Atlas Geophysics Report Number R2013046

South McArthur Basin Gravity Survey

Geoscience Australia

Attention: Mr Phill Wynne

Report completed by:

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1.0 Company Overview

Atlas Geophysics Pty Ltd is an Australian company based in Morley, Western Australia, whose mission is to provide the highest quality geophysical resource data to the mining, petroleum and exploration industry in a safe and timely manner. Through experience, innovation and excellence, the company will exceed its client's expectations and will continually develop its technologies and methodologies to maintain its reputation for being the best in the business.

The company specialises in the acquisition, processing and interpretation of potential field datasets, with particular emphasis on gravity. The director of the company, Leon Mathews B.Sc. Hons (Geophysics), has over 15 years experience in the field of gravity and brings to the company, a young, vibrant and motivated approach to project management. Strategically, through development and research, the company aims to expand into other geophysical acquisition markets that encompass methods such as electrical, electromagnetic, induced polarisation and reflection seismic. The company also has interests in developing an airborne platform capable of acquiring high quality magnetic and radiometric data so it can offer its clients a complete airborne and ground geophysical solution.

Atlas Geophysics Pty Ltd is committed to the values and principles of Health, Safety and Environment. To this end, the company aims to prevent injuries and occupational illness to its employees and minimise any adverse environmental impact its activities may have.

2.0 Project Brief

Atlas Geophysics project P2013046 required the acquisition and processing of **6,275** new regional gravity stations on behalf of Geoscience Australia (GA), funded by the Northern Territory Geological Survey (NTGS) as part of the Creating Opportunities for Resources Exploration (CORE) initiative. The gravity survey, referred to as the "South McArthur Basin Gravity Survey" was assigned GA project number 201381.

The survey was designed to cover most of the Southern McArthur Basin, with parts of the Beetaloo Sub-Basin and Daly Basin also covered in the west. Surveying was conducted from three logistical bases: Daly Waters, Mataranka and Borroloola.

Atlas Geophysics Pty Ltd completed the acquisition of the dataset using helicopter-borne gravity methods. Two helicopter crews were used for the duration of the project.

The survey commenced on 15th October 2013 with survey cessation on 16th November 2013.

2.1 Location, Access and Terrain

The gravity survey spanned an area approximately 75,000 kilometres square (Figure 1) and covered all or parts of the following 1:250,000 map sheets:

- Larimah
- Daly Waters
- Hodgson Downs
- Tanumbirini
- Mount Young
- Bauhinia Downs
- Pellew
- Robinson River

Surveying in the western parts of the survey area was conducted out of the small service/tourist centres of Daly Waters and Mataranka. Both centres are conveniently located alongside the Stuart Highway, about three hours south of Katherine. The last section of the survey was conducted from Borroloola, in the south east corner of the survey area. Access to Borroloola from Daly Waters was via the Carpentaria Highway (about 350km). Pilot changeover and refuelling was relatively straight forward, with the highways providing good access to most parts of the grid. Where access was required in the central parts of the survey, roads and tracks servicing cattle stations were often used.

Some spectacular country was encountered during the survey (especially in the Limmen National Park), with many a crocodile spotted in the water holes and creeks. Surveying in the west saw much dry long grass, with open landing spots often difficult to find. Terrain here was usually fairly flat, with the occasional small hill. Some parts in the west were very heavily wooded, with stands of closely packed trees requiring some stations to be offset. As the crews moved east, the terrain opened up, with less vegetation, but grasses still prevalent. Closer to the coast, north and south of Borroloola, there was more relief, with some rocky and jagged sandstone formations encountered. Vegetation here was mainly eucalypts with a grassy understorey.

2.2 Survey Configuration

For most of the survey, gravity acquisition was conducted using a square grid configuration with stations spaced at 4km. Two sections of the survey areas were in-filled to 2km x 2km spacing (as indicated by the dashed polygons in Figure 1).

A number of stations were offset from their planned station location where helicopter landing was deemed risky e.g. Stuart Highway, thick vegetation, rocky terrain etc. No stations were omitted from the survey.

Appendix A contains a station location plot of the acquired gravity stations.

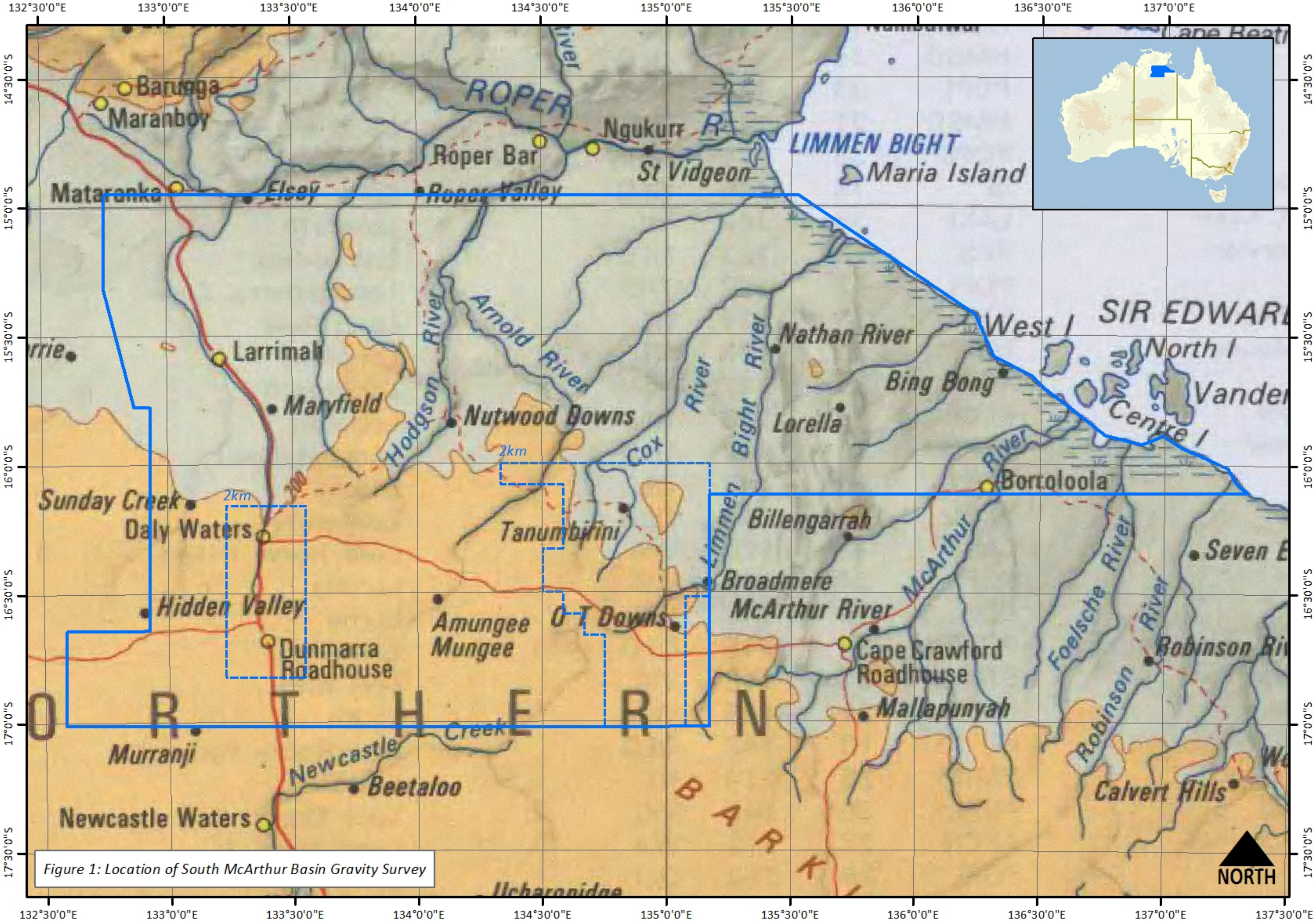


Figure 1: Location of South McArthur Basin Gravity Survey

3.0 Personnel and Subcontractors

Atlas Geophysics Pty Ltd engages only fit, motivated and safe working professionals to conduct its gravity operations. Acquisition staff members are from a range of backgrounds, usually from the geoscience or geotechnical fields, and all are trained in senior first aid, bush survival, and advanced four wheel driving. Overseeing the acquisition and processing is the company's team of geophysicists and data processors – a team with a combined total of over 20 years experience in the acquisition, processing and quality analysis of gravity data.

3.1 Project Supervision

Supervising the project from Perth Operations was director Leon Mathews. Leon has been involved in the acquisition, processing and interpretation of potential field data for over 15 years and has directly overseen the acquisition and processing of over 1,000,000 gravity stations.

Leon was responsible for project supervision, as well as for conducting the processing and quality analysis of the gravity data on a daily basis.

All final data processing, QA, reporting and delivery was performed by Leon Mathews.

3.2 Acquisition/Other Personnel

Other personnel participating in field acquisition of the gravity data on this project were:

Chris Rea	*Supervising Geophysical Technician*
Brian Villahermosa	Geophysicist
Tom Wood	Geophysical Technician
Tom Rowe	Geophysical Technician
Morgan Day	Geophysical Technician
Julius Geronzi	Geophysical Technician
Barry Thompson	Pilot
Anson Murray	Pilot
Pat Gorman	Pilot
Charlie Elliot	Pilot
Tony Neame	Pilot
Ryan Watson	Pilot

3.3 Subcontractors

Adelaide based helicopter operations company, Great Ocean Road Helicopters Pty Ltd, were chosen to supply the helicopters, pilots and engineering support for the duration of this project.

4.0 Equipment and Instrumentation

4.1 GPS/GNSS Receiver Equipment

Leading edge dual-frequency GPS technologies from Leica Geosystems such as the GPS1200 have been utilised on the project to allow for post-processed kinematic (PPK) centimetre level accuracy 3D positions. System specifications for the receivers utilised can be found in the attached brochures (Figures 2-4). The GPS1200 system is equipped with future proof GNSS technology which is capable of tracking all available GNSS signals including the currently available GLONASS. These new generation receivers, in conjunction with full GNSS tracking and processing, offer a new level of unmatched solution accuracy and reliability, especially when compared to existing conventional L1, L2 GPS technologies.

The use of Glonass technology in addition to GPS provides very significant advantages:

- Increased satellite signal observations
- Markedly increased spatial distribution of visible satellites
- Reduced Horizontal and Vertical Dilution of Precision (DOP) factors
- Improved post-processed-kinematic (PPK) performance
- Decreased occupation times means faster acquisition

Twelve Leica GPS1200 geodetic grade receivers were utilised to conduct the survey. Two receivers were used as post-processed kinematic (PPK) rovers in each helicopter, with the other receivers used as base stations for logging static data on multiple control stations.

On the helicopter, the GPS/GNSS antennas were mounted on the tail-boom of the aircraft and a fixed aluminium bracket at the front of the aircraft, with the receivers mounted on a custom mount inside the cabin.

Navigation between gravity stations was facilitated by a Garmin 296 GPS receiver operating in autonomous mode.

4.2 Gravity Instrumentation

Complementing the company's GNSS/GPS technologies is the latest in gravity instrumentation from Scintrex Ltd, the Scintrex CG-5 (Figure 5). The CG-5 digital automated gravity meter offers all of the features of the low noise industry standard CG-3M micro-gravity unit, but is smaller and lighter. It also offers improved noise rejection. By constantly monitoring tilt sensors electronically, the CG-5 automatically compensates for errors in gravity meter tilt. Due to a low mass and the excellent elastic properties of fused quartz, tares are virtually eliminated.

The CG-5 can be transported over very rough terrain, on quad bikes, foot, vehicle or helicopter without taring or drifting. In terms of repeatability, the CG-5 outperforms all existing gravity meter technologies, with a factory quoted repeatability of better than 0.005 mGal.

Table 1 below lists the gravity meters used on the project.

Gravity Meter Type	Gravity Meter Code	Gravity Meter Serial Number
Scintrex CG5	A2	40241
Scintrex CG5	A6	40382

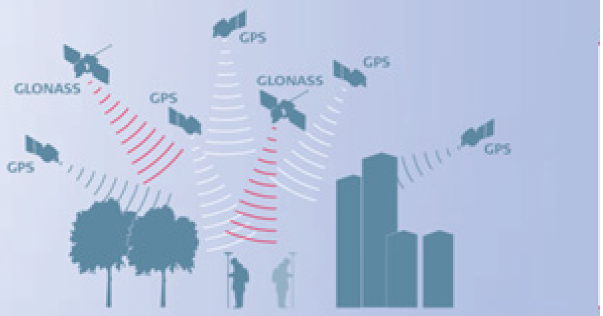
Table 1: Gravity meters used on the project

4.3 Other Equipment

The company utilised the following additional equipment to fully support the operations:

- Two HP Laptop computers for data download and processing
- Seven Iridium satellite phones for long distance communications and scheduled calls
- Personal Protective Equipment for all personnel
- Batteries, battery chargers, solar cells, UPS System
- Survey consumables
- Tools, engineering and maintenance equipment for vehicle servicing
- First aid and survival kits
- Tyres and recovery equipment
- Satellite tracking and communication devices.

Leica GPS1200
Fast, accurate, rugged and reliable



SMARTTRACK+

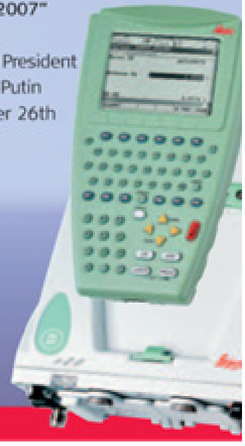
GNSS technology
GPS1200's SmartTrack+ measurement engine now utilizes two global navigation satellite systems increasing the number of tracked satellites. The new SmartTrack+ measurement engine tracks all available GNSS signals (L2C and GLONASS). More satellites means higher productivity, accuracy and reliability. SmartTrack+ acquires satellites within seconds, is ideal in urban canyons and obstructed areas where other receivers often fail. GPS1200 with SmartTrack+ is designed to support the future signals GPS L5 and Galileo.

SmartCheck+
Continuously checking provides the highest possible reliability. A unique, built-in integrity monitoring system checks all results immediately. SmartCheck+ now processes GPS and GLONASS measurements simultaneously for centimeter-accuracy, 20 Hz RTK at 30 km and more. Initialize within seconds and survey in obstructed areas with a GX1230/ATX1230 (GPS only) sensor or increase productivity with a GX1230 GG/ATX1230 GG (GPS and GLONASS).

GLONASS
For many years the GLONASS system was not reliable enough in terms of satellite availability and system performance. With recent launches and commitment from the Russian government, reliability and availability are significantly improved. Under normal conditions there are 2 to 5 additional satellites compared to a GPS only constellation – and even more satellites will be available over the next two years. Now is the time to invest in hybrid GNSS technology.

"The GLONASS system should be created before 2008, as it was originally planned ... We have the possibility. Let us see what can be done in 2006 – 2007"

(Russian President Vladimir Putin December 26th 2005).



Exceptionally rugged
Don't worry about how your crews handle GPS1200. It's built to MIL specs to withstand the roughest use. With its strong, precision-machined magnesium housing, GPS1200 stands up to drops and falls and the jolts and vibrations of machines.

Immune to bad weather
Designed for temperatures from –40° C to +65° C (storage +80° C). GPS1200 shrugs off arctic cold and blistering heat. Fully waterproof – withstands immersion to 1 m – sand and dustproof, it operates perfectly in any conditions from tropical rainfall to desert sandstorms. GPS1200 just keeps on working.

