS80, GDA94)	DD
HEIGHT_GRS80_m	Ellipsoid Height (Geodetic, GRS80, GDA94)	m
N_AUSGEOID09_m	Geoid Ellipsoid separation N (AUSGEOID09)	m
DATE	Observation Date (DD/MM/YYYY)	
TIME	Observation Time (HH:MM:SS)	
DIAL_mGal	Gravity Dial Reading	mGal
SCALE	Scale Factor Applied to Dial Reading	
ETC_mGal	Earth Tide Correction (Longman)	mGal
OBSG07_mGal	Observed Gravity (AAGD07)	mGal
TG80_mGal	Theoretical Gravity (1980 variant)	mGal
ATMC_mGal	Spherical Cap Atmospheric Correction using Ellipsoid Height (Geodetic, GRS80, GDA94)	mGal
EFAC_mGal	Spherical Cap Free Air Correction using Ellipsoid Height (Geodetic, GRS80, GDA94)	mGal
EFAA_mGal	Spherical Cap Free Air Anomaly using Ellipsoid Height (Geodetic, GRS80, GDA94)	mGal
SCBC_267_mGal	Spherical Cap Bouguer Correction (2.67 t/m^3) using Ellipsoid Height (Geodetic, GRS80, GDA9	mGal
SCBC_240_mGal	Spherical Cap Bouguer Correction (2.40 t/m^3) using Ellipsoid Height (Geodetic, GRS80, GDA9	mGal
SCBC_220_mGal	Spherical Cap Bouguer Correction (2.20 t/m^3) using Ellipsoid Height (Geodetic, GRS80, GDA9	mGal
SCBA_267_mGal	Spherical Cap Bouguer Anomaly (2.67 t/m^3) using Ellipsoid Height (Geodetic, GRS80, GDA94	mGal
SCBA_240_mGal	Spherical Cap Bouguer Anomaly (2.40 t/m^3) using Ellipsoid Height (Geodetic, GRS80, GDA94	mGal
SCBA_220_mGal	Spherical Cap Bouguer Anomaly (2.20 t/m^3) using Ellipsoid Height (Geodetic, GRS80, GDA94	mGal
CLOSURE_mGal	Loop Closure	mGal
BASE_GRV	Gravity Base Station Name	