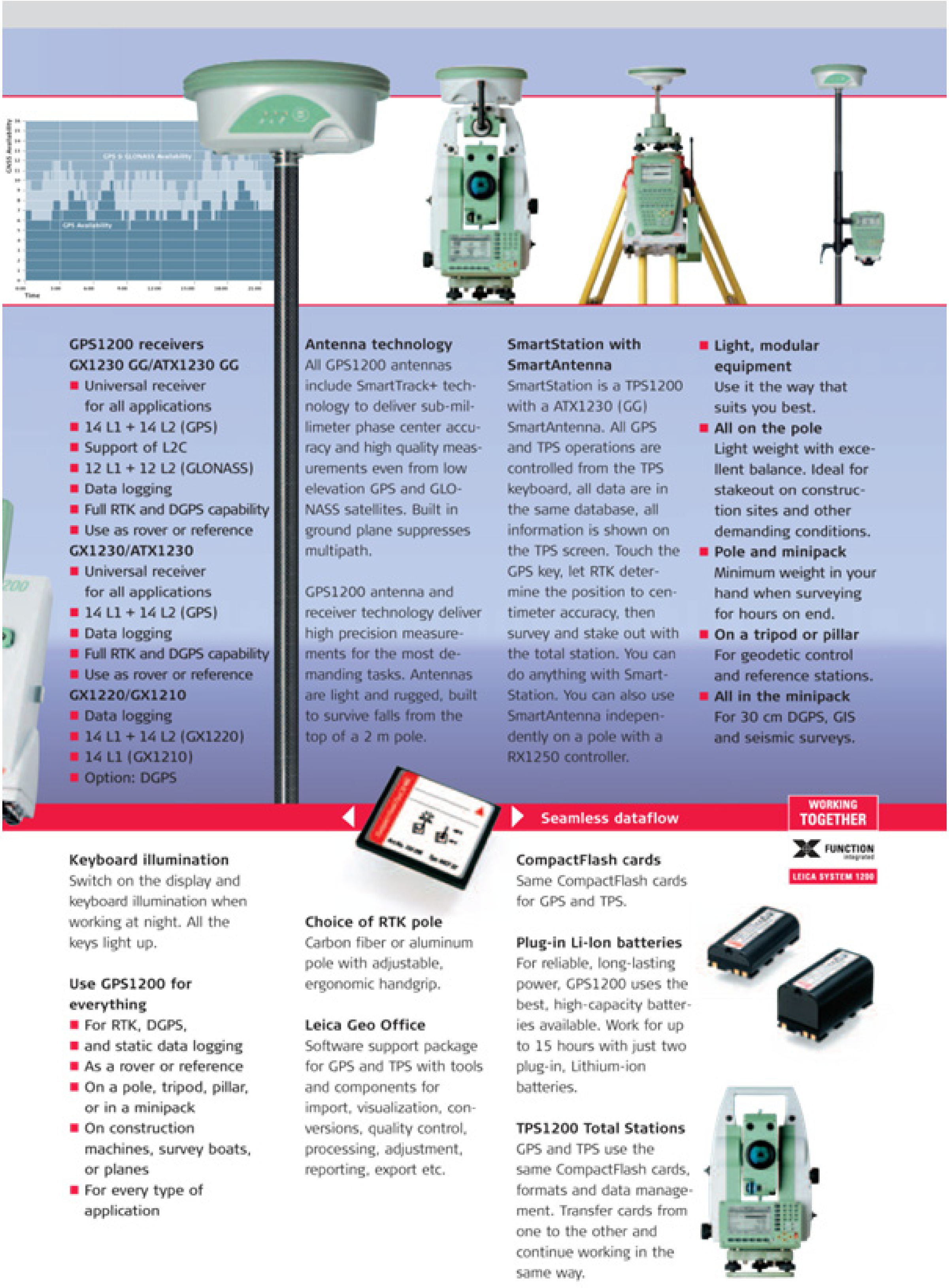
High contrast touch screen
The high quality 1/4 VGA (11 lines by 32 characters) with optional colour option (RX1250) touch screen guarantees perfect clarity and contrast. Whether in fading light or bright sunshine, you can always read the display perfectly. Operate using the touch screen or the QWERTY keyboard, which-ever you prefer.

With or without controller
Connect the controller to the receiver when you need to input information and make full use of the on-board functions and programs.

RTK/DGPS communication
Radio modems, GSM, GPRS and CDMA modules fit in waterproof housings attached to the receiver. Attach either one or two devices for RTK/DGPS reference and rover applications.

With *Bluetooth*® Wireless-Technology built in to the RX1250 controller complete cable free operation and connectivity to compatible wireless products is available.

Figure 2: Leica GPS1200 product brochure



GPS1200 receivers
GX1230 GG/ATX1230 GG
- Universal receiver for all applications
- 14 L1 + 14 L2 (GPS)
- Support of L2C
- 12 L1 + 12 L2 (GLONASS)
- Data logging
- Full RTK and DGPS capability
- Use as rover or reference

GX1230/ATX1230
- Universal receiver for all applications
- 14 L1 + 14 L2 (GPS)
- Data logging
- Full RTK and DGPS capability
- Use as rover or reference

GX1220/GX1210
- Data logging
- 14 L1 + 14 L2 (GX1220)
- 14 L1 (GX1210)
- Option: DGPS

Antenna technology
All GPS1200 antennas include SmartTrack+ technology to deliver sub-millimeter phase center accuracy and high quality measurements even from low elevation GPS and GLONASS satellites. Built in ground plane suppresses multipath.

GPS1200 antenna and receiver technology deliver high precision measurements for the most demanding tasks. Antennas are light and rugged, built to survive falls from the top of a 2 m pole.

SmartStation with SmartAntenna
SmartStation is a TPS1200 with a ATX1230 (GG) SmartAntenna. All GPS and TPS operations are controlled from the TPS keyboard, all data are in the same database, all information is shown on the TPS screen. Touch the GPS key, let RTK determine the position to centimeter accuracy, then survey and stake out with the total station. You can do anything with SmartStation. You can also use SmartAntenna independently on a pole with a RX1250 controller.

- **Light, modular equipment**
  Use it the way that suits you best.
- **All on the pole**
  Light weight with excellent balance. Ideal for stakeout on construction sites and other demanding conditions.
- **Pole and minipack**
  Minimum weight in your hand when surveying for hours on end.
- **On a tripod or pillar**
  For geodetic control and reference stations.
- **All in the minipack**
  For 30 cm DGPS, GIS and seismic surveys.

Seamless dataflow

WORKING TOGETHER

X FUNCTION integrated

LEICA SYSTEM 1200

Keyboard illumination
Switch on the display and keyboard illumination when working at night. All the keys light up.

Use GPS1200 for everything
- For RTK, DGPS,
- and static data logging
- As a rover or reference
- On a pole, tripod, pillar, or in a minipack
- On construction machines, survey boats, or planes
- For every type of application

Choice of RTK pole
Carbon fiber or aluminum pole with adjustable, ergonomic handgrip.

Leica Geo Office
Software support package for GPS and TPS with tools and components for import, visualization, conversions, quality control, processing, adjustment, reporting, export etc.

CompactFlash cards
Same CompactFlash cards for GPS and TPS.

Plug-in Li-Ion batteries
For reliable, long-lasting power, GPS1200 uses the best, high-capacity batteries available. Work for up to 15 hours with just two plug-in, Lithium-ion batteries.

TPS1200 Total Stations
GPS and TPS use the same CompactFlash cards, formats and data management. Transfer cards from one to the other and continue working in the same way.

Figure 3: Leica GPS1200 product brochure

Leica GPS1200

Technical specifications and system features

GPS1200 receivers	GX1230 receiver	GX1220 receiver	GX1210 receiver	ATX1230 SmartAntenna / RX1250
GPS technology	SmartTrack	SmartTrack	SmartTrack	SmartTrack
Type	Dual frequency	Dual frequency	Single frequency	Dual frequency
Channels	12 L1 + 12 L2 / WAAS / EGNOS	12 L1 + 12 L2 / WAAS / EGNOS	12 L1 / WAAS / EGNOS	12 L1 + 12 L2 / WAAS / EGNOS
RTK	Yes, SmartCheck	No	No	Yes, SmartCheck
DGPS + WAAS / EGNOS	Yes	Optional	Optional	Yes
Status indicators	3 LED indicators: for power, tracking, memory.			
Ports	1 power port, 3 serial ports, 1 controller port, 1 antenna port.			1 power/controller port, Bluetooth port
Supply voltage,	Nominal 12 VDC.			
Consumption	5.2 W receiver + controller + antenna			ATX1230: 2.4 W, RX1250 1.1 W
Event input and PPS	Optional:	Optional:	Optional:	
	1 PPS output port	1 PPS output port	1 PPS output port	
	2 event input ports	2 event input ports	2 event input ports	
Standard antenna	SmartTrack AX1202	SmartTrack AX1202	SmartTrack AX1201	SmartTrack ATX1230
Built in groundplane	Built in groundplane	Built in groundplane	Built in goundplane	Built in goundplane

The following apply to all receivers except where stated.

Power supply	Two Li-Ion 3.8Ah/7.2V plug into receiver. One Li-Ion 1.9Ah/7.2V plugs into ATX1230 and RX1250.
Plug-in Li-Ion batteries	Power receiver + controller + SmartTrack antenna
Same for GPS and TPS	for about 15 hours (for data logging).
	Power receiver + controller + SmartTrack antenna + low power radio modem or phone for about 10 hours (for RTK/DGPS).
	Power SmartAntenna + RX1250 controller for about 5 hours (for RTK/DGPS)
External power	External power input 10.5 V to 28 V.
Weights	Receiver 1.20 kg. Controller 0.48 kg (RX1210) and 0.75 kg (RX1250). SmartTrack antenna 0.44 kg. SmartAntenna 1.12 kg. Plug-in Li-Ion battery 0.09 kg (1.9Ah) and 0.19 kg (1.9Ah).
	Carbon fiber pole with SmartTrack antenna and RX1210 controller: 1.80 kg.
	All on pole: carbon fiber pole with SmartAntenna, RX1250 controller and plug-in batteries: 2.84 kg.

Temperature	Operation:	Receiver	–40°C to +65°C
ISO9022		Antennas	–40°C to +70°C
MIL-STD-810F		Controllers	–30°C to +65°C
	Storage:	Receiver	–40°C to +80°C
		Antennas	–55°C to +85°C
		Controllers	–40°C to +80°C
Humidity	Receiver, antennas and controllers		
ISO9022, MIL-STD-810F	Up to 100% humidity.		
Protection against water, dust and sand	Receiver, antennas and controllers: Waterpoof to 1m temporary submersion.		
IP67, MIL-STD-810F	Dust tight		
Shock/drop onto hard surface	Receiver withstands 1m drop onto hard surface. Antennas: withstand 1.5m drop onto hard surface.		
Topple over on pole	Receiver, antennas and controllers: withstand fall if pole topples over.		
Vibrations	Receiver, antennas and controllers:		
ISO9022	withstand vibrations on large construction		
MIL-STD-810F	machines. No loss of lock.		

Figure 4: Leica GPS1200 technical specifications

SPECIFICATIONS

Sensor Type
Fused Quartz using electrostatic nulling

Reading Resolution
1 microGal

Standard Field Repeatability
< 5 microGal

Operating Range
8,000 mGal without resetting

Residual Long-Term Drift (static)
Less than 0.02 mGal/day

Range of Automatic Tilt Compensation
± 200 arc sec

Tares
Typically less than 5 microGals for shocks up to 20 G.

Automated Corrections
Tide, Instrument Tilt, Temperature, Noisy Sample, Seismic Noise Filter.

Dimensions
31 cm (H) x 22 cm x 21 cm
12 in (H) x 8.5 in x 8 in

Weight (including batteries)
8 kg, (17.5 lbs.)

Battery Capacity
2 x 6Ah (10.8V) rechargeable Litium-Ion Smart Batteries. Full day operation in normal survey conditions with two fully charged batteries.

Power Consumption
4.5 Watts at 25°C

Standard Operating Temperature Range
-40°C to +45°C

Ambient Temperature Coefficient
0.2 microGal/°C (typical)

Pressure Coefficient
0.15 microGal/kPa (typical)

Magnetic Field Coefficient
1 microGal/Gauss (typical)

Memory
Flash Technology (data security)
Standard 12 MBytes

Digital Data Output
RS-232 C and USB interface
Is optimized for Win XP™

Analog Data Output
Strip-Chart Recorder

Display Screen
¼ VGA 320 x 240 pixels

Keypad
27 key alpha/numeric

Standard System
- CG-5 Console
- Tripod base
- 2 rechargeable batteries
- Battery Charger, 110/240 V
- External Power 110/240 V
- RS-232 and USB Cables
- Carrying Bag
- Data dump and utilities software
- Operating Manual (CD)
- Transit Case

GPS
Enables GPS station referencing from an external 12 channel smart GPS antenna being connected via the RS-232 port. Standard GPS accuracy: <15m DGPS (WAAS) < 3m. Client has the option to use other higher accuracy GPS receivers outputting NMEA data string through the serial port.

OPTIONS

High Temperature Option
For use in climates that may exceed the normal operating temperate of 45°C. Allows operating temperatures of up to 55°C. This option is intended to be used in climates above freezing and needs to be ordered at the time of purchase.

Battery Belt
Suggested for cold weather operation.

COMPLETE GRAVITY SOLUTIONS

Special Applications
Please contact LRS Scintrex or your local representative.

Training Programs
LRS Scintrex can provide training programs at our office in Canada or at your location.

Application Software
LRS Scintrex can provide software packages to support your data processing, interpretation and mapping needs.

An ISO 9001:2000 registered company

* All specifications are subject to change without notice.

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Figure 5: Scintrex CG-5 specifications

5.0 Vehicle and Helicopter Transportation

5.1 Helicopters

Three Robinson R44 Raven I helicopters were supplied to the project (Photo 1). Two machines were used for survey and the other on standby in case of emergency or breakdown. The helicopters were serviced in accordance with CASA specifications with 100 hourly services carried out in Daly Waters.

The helicopters were equipped with an EPIRB device, comprehensive first aid and survival kits. Communications were via VHF radio and Iridium satellite phone. Helicopter movements were tracked using a satellite tracking system.

Aviation fuel and oils were supplied ex Katherine.

5.2 Support Vehicles

Facilitating refuelling operations were two 4WD Toyota Landcruiser utilities and an Isuzu FTS750 truck. A Toyota 4WD Landcruiser utility was used for crew and pilot transport, helicopter refuels and crew changeovers. The vehicles were fitted with the following equipment:

- Iridium satellite phone
- Garmin navigation grade GPS receiver with moving map display
- Spare navigation grade GPS receiver with batteries
- First aid and survival kit
- Two spare tyres
- Recovery equipment for tyre repair
- Recovery equipment including winch for bogging, stranding.
- Comprehensive tool-kit
- 10L of drinking water
- Satellite tracking device

All vehicles used on the project were supplied, serviced and maintained by Atlas Geophysics. The field crew carried out daily pre-start checks on all vehicles and these have been documented in Atlas Geophysics pre-start log books.

Photo 1: Helicopter VH-YMA near Borroloola

6.0 Camping / Accommodation

The crew were accommodated and messed at local facilities in Daly Waters, Mataranka and Borroloola – all had excellent facilities.

7.0 Communications, Internet and Scheduled Calls

The primary method of communication for the field crews was via Iridium satellite phones. The helicopter crews made scheduled calls to the field operations base at hourly intervals. In addition to scheduled calls, the position of the helicopters was reported to the operations base at 10 minute intervals using Omnitrack satellite tracking technology.

Internet connections for client contact and data server access were established using a Telstra Turbo Gateway NextG internet modem and a Broadband Global Area Network (BGAN) satellite internet network system for remote locations.

8.0 Survey Methodology

All gravity data were acquired using Atlas Geophysics Pty Ltd helicopter-borne techniques. These techniques, which involve concurrent GPS and gravity acquisition, allow for rapid acquisition of very high quality data.

8.1 Gravity and GPS Control Establishment

Two primary GPS and gravity control stations were established, each near to the logistical base. An existing Atlas/GA base was used at Borroloola (Table 2).

At each primary control station a permanent monument was erected to mark and witness the station. The monument consisted of a 40cm star picket driven into the ground with about 10cm protruding alongside a small square concrete slab set level in concrete. The star picket marked the position of the GPS control station and the concrete slab marked the position of the gravity control station. A steel star picket of 1.5m length was placed within 0.5m of each control point and carried an Atlas Geophysics Pty Ltd witness plaque numbered with a unique station number (Figure 6).

Control Station ID	Lat / Long / Ht (GDA94, GRS80)	Observed Gravity (AAGD07 $\mu m/s^2$)
201304600001 (GA 20138100001) *Daly Waters Hi Way Inn*	-16 18 25.7348 133 23 11.8316 258.342	9783723.92
201304600002 (GA 20138100002) *Mataranka Territory Manor*	-14 55 3.3032 133 4 6.2439 176.815	9783525.61
GRVGPS0068 (GA 20138100068) *Borroloola A/S*	-16 04 15.2198 136 18 13.2744 64.944	9784290.11

Table 2: Gravity and GPS control stations used to control the survey

The details of all primary control stations have been recorded on Atlas Geophysics Pty Ltd control station summary sheets. The sheets include the geodetic coordinates, observed gravity value, station description, locality sketch, locality map and a digital photo of the station. The sheets are contained in Appendix B.

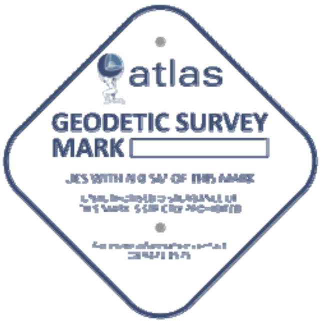


Figure 6: Atlas Geophysics Pty Ltd survey witness plaque

8.1.1 GPS Control

If not already existing, primary GPS control was established for all control stations and this allowed all position and height information obtained from the gravity survey to be tied to the Geocentric Datum of Australia (GDA94), the Geodetic Reference System 1980 (GRS80) and Australian Height Datum (AHD).

Secondary GPS control was used to restrict kinematic baseline length. 12 separate remote, control stations were established in the field and all were marked with a 40cm steel rod driven into the ground with about 1cm protruding (not identified). In the field, whilst the survey was underway, temporary coordinates for these stations were established using static base-line processing to the primary control station over a minimum ten hour period.

Upon final processing, coordinates for all primary and secondary control stations were obtained using the 5 second static GPS data logged at each station whilst the gravity survey was underway. The static data has been submitted to Geoscience Australia's AUSPOS processing system to produce first-order geodetic coordinates accurate to better than 10mm for the x, y and z observables. Multiple days of static GPS data have been submitted to ensure accuracy and reliability of the solution.

Initial surveying was conducted using adopted control station coordinates since the AUSPOS system requires approximately two weeks before a Final Ephemeris Solution can be delivered. The adopted coordinates were derived from an autonomous GPS measurement at the primary control station giving an accuracy of better than 0.5m for x, y coordinates and better than 15m for the z coordinate. Once the final ephemeris solution for the control station coordinates was delivered by AUSPOS, all control and field GPS measurements had the necessary DC shift applied to give accurate, absolute positions for east, north and elevation. A listing of final coordinates for all control stations are contained in Appendix C.

8.1.2 Gravity Control

Where it did not exist, primary gravity control was established at the same location as the primary GPS control stations. Once tied to the Australian Fundamental Gravity Network (AFGN), the gravity control stations allowed all field gravity observations to be tied to the Australian Absolute Gravity Datum 2007 (AAGD07).

An accurate observed or absolute gravity value for the control stations was established via "ABABA" ties with the project gravity meters to nearby AFGN stations. Table 3 summarises the control ties conducted and Appendix D contains the control tie data. Expected accuracy of the tie surveys would be better than 0.1 µm/s^2 (or 0.01 mGal).

Control Station ID	AFGN station tied to	Date of ties
201304600001 (GA 20138100001) *Daly Waters Hiway Inn*	1964910133 Daly Waters A/S	16/10/2013
201304600002 (GA 20138100002) *Mataranka* *Territory Manor*	1964910133 Daly Waters A/S	28/10/2013 31/10/2013
GRVGPS0068 (GA 20138100068) *Borroloola A/S*	Existing	N/A

Table 3: Primary gravity and GPS control stations used to control the survey

8.2 GPS Data Acquisition, Processing and Quality Analysis

GPS/GNSS data were collected in static mode at each of the control stations and in kinematic mode with the helicopters using geodetic grade Leica GPS1200 receivers. Rigorous post-processing of the recorded kinematic data allowed for excellent GPS/GNSS ambiguity resolution and 3-D solution coordinate qualities better than 5cm for each of the gravity station locations. Atlas Geophysics QA procedures have ensured the final GPS/GNSS data have met and exceeded contract specifications.

8.2.1 GPS/GNSS Acquisition

Each GSL was positioned using navigation grade Garmin receivers fitted to custom mounts inside the cockpit of the helicopter. Accuracy of the positioning system was better than 5m and where practicable, the helicopter crew landed as close to the programmed station location as possible. Where it was too dangerous to land, stations were moved from the programmed coordinate.

For the kinematic helicopter operations, the GPS/GNSS sensors were mounted on a fixed aluminium bracket at the front of the aircraft (primary) and on the tail boom of the aircraft (secondary backup, with phase data logged by the receivers inside the cockpit. Data were logged at five second epochs onto Compact Flashcards (CF) for later downloading and processing. Static data were also concurrently logged at the primary and secondary GPS control stations to allow for later kinematic processing.

8.2.2 GPS/GNSS Processing

The acquired raw GPS/GNSS data were processed nightly using Novatel Waypoint Grafnav v8.50 post-processing software (Figure 7). GrafNav is a fully-featured kinematic and static GPS/GNSS post-processing package that uses Waypoint's robust GPS/GNSS processing carrier phase kinematic (CPK) filter engine. The software is capable of processing raw kinematic GPS/GNSS data from most GPS/GNSS receivers and allows the user to process the roving data from as many as eight separate control stations to achieve accuracies at the centimetre level. The software can automatically switch from static to kinematic processing and has a fixed static solution for static initialisation of short or medium baselines that are below 30km. Kinematic Ambiguity Resolution (KAR) allows the session to start in kinematic mode and can help fix otherwise unrecoverable cycle slips. Ionospheric processing and modelling is also included with the software and can help improve accuracy, especially over long baselines. Advantages of the Waypoint processing engine over other packages include:

Fast Processing – The Grafnav engine is one of the fastest on the market. For a single base station, a 2.40 Mhz PIII CPU can expect to process GPS data at 670 epochs/second. This means that a 4-hour 2 Hz data set will process one direction in 22 seconds. For two bases, processing takes 250 epochs/second or about 1 minute for the same 4-hour data set. For 4 bases, these times are 50 epochs/second or about 5 minutes.

Reliable OTF Processing – Waypoint's on-the-fly KAR algorithm has had years of development and testing. Various implementations and numerous options are available to control this powerful feature.

Multi-Base (MB) processing – With Version 8.50, GrafNav now supports true multiple control station processing where all of the baselines are incorporated into one sophisticated Kalman filter. This can spatially de-correlate some of the error sources while also allowing integer ambiguity determination using the closest base station. Satellite drop-outs at one base will also be compensated by the others. The two biggest advantages are improved overall accuracies and much less operator effort required to process and QC such data.

Accurate Static Processing – Three modes of static processing are implemented in the main processing kernel.

Dual Frequency Support – Full dual frequency GPS processing comes with the software. For ambiguity resolution, this entails wide/narrow lane solutions for KAR, fixed static and quick static. 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 initialisation 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. GrafNav also has the ability to combine these two solutions to obtain a globally optimum one.

GPS + GLONASS – The GrafNav kernel has the ability to also process GPS+GLONASS data. This is especially advantageous for applications in forested areas, where the additional satellite coverage can improve accuracies.

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 amount of code has been added specifically for the detection and removal of Doppler errors.

High Dynamics – The GrafNav kernel can handle extremely high dynamics from missiles, rockets, dropped ordinances, and fast flying aircraft.

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

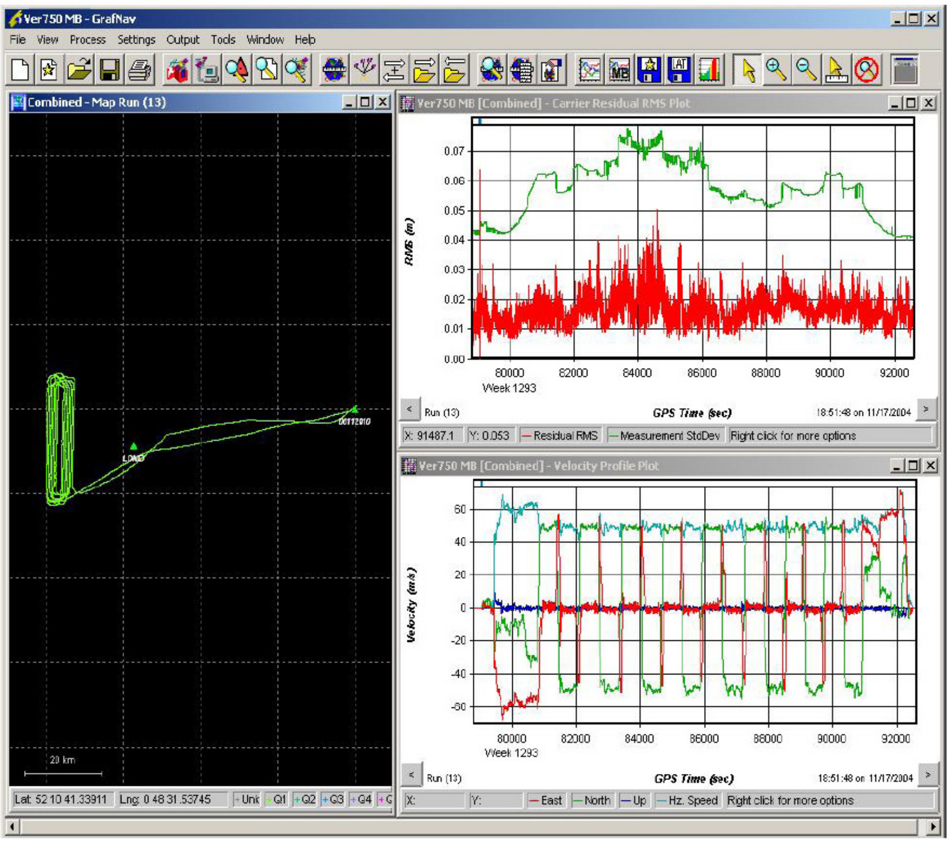


Figure 7: Waypoint Grafnav Processing Software

Once each epoch was processed to give a solution for the WGS84 position and elevation at ground level (i.e. corrected for sensor height), conversion between GPS/GNSS derived WGS84/GDA94 coordinates to Map Grid of Australia (MGA) coordinates was conducted within Waypoint. For most practical applications, where a horizontal accuracy of only a metre or greater is required, GDA94 coordinates can be considered the same as WGS84. MGA94 coordinates were obtained by projecting the GPS-derived WGS84 coordinates using a Universal Transverse Mercator (UTM) projection with zone 53. For more information about WGS84, GDA94 and MGA94 coordinates, the reader is asked to visit the Geoscience Australia website http://www.ga.gov.au/earth-monitoring/geodesy/

Elevations above the Australian Height Datum (AHD) were modelled using Waypoint 8.50 software and the latest geoid model for Australia, AUSGEOID09. Information about the geoid and the modelling process used to extract separations (N values) can be found at http://www.ga.gov.au/geodesy/ausgeoid/. To obtain AHD elevation, the modelled N value is subtracted from the GPS derived WGS84/GRS80 ellipsoidal height (Figure 8).

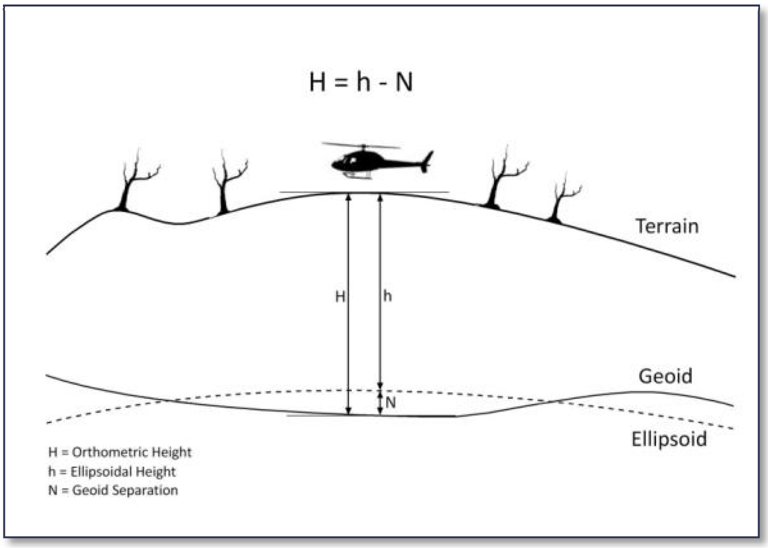


Figure 8: Geoid-Ellipsoid Separation

8.2.3 GPS/GNSS Quality Analysis

Rigorous quality analysis procedures were applied to the acquired GPS/GNSS data on a daily basis using Waypoint Grafnav's built in QA tools. Some of the tools used on this project include:

Combined Separation Plot: This plot shows the difference between the forward and reverse solutions (Figure 9). A perfect solution would have a separation of zero as this indicated the carrier phase ambiguities have been determined to be exactly the same value in both directions. A separation of better than 0.1m on a helicopter survey would indicate that the data is of high quality.

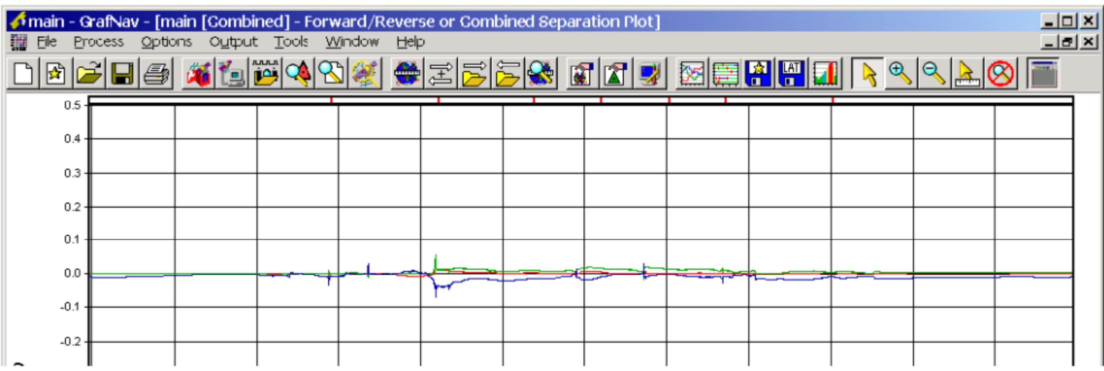


Figure 9: Combined Separation Plot

Float or Fixed Ambiguity Status Plot: This plot shows if the final solution is float or fixed (Figure 10). Fixed integer ambiguities generally have better accuracies (usually < 10cm accuracy). Ideally the plot should show fixed as this indicated an integer ambiguity fix on both forward and reverse directions.

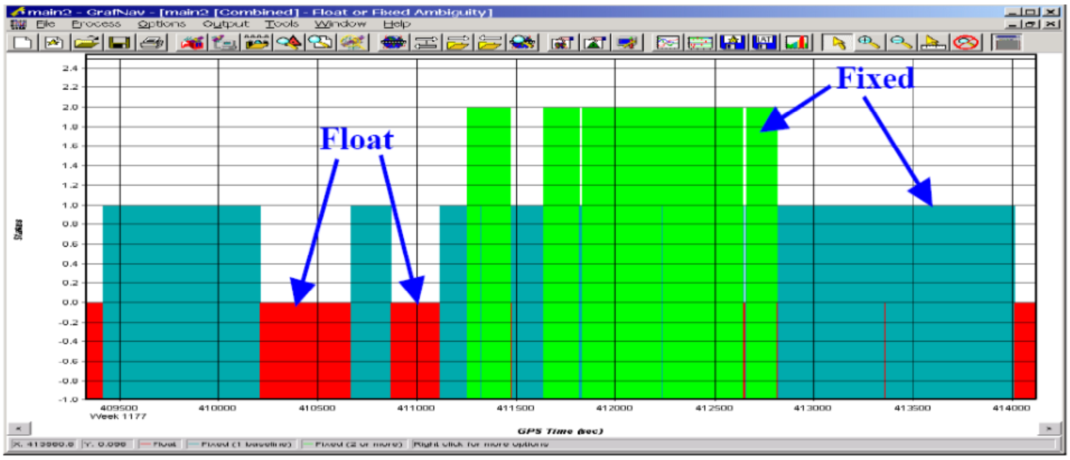


Figure 10: Float or Fixed Ambiguity Status Plot

Quality Factor Plot: This plot shows the quality of the final solution (Figure 11). There are five different quality factors plotted and these factors are also output in the Atlas Geophysics Pty Ltd GPS data file.

Quality 1 – Fixed Integer (Green)
Quality 2 – Stable Float (Aqua)
Quality 3 – Converging Float (Blue)
Quality 4 – DGPS or worse (Red)
Quality 5 – Single Point (Yellow)

Increasing quality factors indicate a worse solution. This is not a perfect indication, but it can be useful to isolate problems.

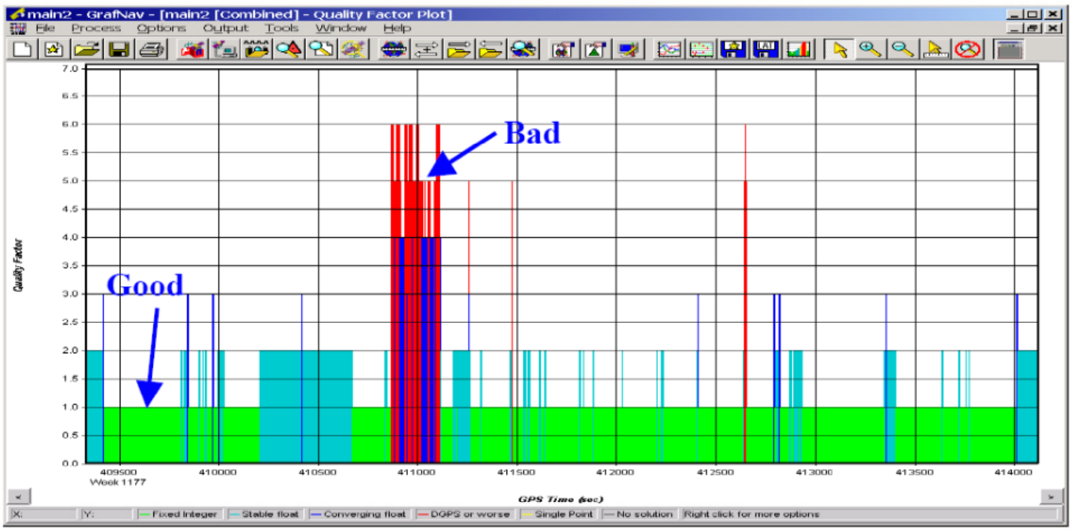


Figure 11: Quality factor plot

Complementing Waypoint GrafNav QA tools is the company's own in-house GPS quality analysis software. A module built into AGRIS (Atlas Geophysics Reduction and Information Software) allows the user to import the Waypoint output files and examine quality factors such as station repeatability between multiple control stations, coordinate velocity, dilution of precision, coordinate quality factor and standard error for each gravity station location. The procedure is carried out before merging the positional data with gravity data for final reduction to Bouguer Anomaly. Comprehensive statistics, repeatability analysis and histogram plotting are also performed.

QA procedures were applied to the GPS/GNSS data on a daily basis and any gravity stations not conforming to contract specifications were repeated by the company at no cost to the client.

8.3 Gravity Data Acquisition, Processing and Quality Analysis

Gravity data were gained using the company's rapid acquisition, high accuracy helicopter-borne techniques. The company's own in-house reduction and QA software was used to reduce the data on a daily basis to ensure quality and integrity. Final delivered data met and exceeded contract specifications.

8.3.1 Calibration of the Gravity Meter

The gravity meters used for survey on this project were calibrated pre and post survey on the Guildford Cemetery – Helena Valley Primary School calibration range (2010990117-2010990217) in Western Australia. The calibration process has validated the gravity meter's scale factor to ensure reduction of the survey data produces correct Observed Gravities from measured dial reading values. Table 4 summarises the results of the calibration ties and lists the resultant scale factor for the survey gravity meter. Appendix E contains the reduced data used to create the summary.

PRE SURVEY CALIBRATION RUN 05/09/2013				
Meter Code	Meter SN	Calc 2010990217 AAGD07 ($\mu m/s^2$)	Diff ($\mu m/s^2$)	Scale
A2	40241	9794483.92	0.07	0.999283
A6	40382	9794483.90	0.05	1.000000

POST SURVEY CALIBRATION RUN 13/01/2013 and 14/01/2014				
Meter Code	Meter SN	Calc 2010990217 AAGD07 ($\mu m/s^2$)	Diff ($\mu m/s^2$)	Scale
A2	40241	9794483.86	0.01	0.999283
A6	40382	9794483.73	0.12	1.000000

Table 4: Gravity meter scale factors

Weekly tilt-tests and cycles were conducted to ensure the meter's drift and tilt correction factors were valid. Gravity meter drift rates were monitored on a day to day basis using AGRIS software.

8.3.2 Acquisition of the Gravity Data

Gravity data were acquired concurrently with GPS/GNSS data using Scintrex CG5 gravity meters. Data were acquired in a single shift of ten hours duration, with each shift consisting of a single loop controlled by observations at the gravity control stations. Each loop contained a minimum of two repeated readings so that an interlocking network of closed loops was formed. A total of **10.00%** repeats were acquired for quality control purposes. Repeat readings were evenly distributed on a time-basis throughout each of the gravity loops.

The gravity acquisition crew consisted of a single gravity operator and pilot per helicopter. The pilot was responsible for safely navigating to each station, and once at the station, the operator disembarked from the helicopter and acquired the gravity data. The observation point was always situated in front of the aircraft, in the pilot's view. Under no circumstances were readings taken outside of the pilot's view as this can jeopardise the safety of the operator. As the helicopter always landed on flat ground, the error due to the gravity observation not being coincident with the GPS/GNSS observation is minimal. A small latitude based error of less than 0.05 $\mu m/s^2$ would apply, but this is not seen to be appreciable on a regional gravity survey, so is not corrected for.

At each station, the gravity operator took a minimum of two gravity readings of 20 second duration so that any seismic or wind noise could be detected. Control station readings were set to 60 second duration. Before taking the reading, the operator ensured that the instrument tilt-reading was restricted to less than 5 arc-seconds and after the reading, not higher than 20 arc-seconds. Tilt-testing prior to project commencement showed that the gravity meters performed well even at extreme tilts (better than 0.05 $\mu m/s^2$ at +150/-150 arc-seconds).

If two separate readings did not agree to better than 0.20 $\mu m/s^2$ (0.10 $\mu m/s^2$ for control station readings), then the operator continued taking readings until the tolerance between consecutive readings was achieved. At the conclusion of the gravity reading, the final data display on the gravity meter was analysed to ensure the instrument was performing to specification and that the station observation provided data conforming to the project specifications. The operator also checked that the temperature, standard deviation and rejection values were within required tolerance before recording the reading. At each station, the operator recorded the gravity data digitally in the gravity meter as well as in an Atlas Geophysics Pty Ltd field book so that instrument drift and reading repeatability could be analysed easily whilst in the field. Data recorded at each GSL was assigned a unique station code and station number.

Repeat stations were marked with a biodegradable flagging tape for subsequent reoccupation. When reoccupying stations, the pilot positioned the helicopter as close to the original landing spot as possible (usually better than 0.5m). A very small percentage of the repeat stations were positioned greater than 0.5m from the original location due to soft ground and/or windy conditions, but always on flat ground at the same level as the original observation. All repeat gravity observations were taken in exactly the same location, even if the helicopter landed slightly offset from the original position.

8.3.3 Processing of the Gravity Data

The acquired gravity data were processed using the company's in-house gravity pre-processing and reduction software, AGRIS. This software allows for full data pre-processing, reduction to Bouguer Anomaly, repeatability and statistical analysis, as well as full quality analysis of the output dataset.

The software is capable of downloading Scintrex CG3/CG5 and Lacoste Romberg gravity data. Once downloaded, the gravity data is analysed for consistency and preliminary QA is performed on the data to check that observations meet specification for standard deviation, reading rejection, temperature and tilt values. Once the data is verified, the software averages the multiple readings and performs a merge with the GPS data (which it has also previously verified) and performs a linear drift correction and earth tide correction. Calculation of Free Air and Bouguer Anomalies is then performed using the contract specified formulae.

The following corrections were applied to the dataset to produce Bouguer Anomaly values for each of the gravity stations. All formulae produce values in µm/s^2.

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

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

where,
r_c corrected reading in µm/s^2
r gravity meter reading in dial units
$S(r)$ scale factor (dial units/mGal)

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

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

where,
r_t tide corrected reading in µm/s^2
r_c scale factor corrected reading in µm/s^2
g_{tide} Earth Tide Correction (ETC) in µm/s^2

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

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

where,

ID Instrument Drift in µm/s^2 /hour
r_{cs2} control station 2nd reading in µm/s^2
r_{cs1} control station 1st reading in µm/s^2
t_{cs2} control station 2 time
t_{cs1} control station 1 time

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

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

where,

G_o Observed Gravity in µm/s^2
g_{cs1} control station 1 known observed gravity in µm/s^2
r_t tide corrected reading in µm/s^2
r_{cs1} control station 1 reading in µm/s^2
t reading time
t_{cs1} control station 1 time
ID instrument drift in µm/s^2/hour

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

$$G_n = 9780326.7715((1 + 0.001931851353(sin^2 l)/(SQRT(1 - 0.0066943800229(sin^2 l)))$$

where,

G_n Theoretical Gravity in gravity units
l GDA94 latitude at the gravity station in decimal degrees

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

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

where,

AC Atmospheric Correction in gravity units
h elevation above the GRS80 ellipsoid in metres

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

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

where,
FAC Free Air Correction in gravity units
l GDA94 latitude at the gravity station in decimal degrees
h elevation above the GRS80 ellipsoid in metres

Bouguer Correction: If a gravity observation is made above the reference ellipsoid, the effect of rock material between the observation and the ellipsoid must be taken into account. The mass of rock makes a positive contribution to the gravity value. The correction is calculated using the closed form equation for the gravity effect of a spherical cap of radius 166.7km, based on a spherical Earth with a mean radius of 6,371.0087714km, height relative the ellipsoid and a rock density of 2.67 t/m^3.

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

where,
BC Bouguer Correction in gravity units
G gravitational constant = $6.67428 \cdot 10^{-11} m^3 kg^{-1} s^{-2}$
ρ rock density (2.67 t/m^3)
h elevation above the GRS80 ellipsoid in metres
R $(R_o + h)$ the radius of the earth at the station
R_o mean radius of the earth = 6,371.0087714 km (on the GRS80 ellipsoid)
μ & λ are dimensionless coefficients defined by:

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

where,
η h/R

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

where,
d $3 \cdot cos^2\alpha - 2$
f $cos\alpha$
k $sin^2\alpha$
p $-6 \cdot cos^2\alpha \cdot \sin(\alpha/2) + 4 \cdot sin^3(\alpha/2)$
δ (R_o/R)
m $-3 \cdot k \cdot f$
n $2 \cdot [sin\,(\alpha/2) - sin^2(\alpha/2)]$
α S/R_o with S = Bullard B Surface radius = 166.735 km

Terrain Correction: The terrain correction accounts for variations in gravity values caused by variations in topography near the observation point. The correction accounts for the attraction of material above the assumed spherical cap and for the over-correction made by the Bouguer correction when in valleys. The terrain correction is positive regardless of whether the local topography consists of a mountain or a valley. Section 8.3.4 contains a more in-depth discussion of the terrain correction process.

Free Air Anomaly: The free air anomaly is the difference between the observed gravity and normal gravity that has been computed for latitude and corrected for the elevation of the gravity station above or below the reference ellipsoid:

$$FAA = G_o - (G_n - AC) - FAC$$

where,
FAA Free Air Anomaly in gravity units
G_o Observed Gravity in gravity units
G_n Normal Gravity in gravity units
AC Atmospheric Correction in gravity units
FAC Free Air Correction in gravity units

Bouguer Anomaly: The Bouguer anomaly is computed from the free air anomaly above by removing the attraction of the spherical cap calculated by the Bouguer correction.

$$BA = FAA - BC$$

where,
BA Bouguer Anomaly in gravity units
FAA Free Air Anomaly in gravity units
BC Bouguer Correction in gravity units

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

$$CBA = BA + TC$$

where,
CBA Complete Bouguer Anomaly in gravity units
BA Bouguer Anomaly in gravity units
TC Terrain Correction in gravity units

8.3.4 Terrain Corrections

Terrain corrections, which account for the variation in gravity due to topography proximal to the gravity station, were computed using a digital elevation model (DEM) and RASTERTC software from Geopotential. RASTERTC software permits the user to input a DEM in the form of a binary grid file, and gravity data in an ASCII file. From this information, the software is capable of calculating extremely accurate terrain corrections. For more detailed information regarding the software and algorithm, the reader is asked to visit the Geopotential website http://geopotential.com/docs/RasterTC/RasterTC.html

Elevation data were sourced from the 1 second SRTM Level 2 Derived Smoothed Digital Elevation Model (DEM-S) Version 1.0 which has an equivalent cell size of 30m. Data were extracted to provide a 30km buffer from the extents of the gravity survey.

A comparison against GPS heights recorded during the gravity survey revealed that the DEM data were sufficiently accurate to be used in regional terrain corrections. The average difference between GPS height and DEM heights was -1.81 m and the standard deviation of the differences was 2.37 m.

When executing the terrain correction, the following inputs were used with RASTERTC:

R_{MIN} = 30 m
R_{MED} = 250 m
R_{MAX} = 30000 m
Angle = 6 degrees

RMIN was selected to enable correction for topography near to the gravity station and coincided with the grid cell size of the SRTM DEM. RMAX was selected to allow for outer zone correction of severe topography at large distances from the gravity station. RMED was chosen so that the DEM would be sampled at an interval close to the grid cell size of the DEM when using the 6 degree integration angle.

The terrain correction software provides indicators for terrain correction quality and accuracy as part of its output (included on the data DVD as Appendix J). The output variables QFINNER and QFOUTER specify the quality factor for each correction made. If these factors have a value of 0, then the user can assume that the terrain correction proceeded successfully. If non-zero values are reported, then the value of the QF factor will provide an indication as to possible problems or inadequacies in the correction.

For the inner zone correction, an 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 5).

For the outer zone correction, a result of 0 means that the correction proceeded successfully. If a portion of the outer-zone terrain is missing from the DEM 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	Explanation 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

Table 5: Terrain Correction Error Codes

8.3.5 Quality Analysis of the Processed Gravity data

Following reduction of the data to Bouguer Anomaly, repeatability and QA procedures were applied to both the positional and gravity observations using AGRIS software. AGRIS checks the following as part of its QA processing:

- Easting Observation Repeatability and Histogram
- Northing Observation Repeatability and Histogram
- Elevation Observation Repeatability and Histogram
- Gravity Observation Repeatability and Histogram
- Gravity SD, Tilt XY, Temperature, Rejection, Reading Variance
- Gravity meter drift / closure
- Gravity meter loop time, drift per hour
- GPS Dilution of Precision, Coordinate Quality Factor, Standard Error
- Variation of surveyed station location from programmed location

QA procedures were applied to the gravity data on a daily basis and any gravity stations not conforming to contract specifications were repeated by the company at no cost to the client.

8.3.6 Additional Processing, Gridding and Plotting

Complementing the QA procedures is additional daily gridding, imaging and plotting of the elevation and gravity data. Once processed to Bouguer Anomaly and assessed for QA, data are imported into Geosoft Oasis Montaj or ChrisDBF software for gridding at 1/5th the station spacing to produce ERMapper compatible grid files. Resultant grids are contoured, filtered and interpreted using ERMapper and ArcMap software to check that data is smoothly varying and that no spurious anomalies are present. A first vertical, tilt angle and horizontal derivative filter are routinely applied to the data as these filters allow for excellent noise recognition. Once identified, any spurious stations can be field checked by the helicopter crew the following day and repeated if required. During the course of the survey one anomalous station was field checked and found to be valid.

Plotting of the acquired stations on a daily basis allowed for identification of any missed stations which were then gained the following day.

9.0 Results

Despite thick vegetation, high grass and the very hot and humid weather conditions experienced throughout the duration of the project, the survey was completed ahead of schedule. Thankfully, the survey was completed before the onset of the wet season which would have made surveying almost impossible.

A total of **6,275** new gravity stations were gained during the survey.

Final data have been delivered to a technically excellent standard and are presented both digitally and hardcopy as Appendices to this report.

9.1 Survey Timing and Production Rates

The survey crew began gravity data acquisition on Tuesday 15th October 2013 with survey cessation on Saturday 16th November 2013. The only downtime experienced was due to logistical base moves, remote GPS base establishment, a few periods of inclement weather and some minor helicopter maintenance. On the whole, production was consistent and constant with the crew's efforts commendable considering the uncomfortable weather conditions.

A full production report can be found on the data DVD (Appendix J).

9.2 Data Formats

Final point located data for the project have been delivered in ASEG-GDF2 compliant format. Appendix I contains a listing of the definition and description files accompanying the final data.

Raw GPS-GNSS and gravity data in their respective native formats have been included on the data DVD as Appendix J. Table 6 overleaf summarises the deliverables.

Final Delivered Data	Format	Data DVD	Hardcopy
Gravity Database	Point located data ASEG-GDF2	•	
Raw Positional Data	AGRIS format, comma delimited	•	
Raw Gravity Data	Scintrex CG5 format	•	
Raw GPS-GNSS Data	Waypoint GPB Binary	•	
Gravity Control Data	Microsoft Excel Format	•	•
Calibration Data	Microsoft Excel Format	•	•
Repeat Data	Microsoft Excel Format	•	•
Terrain Corrections	RASTERTC output file	•	
Final Grids	ERMapper Grids .ers	•	
Final Images	Geotiff Images	•	•
Acquisition Report	PDF .pdf	•	•

Table 6: Final Deliverables

9.3 Data Repeatability: All Observations

The repeatability of both the gravity and GPS data was excellent. In total, **628** gravity and GPS repeat stations were collected and analysed. As a percentage, this equates to **10.00%** of the total number of new gravity stations acquired. Repeat stations were acquired so that an even distribution between gravity loops was established and that all loops were interlocked.

Descriptive statistics pertaining to the repeatability are contained in Table 7 and Appendix F contains a tabulation of the actual repeat data for the entire survey.

The standard deviation of the gravity repeat deviations was **0.41 μm/s²** and the standard deviation of the GPS derived elevation repeat deviations was **0.081m**. These statistics confirm that the data has met and exceeded contract specifications.

	Elevation Repeat (mGRS80)	Gravity Repeat (μm/s²)
Mean	-0.003	0.04
Standard Error	0.003	0.02
Median	-0.004	0.05
Mode	-0.026	0.15
Standard Deviation	0.083	0.41
Sample Variance	0.007	0.17
Kurtosis	-0.354	-0.29
Skewness	0.075	0.02
Range	0.401	1.96
Minimum	-0.201	-0.96
Maximum	0.200	1.00
Sum	-1.643	23.88
Count	628	628

Table 7: Repeat Statistics

9.3.1 Repeatability Histograms

Histograms showing the distribution of repeat differences for both the GPS and gravity observations are shown in Figures 12 and 13.

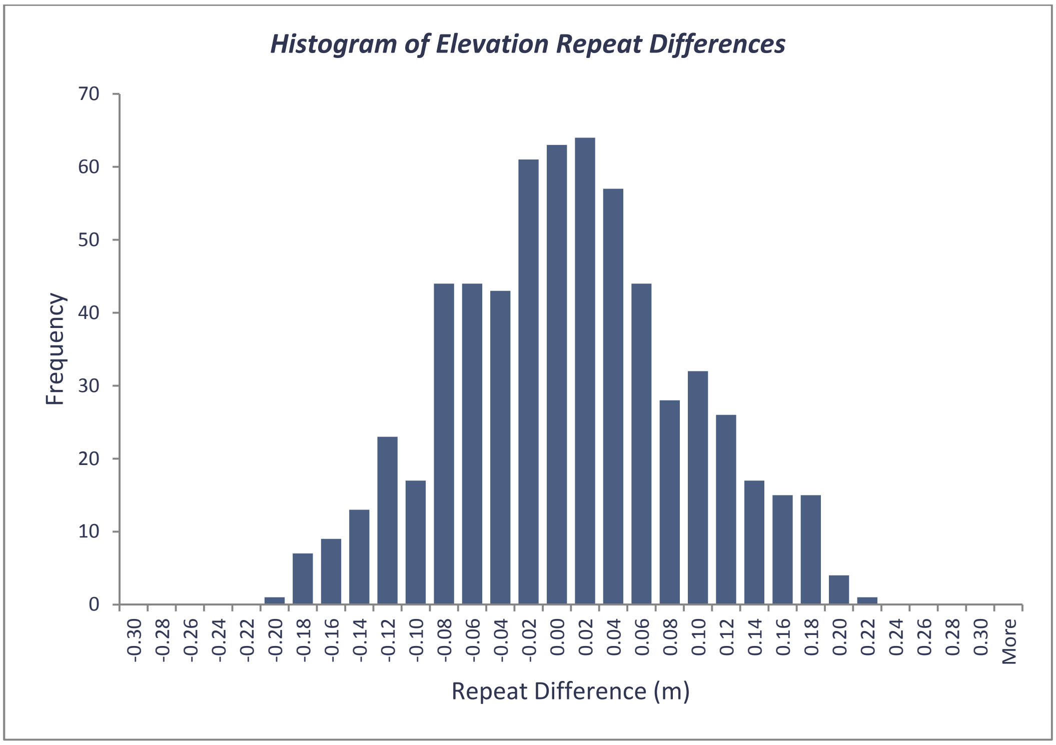


Figure 12: Histogram of GPS Repeat Differences

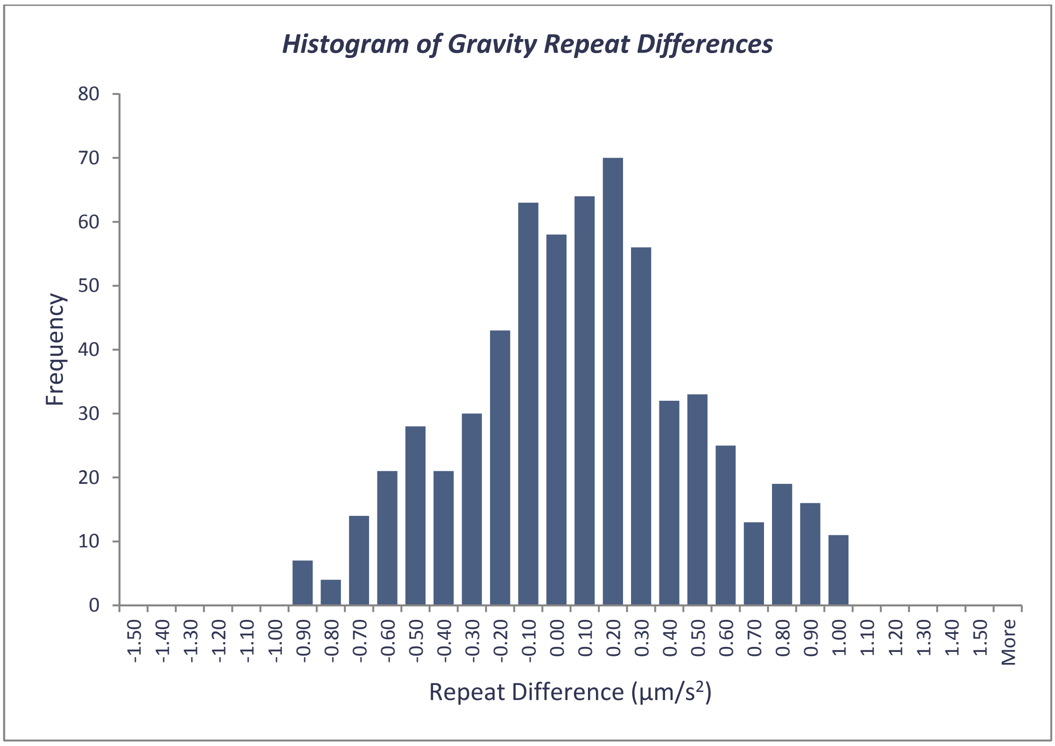


Figure 13: Histogram of Gravity Repeat Differences

9.4 Data Repeatability: Multiple Control Station Observations Only

The repeatability of gravity and GPS observations made with respect to multiple control stations was also analysed separately to the main database.

Descriptive statistics pertaining to the repeatability are contained in Table 8 and Appendix G contains a tabulation of the actual repeat data controlled from multiple control stations.

The standard deviation of the gravity repeat deviations was **0.41µm/s^2** and the standard deviation of the GPS derived elevation repeat deviations was **0.097m**. These statistics confirm that the data has met and exceeded contract specifications for data controlled from multiple control stations.

	Elevation Repeat (mGRS80)	Gravity Repeat (µm/s^2)
Mean	-0.003	0.05
Standard Error	0.012	0.08
Median	-0.014	0.11
Mode	-0.030	0.58
Standard Deviation	0.097	0.41
Sample Variance	0.009	0.16
Kurtosis	-0.802	-0.53
Skewness	0.110	-0.51
Range	0.371	1.31
Minimum	-0.177	-0.73
Maximum	0.194	0.58
Sum	-0.171	1.08
Count	61	23

Table 8: Repeat Statistics

9.4.1 Multiple Control Station Repeatability Histograms

Histograms showing the distribution of repeat differences for both the GPS and gravity observations from multiple control stations are shown in Figures 14 and 15.

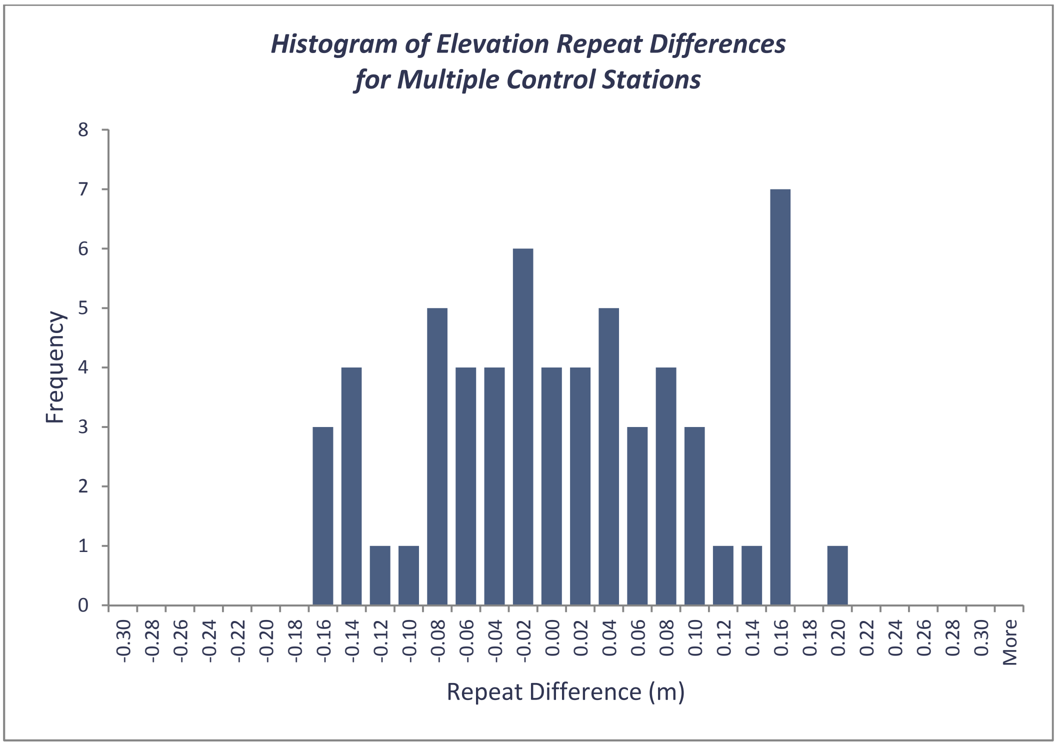


Figure 14: Histogram of GPS Repeat Differences

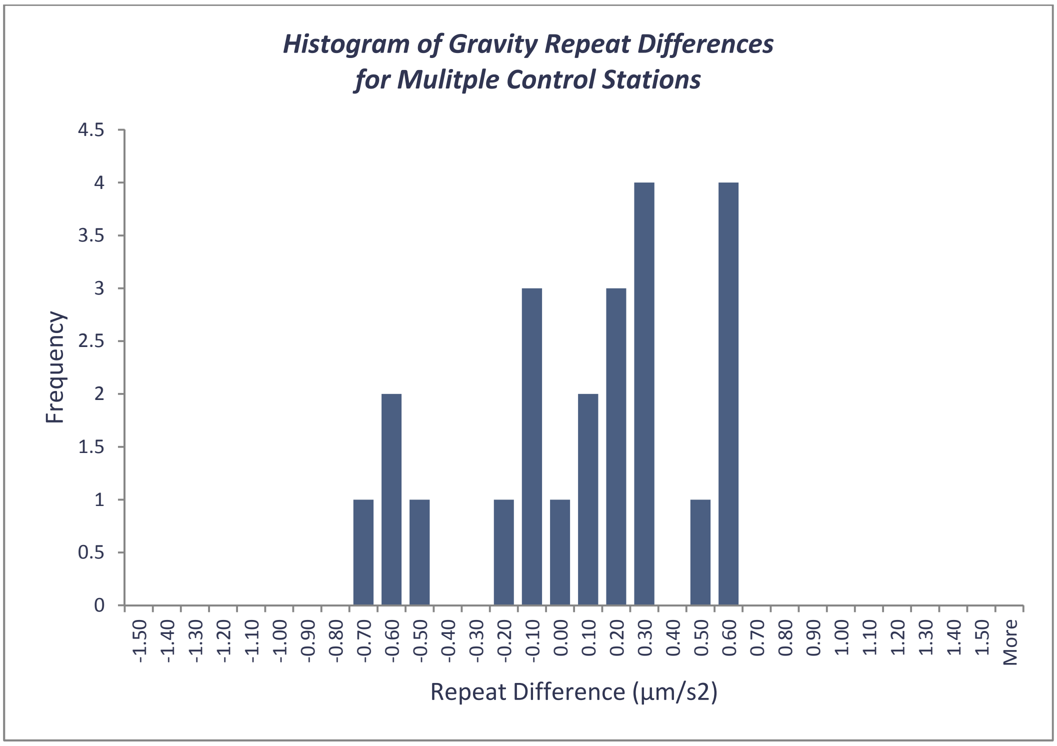


Figure 15: Histogram of Gravity Repeat Differences

9.5 Grids, Images and Plots

Final reduced data have been gridded using ChrisDBF software and a minimum curvature algorithm with multiple loops. All grids are provided in ERMapper compatible .ers format and are in units of $\mu m/s^2$ and m (GRS80).

Grids for GPS Derived Elevation (GRS80), Complete Spherical Cap Bouguer Anomaly (CSCBA267) and 1st vertical derivative of Complete Bouguer Anomaly (CBA267VD) were produced for this particular project. The grid cell size for all grids is 800m.

The grids produced have been imaged using Geosoft Oasis Montaj mapping and processing software. Five plots of these images have been included with this report to assist in data interpretation (Appendix A). The plots have been included digitally on the data DVD in Arcmap GIS compatible TIFF format.

Station Location Plot: The first plot displays the acquired gravity station locations overlayed on a 1:1 million topographic map of the area and surrounds. As evident on the plot, some stations have been moved off the original programmed co-ordinates due to terrain and safety considerations.

GPS Derived Elevation: This plot displays a pseudocoloured grid of the digital elevation data obtained from the gravity survey (GRS80). A histogram equalisation colour stretch has been applied when pseudocolouring and a sunshade from the north-east has been applied.

Complete Bouguer Anomaly 2.67 Contours: This plot displays a pseudocoloured grid of Complete Bouguer Anomaly calculated with a rock density of 2.67 t/m^3. A histogram equalisation stretch has been applied when pseudocolouring. Overlying the image data are contours created at an appropriate interval.

Complete Bouguer Anomaly 2.67 Sunshade: This plot displays a pseudocoloured grid of Complete Bouguer Anomaly calculated with a rock density of 2.67 t/m^3. A histogram equalisation stretch has been applied when pseudocolouring and a sunshade from the north-east has been applied.

Vertical Derivative Image: This plot displays a pseudocoloured grid of the first vertical derivative of Complete Bouguer Anomaly calculated with a rock density of 2.67 t/m^3. A histogram equalisation stretch has been applied when pseudocolouring and sunshading from the north-east has been applied. This image represents the rate of change of the Complete Bouguer Anomaly and is useful for detecting lineaments and body edges, especially where there are large regional gradients present.

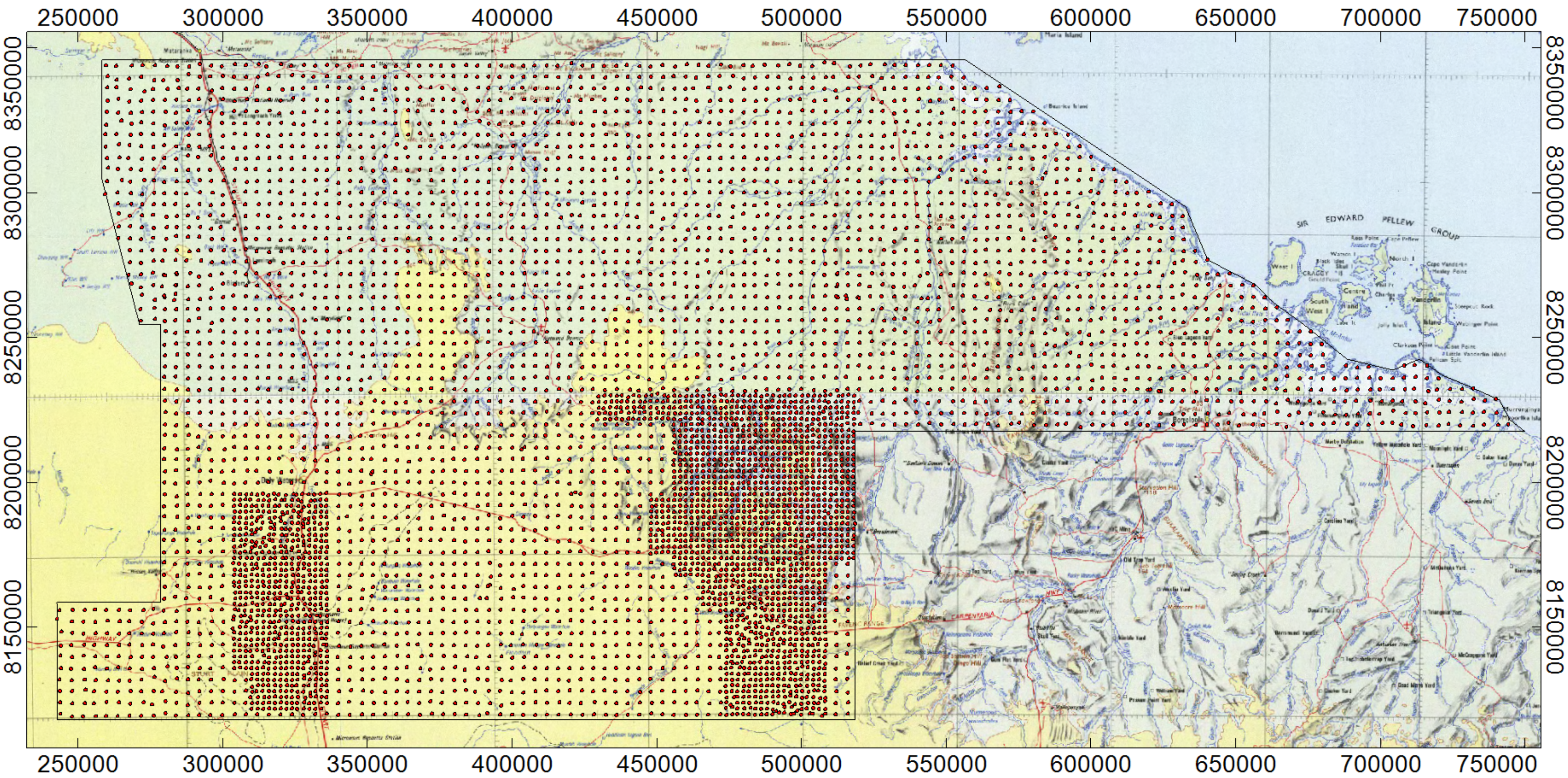
10.0 Conclusion

Atlas Geophysics Pty Ltd is confident that it has delivered high quality data to its client, to a high standard and in the safest way possible.

The company was pleased to be involved in the acquisition and processing of the gravity data collected on this project and look forward to working with Geoscience Australia again in the future.

Leon Mathews
Director

APPENDIX A
Plots and Images



Scale 1:2320000

25000 0 25000 50000 75000

(meters)

GDA94 / MGA zone 53

GEOSCIENCE AUSTRALIA

P2013046 GA SOUTH MCARTHUR BASIN GRAVITY SURVEY

Plot of Gained Gravity Stations

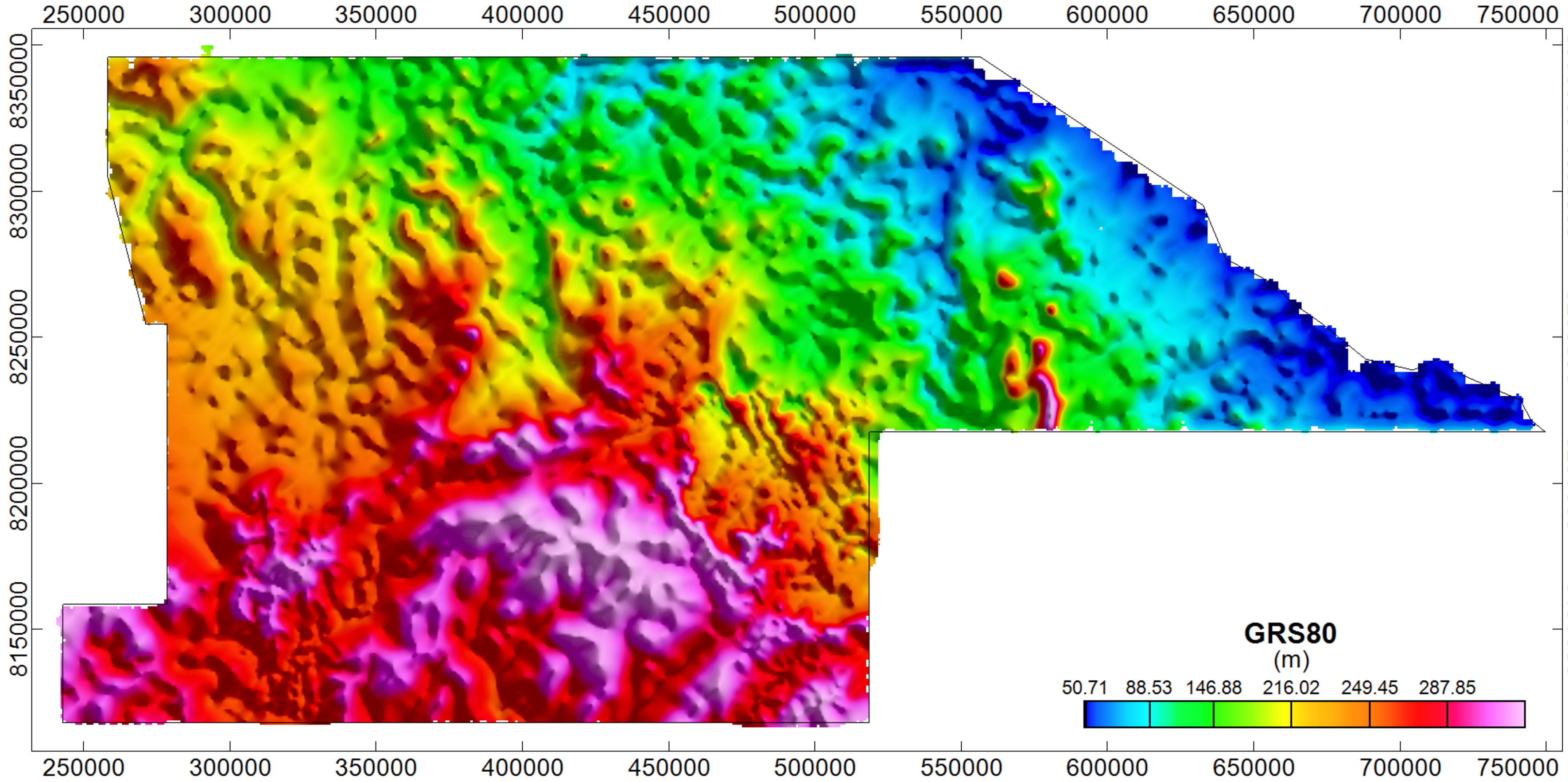
4000m x 4000m and 2000m x 2000m Grid Configuration

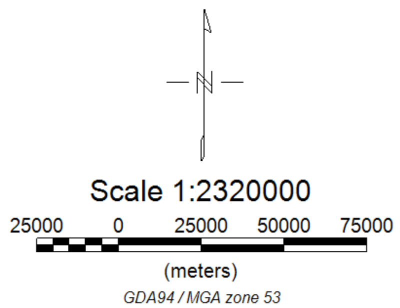
ATLAS GEOPHYSICS PTY LTD

FINAL DATA RELEASE

www.atlasgeo.com.au

drawn by : BEH





GEOSCIENCE AUSTRALIA

P2013046 GA SOUTH MCARTHUR BASIN GRAVITY SURVEY

Pseudocoloured Image of GPS Derived Elevation (GRS80)

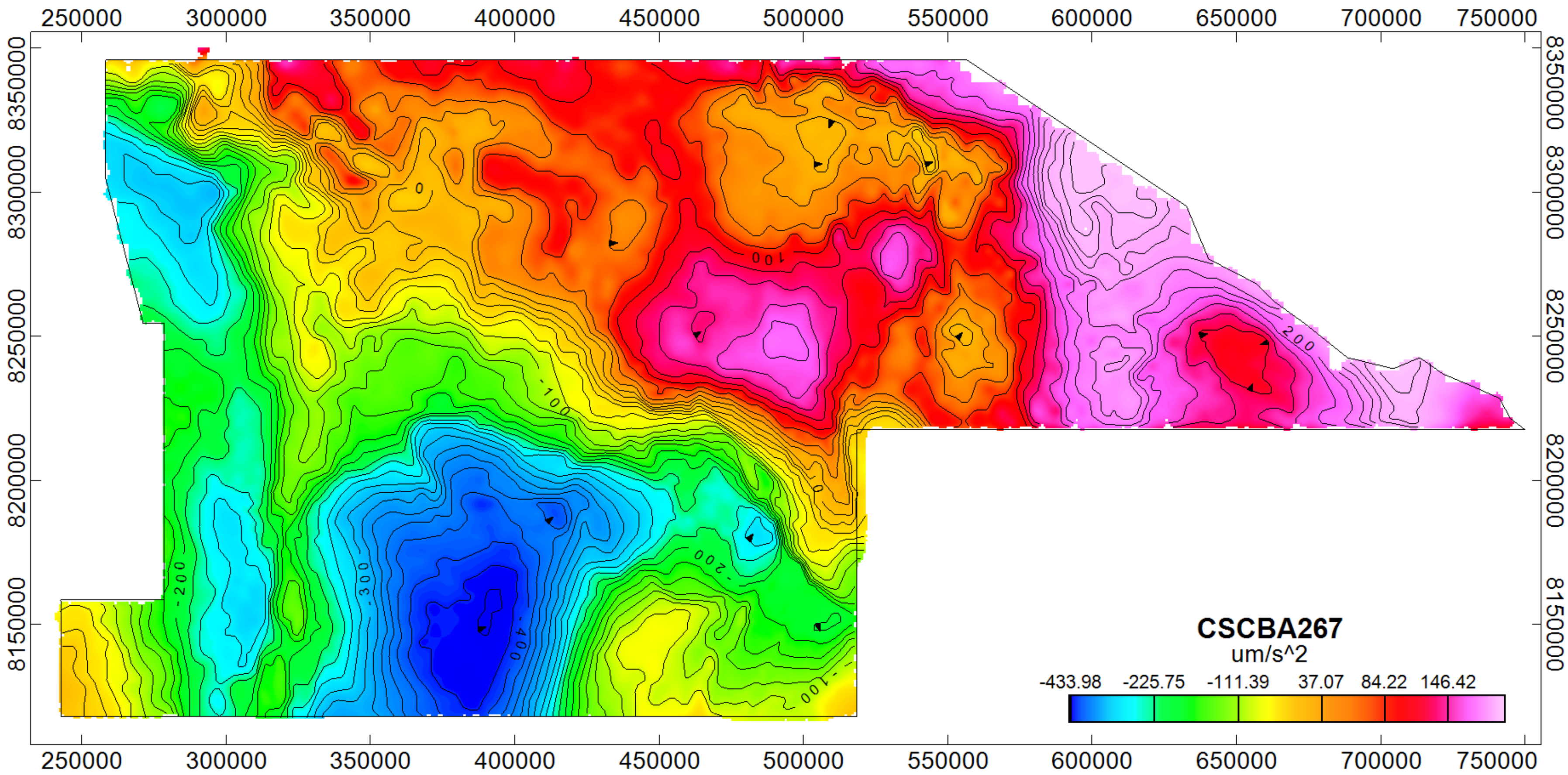
Shade = NE , Contours = None, Histo =Equalised

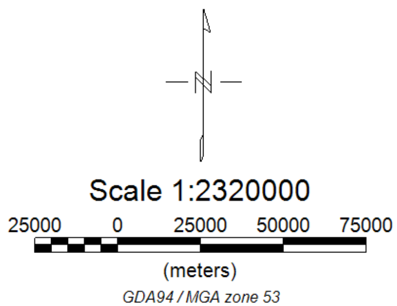
ATLAS GEOPHYSICS PTY LTD

FINAL DATA RELEASE

www.atlasgeo.com.au

drawn by : LRM





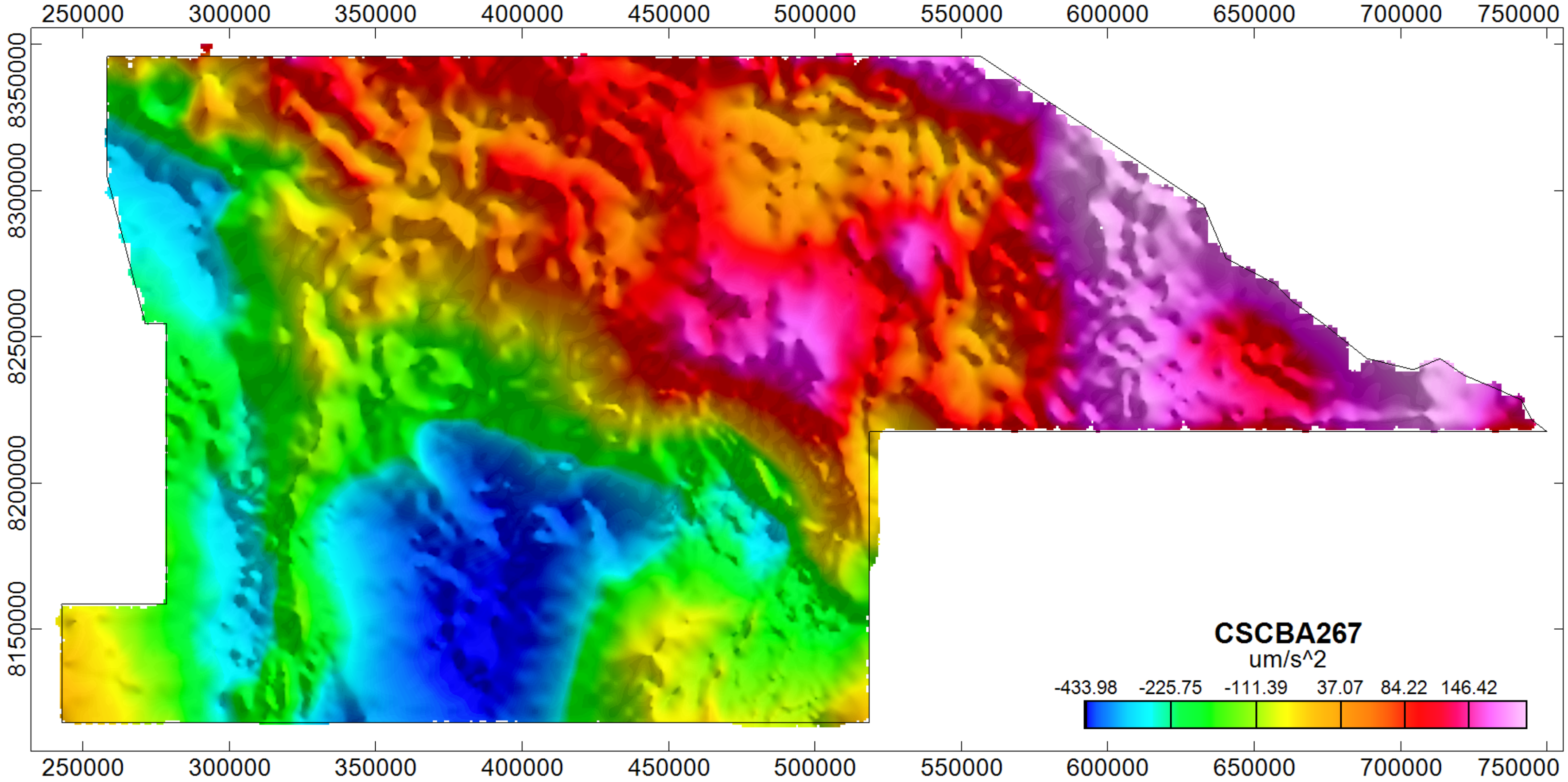
GEOSCIENCE AUSTRALIA

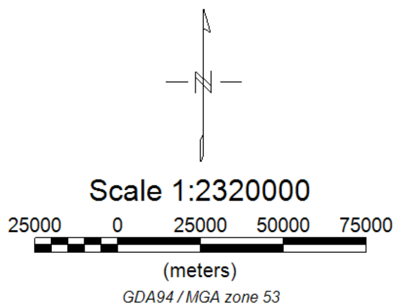
P2013046 GA SOUTH MCARTHUR BASIN GRAVITY SURVEY

Pseudocoloured Image of Complete SC Bouguer Anomaly t/m^3
Shade = None , Contours = 20 um/s^2, Histo =Equalised

ATLAS GEOPHYSICS PTY LTD
FINAL DATA RELEASE
www.atlasgeo.com.au

drawn by : LRM





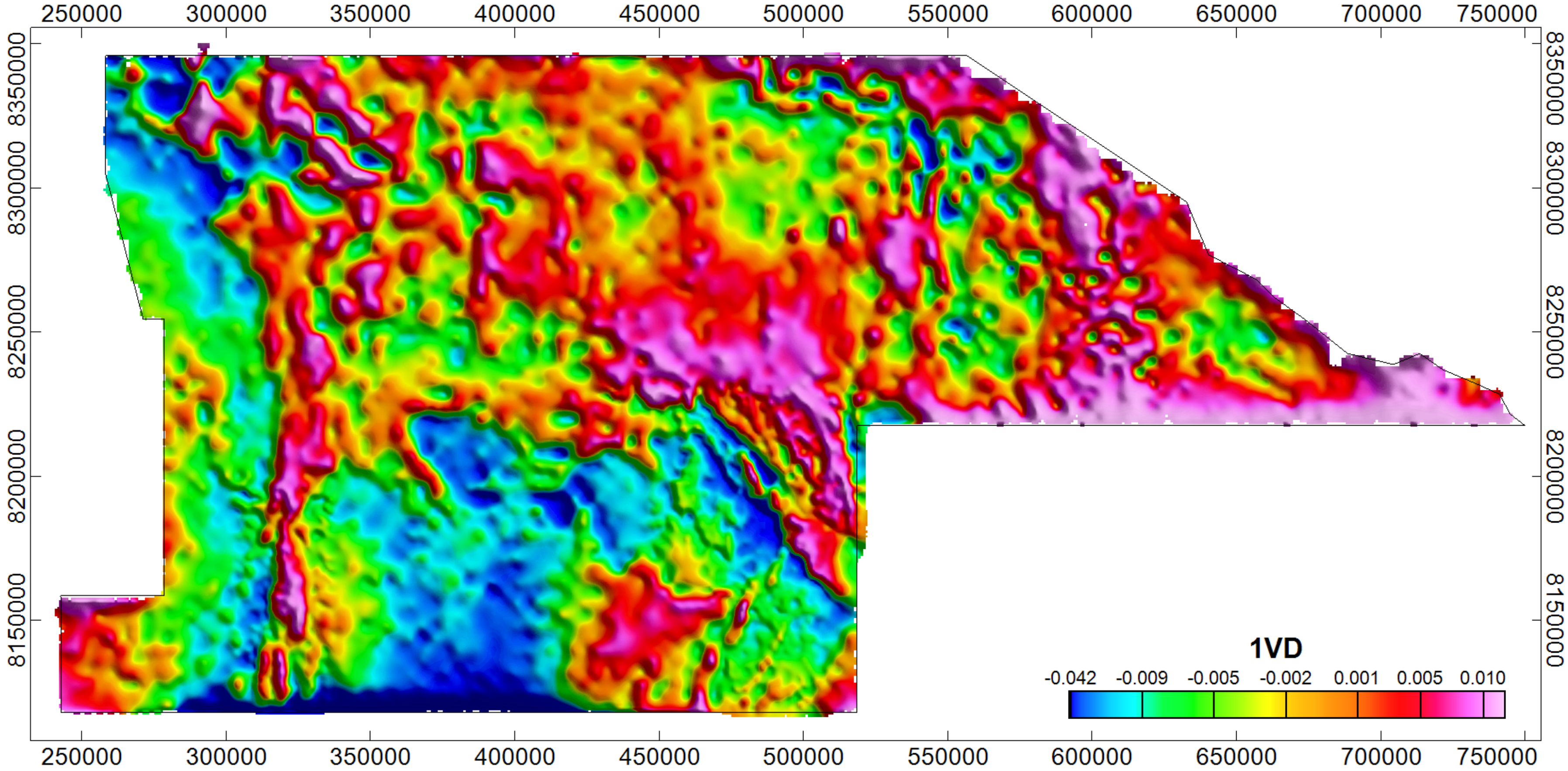
GEOSCIENCE AUSTRALIA

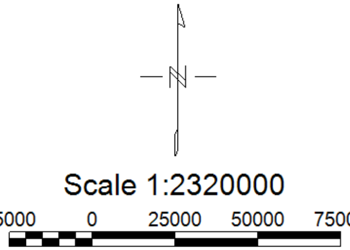
P2013046 GA SOUTH MCARTHUR BASIN GRAVITY SURVEY

Pseudocoloured Image of Complete SC Bouguer Anomaly t/m^3
Shade = NE , Contours = None, Histo =Equalised

ATLAS GEOPHYSICS PTY LTD
FINAL DATA RELEASE
www.atlasgeo.com.au

drawn by : LRM





Scale 1:2320000

25000 0 25000 50000 75000

(meters)

GDA94 / MGA zone 53

GEOSCIENCE AUSTRALIA

P2013046 GA SOUTH MCARTHUR BASIN GRAVITY SURVEY

Pseudocoloured Image of 1VD of Complete SC Bouguer Anomaly t/m^3

Shade = NE , Contours = None, Histo =Equalised

ATLAS GEOPHYSICS PTY LTD

FINAL DATA RELEASE

www.atlasgeo.com.au

drawn by : LRM

APPENDIX B
Control Station Descriptions

201304600001 (GA 20138100001) – DALY WATERS HIWAY INN

GDA94/GRS80		MGA Z53		AMG Z53	
Latitude	-16 18 25.7348	*Easting*	327,628.777	*Easting*	327,499.178
Longitude	133 23 11.8316	*Northing*	8,196,407.510	*Northing*	8,196,238.432
Ellipsoidal Height	258.342	*Orthometric Height*	216.907	*Orthometric Height*	216.907

OBSERVED GRAVITY	
AAGD07 μm/s²	9783723.92

Occupation Method/Location Details

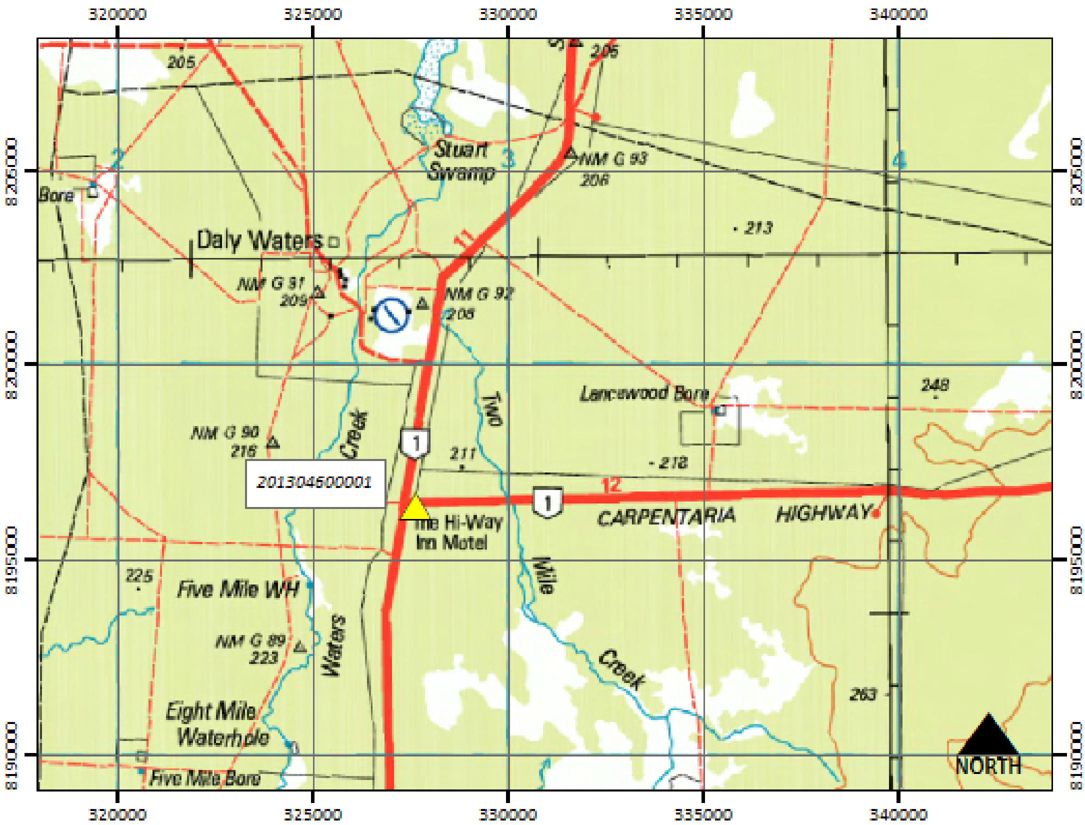
The GPS control point consists of a dumpy steel star picket driven into the ground to a height of 10cm above ground level. The gravity control point consists of a small concrete slab (30cm square) concreted into the ground, opposite the GPS control point. The control station is witnessed by an Atlas Geophysics survey plaque attached to a 1.5 metre steel picket placed within 0.5m of both control points.

Gravity Control was established by Atlas Geophysics via ABA loops with one of the project gravity meters to AFGN station 1964910133 Daly Waters A/S. Expected accuracy would be better than 0.1 μm/s^2.

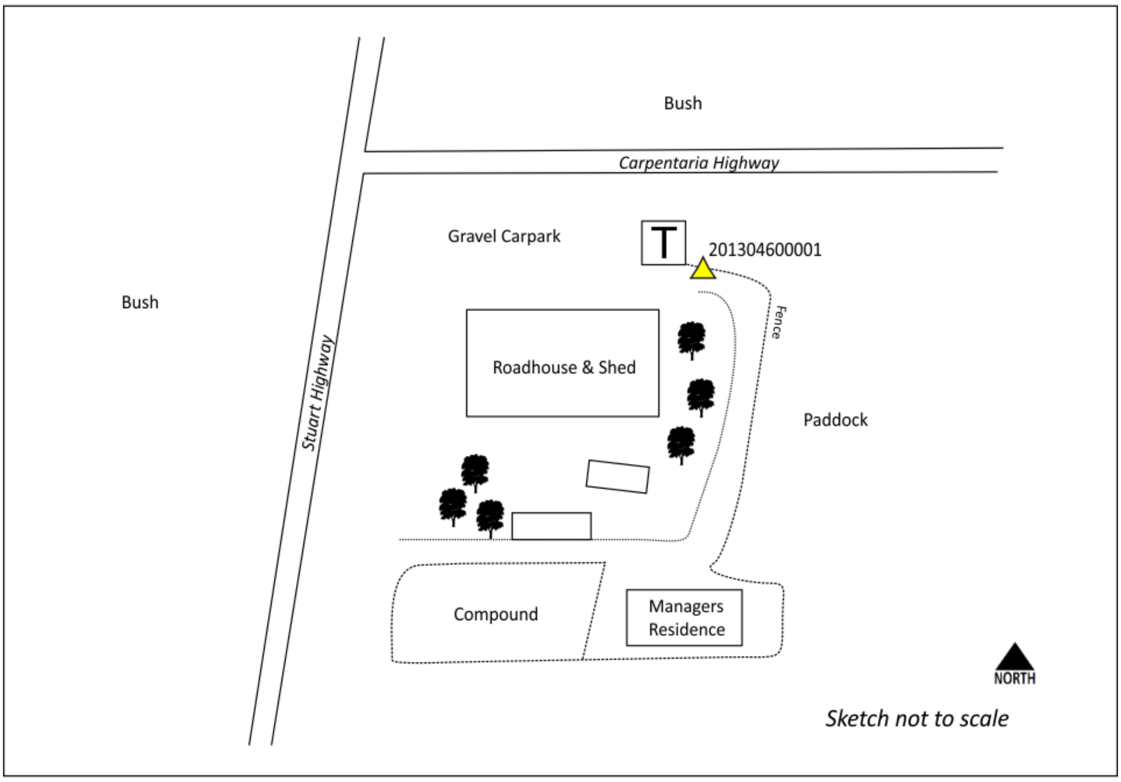
GPS Control was established using AUSPOS. Three separate +10 hour sessions were submitted to Geoscience Australia's online processing system, AUSPOS. Returned coordinates were accurate to better than 0.01m.

The station is located within the confines of the Daly Waters Hiway Inn Caravan Park, in the north-east corner of the complex. The station sits about about 1m south of the intersection of a white steel boundary fence and a wire mesh fence surrounding a Telstra communications tower. Daly Waters Hiway Inn is located at the intersection of the Stuart Highway and Carpentaria Highway.

Photograph of Control Station 201304600001



Location of Control Station 201304600001



Locality Sketch of Control Station 201304600001

201304600002 (GA 20138100002) – MATARANKA TERRITORY MANOR

GDA94/GRS80		MGA Z53		AMG Z53	
Latitude	-14 55 3.3032	*Easting*	292,224.992	*Easting*	292,095.132
Longitude	133 4 6.2439	*Northing*	8,349,887.672	*Northing*	8,349,719.293
Ellipsoidal Height	176.815	*Orthometric Height*	130.204	*Orthometric Height*	130.204

OBSERVED GRAVITY	
AAGD07 μm/s²	9783525.61

Occupation Method/Location Details

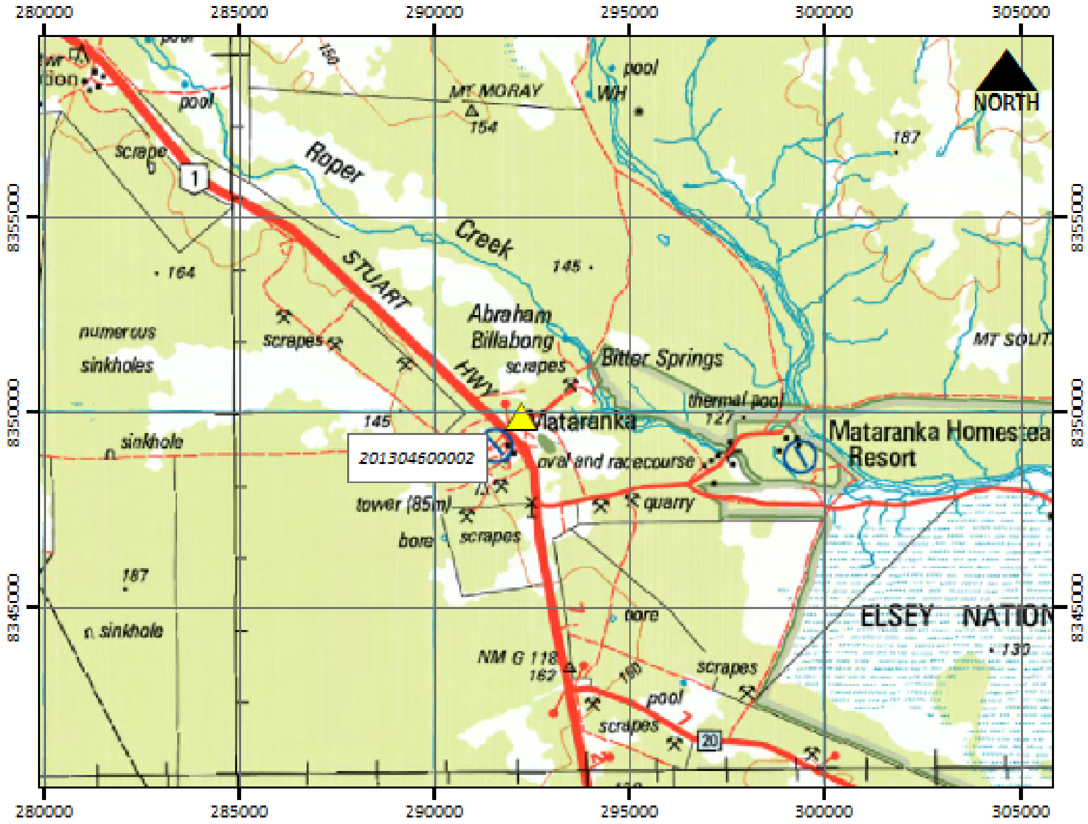
The GPS control point consists of a dumpy steel star picket driven into the ground to a height of 10cm above ground level. The gravity control point consists of a small concrete slab (30cm square) concreted into the ground, opposite the GPS control point. The control station is witnessed by an Atlas Geophysics survey plaque attached to a 1.5 metre steel picket placed within 0.5m of both control points.

Gravity Control was established by Atlas Geophysics via multiple ABA loops with two gravity meters to AFGN station 1964910133 Daly Waters A/S. Expected accuracy would be better than 0.1 μm/s^2.

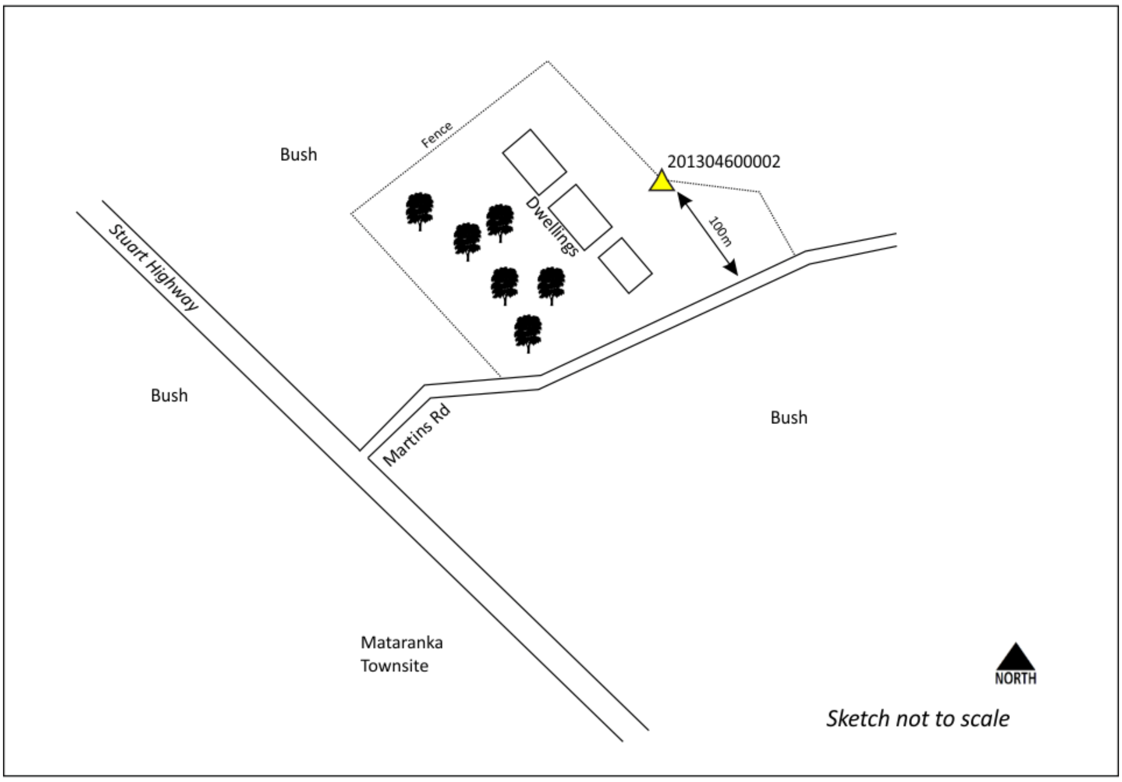
GPS Control was established using AUSPOS. Three separate +10 hour sessions were submitted to Geoscience Australia's online processing system, AUSPOS. Returned coordinates were accurate to better than 0.01m.

The control station is located adjacent to the boundary fence of the Territory Manor Caravan Park, Mataranka. The station sits on the south side of a cyclone fence marking the northern boundary of the park (approximately 100m from the cabins). Territory Manor Caravan Park is accessible off the Stuart Highway using Martins Road.

Photograph of Control Station 201304600002



Location of Control Station 201304600002



Locality Sketch of Control Station 201304600002

APPENDIX C
GPS Control Information

201304600001
1310 -16 18 25.73484 133 23 11.83132 258.326 216.891 GDA94
DATA -16 18 25.73479 133 23 11.83166 258.354 216.918 GDA94
DATA -16 18 25.73476 133 23 11.83169 258.347 216.911 GDA94

GDA94AVE
-16 18 25.7348
133 23 11.8316

-16.30714856
133.38661989

GRS80HT
258.342

AHDHT
216.907

N
41.435

MGA53
327628.777
8196407.509

AMG53
327499.178
8196238.432

201304600002
DATA -14 55 03.30316 133 04 06.24401 176.823 130.212 GDA94
DATA -14 55 03.30312 133 04 06.24393 176.808 130.197 GDA94
DATA -14 55 03.30321 133 04 06.24385 176.814 130.203 GDA94

GDA94AVE
-14 55 3.3032
133 4 6.2439

-14.91758422
133.06840108

GRS80HT
176.815

AHDHT
130.204

N
46.611

MGA53
292224.992
8349887.672

AMG53
292095.132
8349719.293

201304600101
1311 -15 17 45.76901 133 08 13.70075 224.438 179.793 GDA94
1311 -15 17 45.76910 133 08 13.70082 224.446 179.801 GDA94
1311 -15 17 45.76894 133 08 13.70075 224.444 179.799 GDA94

GDA94AVE
-15 17 45.7690
133 8 13.7008

-15.29604694
133.13713911

GRS80HT
224.443

AHDHT
179.798

N
44.645

MGA53
299976.200
8308071.437

AMG53
299846.405
8307902.858

201304600102
1311 -15 20 17.72052 133 55 11.60398 180.590 134.100 GDA94
1311 -15 20 17.72053 133 55 11.60397 180.579 134.089 GDA94
1311 -15 20 17.72049 133 55 11.60404 180.585 134.095 GDA94

GDA94AVE
-15 20 17.7205
133 55 11.6040

-15.33825569
133.91989000

GRS80HT
180.585

AHDHT
134.095

N
46.490

MGA53
384058.715
8303971.770

AMG53
383929.324
8303803.213

201304600103
1311 -15 20 29.86951 134 42 15.31135 132.994 85.082 GDA94
1311 -15 20 29.86944 134 42 15.31134 132.980 85.068 GDA94
1311 -15 20 29.86946 134 42 15.31129 133.005 85.093 GDA94

GDA94AVE
-15 20 29.8695
134 42 15.3113

-15.34163042
134.70425314

GRS80HT
132.993

AHDHT
85.081

N
47.912

MGA53
468255.924
8303865.921

AMG53
468126.933
8303697.378

201304600104
1311 -15 20 07.25653 135 33 35.51507 57.691 8.259 GDA94
1311 -15 20 07.25667 135 33 35.51532 57.706 8.274 GDA94
1311 -15 20 07.25647 135 33 35.51527 57.709 8.277 GDA94

GDA94AVE
-15 20 7.2566
135 33 35.5152

-15.33534906
135.55986533

GRS80HT
57.702

AHDHT
8.270

N
49.432

MGA53
560095.702
8304504.711

AMG53
559967.144
8304336.159

201304600105
1311 -15 26 36.48765 136 07 40.28230 54.902 4.246 GDA94
1311 -15 26 36.48772 136 07 40.28224 54.916 4.260 GDA94
1311 -15 26 36.48761 136 07 40.28244 54.900 4.244 GDA94

GDA94AVE
-15 26 36.4877
136 7 40.2823

-15.44346881
136.12785619

GRS80HT
54.906

AHDHT
4.250

N
50.656

MGA53
621006.206
8292306.251

AMG53
620877.928
8292137.616

201304600106
1310 -15 59 06.61638 133 19 03.72893 238.100 195.643 GDA94
1310 -15 59 06.61652 133 19 03.72903 238.123 195.666 GDA94
1310 -15 59 06.61654 133 19 03.72899 238.119 195.662 GDA94

GDA94AVE
-15 59 6.6165
133 19 3.7290

-15.98517125
133.31770250

GRS80HT
238.114

AHDHT
195.657

N
42.457

MGA53
319972.984
8231976.909

AMG53
319843.330
8231807.986

201304600107
1311 -15 59 40.90965 134 46 36.34470 152.451 106.369 GDA94
1310 -15 59 40.90956 134 46 36.34482 152.463 106.381 GDA94
1310 -15 59 40.90957 134 46 36.34466 152.469 106.387 GDA94

GDA94AVE
-15 59 40.9096
134 46 36.3447

-15.99469711
134.77676242

GRS80HT
152.461

AHDHT
106.379

N
46.082

MGA53
476114.779
8231638.379

AMG53
475985.826
8231469.502

201304600108
1311 -15 54 46.13966 135 33 19.34326 108.806 61.066 GDA94
1311 -15 54 46.13953 135 33 19.34329 108.795 61.055 GDA94
MBLG -15 54 46.13955 135 33 19.34324 108.801 61.061 GDA94

GDA94AVE
-15 54 46.1396
135 33 19.3433

-15.91281656
135.55537314

GRS80HT
108.801

AHDHT
61.061

N
47.740

MGA53
559446.739
8240629.337

AMG53
559318.159
8240460.490

201304600109
1311 -16 01 27.51692 137 00 50.55210 53.174 3.273 GDA94

GDA94AVE
-16 1 27.5169
137 0 50.5521

-16.02431025
137.01404225

GRS80HT
53.174

AHDHT
3.273

N
49.901

MGA53
715497.345
8227329.712

AMG53
715369.448
8227160.716

201304600110
1310 -16 37 48.33137 133 05 09.80512 270.487 230.510 GDA94
1310 -16 37 48.33133 133 05 09.80516 270.492 230.515 GDA94
1310 -16 37 48.33143 133 05 09.80517 270.497 230.520 GDA94

GDA94AVE
-16 37 48.3314
133 5 9.8052

-16.63009206
133.08605700

GRS80HT
270.492

AHDHT
230.515

N
39.977

MGA53
295846.319
8160389.161

AMG53
295716.606
8160219.907

201304600111
1310 -16 38 19.16224 133 57 27.91092 283.284 242.311 GDA94
1310 -16 38 19.16218 133 57 27.91104 283.286 242.313 GDA94
1310 -16 38 19.16230 133 57 27.91086 283.279 242.306 GDA94

GDA94AVE
-16 38 19.1622
133 57 27.9109

-16.63865617
133.95775303

GRS80HT
283.283

AHDHT
242.310

N
40.973

MGA53
388844.300
8160128.411

AMG53
388714.982
8159959.206

201304600112
1310 -16 38 39.79354 134 45 14.18073 304.823 261.198 GDA94
1310 -16 38 39.79355 134 45 14.18079 304.819 261.194 GDA94
1310 -16 38 39.79349 134 45 14.18070 304.817 261.192 GDA94

GDA94AVE
-16 38 39.7935
134 45 14.1807

-16.64438708
134.75393908

GRS80HT
304.820

AHDHT
261.195

N
43.625

MGA53
473759.519
8159767.819

AMG53
473630.558
8159598.629

201304600113

1310 -15 50 32.01728 134 08 32.80989 194.268 149.320 GDA94
1310 -15 50 32.01726 134 08 32.80987 194.261 149.313 GDA94
1310 -15 50 32.01724 134 08 32.80978 194.270 149.322 GDA94

GDA94AVE
-15 50 32.0173
134 8 32.8098

-15.84222703
134.14244717

GRS80HT
194.266

AHDHT
149.318

N
44.948

MGA53
408174.486
8248328.860

AMG53
408045.224
8248160.049

APPENDIX D
Gravity Control Processing and Information

201304600001 GRAVITY CONTROL TIES

1 = 201304600001 Daly Waters Hiway Inn
133 = 1964910133 Daly Waters A/S
Ties carried out by vehicle

METER
A6

station	gda94_longitude_dd	gda94_latitude_dd	date_ddmmyyyy	time_hhmmss	dialrdng_mgal	etc_mgal	aagd07_mgal	metersn
1	133.387000	-16.307000	16/10/2013	15:29:42	2444.134	-0.048	980000.000	40382
1	133.387000	-16.307000	16/10/2013	15:30:48	2444.134	-0.049	980000.000	40382
133	133.377000	-16.264000	16/10/2013	15:48:47	2446.350	-0.060	980002.213	40382
133	133.377000	-16.264000	16/10/2013	15:49:53	2446.352	-0.060	980002.215	40382
1	133.387000	-16.307000	16/10/2013	16:05:45	2444.136	-0.068	979999.999	40382
1	133.387000	-16.307000	16/10/2013	16:06:51	2444.137	-0.068	980000.000	40382
1	133.387000	-16.307000	16/10/2013	16:06:51	2444.137	-0.068	980000.000	40382
133	133.377000	-16.264000	16/10/2013	16:52:35	2446.349	-0.078	980002.211	40382
133	133.377000	-16.264000	16/10/2013	16:53:41	2446.350	-0.078	980002.212	40382
1	133.387000	-16.307000	16/10/2013	17:14:37	2444.132	-0.077	980000.000	40382
1	133.387000	-16.307000	16/10/2013	17:15:43	2444.132	-0.077	980000.000	40382
1	133.387000	-16.307000	16/10/2013	17:15:43	2444.132	-0.077	980000.000	40382
133	133.377000	-16.264000	16/10/2013	17:29:11	2446.349	-0.074	980002.214	40382
133	133.377000	-16.264000	16/10/2013	17:30:17	2446.350	-0.074	980002.215	40382
1	133.387000	-16.307000	16/10/2013	17:46:34	2444.136	-0.068	980000.000	40382
1	133.387000	-16.307000	16/10/2013	17:49:11	2444.136	-0.067	980000.000	40382

AVG 133	980002.213	
DIFF 133_1	2.213	
KNOWN 133	978374.605	
CALC 1	978372.392	mGal AAGD07
	9783723.92	**µm/s^2 AAGD07**

201304600002 GRAVITY CONTROL TIES

2 = 201304600002 Mataranka Territory Manor
133 = 1964910133 Daly Waters A/S
Ties carried out by vehicle

METER
A6

station	gda94_longitude_dd	gda94_latitude_dd	date_ddmmyyyy	time_hhmmss	dialrdng_mgal	etc_mgal	aagd07_mgal	metersn
133	133.377000	-16.264000	28/10/2013	11:59:04	2450.901	0.015	978374.605	40382
133	133.377000	-16.264000	28/10/2013	12:00:10	2450.900	0.015	978374.604	40382
2	133.068000	-14.918000	28/10/2013	13:53:06	2428.881	-0.004	978352.565	40382
2	133.068000	-14.918000	28/10/2013	13:54:12	2428.882	-0.004	978352.566	40382
133	133.377000	-16.264000	28/10/2013	15:19:48	2450.912	0.004	978374.604	40382
133	133.377000	-16.264000	28/10/2013	15:20:54	2450.913	0.004	978374.605	40382
133	133.377000	-16.264000	28/10/2013	15:20:54	2450.913	0.004	978374.605	40382
2	133.068000	-14.918000	28/10/2013	16:43:51	2428.843	0.028	978352.558	40382
2	133.068000	-14.918000	28/10/2013	16:44:56	2428.843	0.028	978352.558	40382
133	133.377000	-16.264000	28/10/2013	18:16:30	2450.854	0.063	978374.603	40382
133	133.377000	-16.264000	28/10/2013	18:17:35	2450.856	0.063	978374.605	40382
133	133.377000	-16.264000	31/10/2013	12:32:42	2452.028	0.085	978374.605	40382
133	133.377000	-16.264000	31/10/2013	12:33:48	2452.029	0.084	978374.605	40382
2	133.068000	-14.918000	31/10/2013	14:12:27	2430.053	0.002	978352.558	40382
2	133.068000	-14.918000	31/10/2013	14:13:32	2430.054	0.001	978352.558	40382
133	133.377000	-16.264000	31/10/2013	15:55:25	2452.147	-0.057	978374.603	40382
133	133.377000	-16.264000	31/10/2013	15:56:30	2452.149	-0.057	978374.605	40382
						CALC 1	978352.561	mGal AAGD07
							9783525.61	**µm/s² AAGD07**

APPENDIX E
Gravity Meter Calibration Data

P2013046_GA_SOUTH_MCARTHUR_BASIN

PRE SURVEY CALIBRATION DATA

1 = 2010990117 CS1 Guildford Cemetery 9793899.63 µm/s^2 AAGD07

2 = 2010990217 CS2 Helena Valley Primary School **9794483.85 µm/s^2 AAGD07**

data in Gravity Units

STATION	MGAE	MGAN	DATE	TIME	OBSGAAD07_µm/s2	DRIFT_µm/s2	SERIAL
A2 METER							
1	420754.17	6464380.51	05/09/2013	10:12:32	9793899.63	-0.42	40241
1	420754.17	6464380.51	05/09/2013	10:13:38	9793899.63	-0.42	40241
2	417649.82	6460586.82	05/09/2013	11:39:11	9794483.82	-0.42	40241
2	417649.82	6460586.82	05/09/2013	11:40:17	9794483.81	-0.42	40241
1	420754.17	6464380.51	05/09/2013	12:04:29	9793899.62	-0.42	40241
1	420754.17	6464380.51	05/09/2013	12:05:35	9793899.63	-0.42	40241
1	420754.17	6464380.51	05/09/2013	12:05:35	9793899.63	-0.23	40241
2	417649.82	6460586.82	05/09/2013	12:33:37	9794484.01	-0.23	40241
2	417649.82	6460586.82	05/09/2013	12:34:43	9794484.03	-0.23	40241
1	420754.17	6464380.51	05/09/2013	13:00:03	9793899.61	-0.23	40241
1	420754.17	6464380.51	05/09/2013	13:01:09	9793899.63	-0.23	40241
				AVG2	**9794483.92**		
A6 METER							
1	420754.17	6464380.51	05/09/2013	10:12:09	9793899.63	-0.42	40382
1	420754.17	6464380.51	05/09/2013	10:13:45	9793899.63	-0.42	40382
2	417649.82	6460586.82	05/09/2013	11:39:01	9794483.99	-0.42	40382
2	417649.82	6460586.82	05/09/2013	11:41:12	9794483.97	-0.42	40382
1	420754.17	6464380.51	05/09/2013	12:04:50	9793899.62	-0.42	40382
1	420754.17	6464380.51	05/09/2013	12:06:35	9793899.61	-0.42	40382
2	417649.82	6460586.82	05/09/2013	12:35:43	9794483.81	-0.23	40382
2	417649.82	6460586.82	05/09/2013	12:36:13	9794483.82	-0.23	40382
1	420754.17	6464380.51	05/09/2013	13:01:22	9793899.62	-0.23	40382
1	420754.17	6464380.51	05/09/2013	13:02:34	9793899.63	-0.23	40382
				AVG2	**9794483.90**		

P2013046_GA_SOUTH_MCARTHUR_BASIN

POST SURVEY CALIBRATION DATA

1 = 2010990117 CS1 Guildford Cemetery 9793899.63 µm/s^2 AAGD07

2 = 2010990217 CS2 Helena Valley Primary School **9794483.85 µm/s^2 AAGD07**

data in Gravity Units

STATION	MGAE	MGAN	DATE	TIME	OBSGAAD07_µm/s2	DRIFT_µm/s2	SERIAL
A2 METER							
1	420754.17	6464380.51	13/01/2014	13:02:56	9793899.63	-0.06	40241
1	420754.17	6464380.51	13/01/2014	13:04:02	9793899.64	-0.06	40241
2	417649.82	6460586.82	13/01/2014	13:42:00	9794483.75	-0.06	40241
2	417649.82	6460586.82	13/01/2014	13:43:06	9794483.77	-0.06	40241
1	420754.17	6464380.51	13/01/2014	14:12:33	9793899.63	-0.06	40241
1	420754.17	6464380.51	13/01/2014	14:12:33	9793899.63	-0.02	40241
1	420754.17	6464380.51	13/01/2014	14:13:39	9793899.63	-0.02	40241
2	417649.82	6460586.82	13/01/2014	14:52:00	9794483.97	-0.02	40241
2	417649.82	6460586.82	13/01/2014	14:53:06	9794483.96	-0.02	40241
1	420754.17	6464380.51	13/01/2014	15:22:03	9793899.62	-0.02	40241
1	420754.17	6464380.51	13/01/2014	15:23:09	9793899.63	-0.02	40241
				AVG2	**9794483.86**		
A6 METER							
1	420754.17	6464380.51	14/01/2014	09:37:39	9793899.63	0.14	40382
1	420754.17	6464380.51	14/01/2014	09:38:49	9793899.60	0.14	40382
2	417649.82	6460586.82	14/01/2014	10:07:47	9794483.69	0.14	40382
2	417649.82	6460586.82	14/01/2014	10:08:52	9794483.66	0.14	40382
1	420754.17	6464380.51	14/01/2014	10:36:22	9793899.66	0.14	40382
1	420754.17	6464380.51	14/01/2014	10:37:32	9793899.63	0.14	40382
1	420754.17	6464380.51	14/01/2014	10:37:32	9793899.63	0.21	40382
2	417649.82	6460586.82	14/01/2014	11:04:31	9794483.81	0.21	40382
2	417649.82	6460586.82	14/01/2014	11:05:41	9794483.77	0.21	40382
1	420754.17	6464380.51	14/01/2014	11:32:33	9793899.68	0.21	40382
1	420754.17	6464380.51	14/01/2014	11:33:43	9793899.63	0.21	40382
				AVG2	**9794483.73**		

APPENDIX F
Repeat Listing: All Observations

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s^2	DATE_DDMMYY	TIME_HHMMSS	METERSN
20138101106	283838.6	8139902.5	0.022	-0.64	16102013	150038	40241
20138101035	300029.5	8187884.5	0.016	0.04	17102013	071546	40241
20138101148	296100.0	8171362.7	0.042	0.42	17102013	073656	40241
20138101012	295842.5	8160406.4	0.010	0.20	17102013	075604	40241
20138101147	283565.5	8160600.3	0.015	0.08	17102013	081254	40241
20138101175	268058.2	8123720.2	-0.031	-0.66	17102013	102440	40241
20138101174	272588.0	8124207.9	-0.047	-0.40	17102013	102938	40241
20138101146	276092.1	8156410.9	0.029	0.54	17102013	121856	40241
20138101165	279619.4	8155851.5	-0.042	0.27	17102013	122346	40241
20138101223	260057.1	8143848.9	0.019	-0.10	17102013	145700	40241
20138101166	275965.2	8151447.6	0.150	-0.12	17102013	151444	40241
20138101146	276089.1	8156408.6	0.033	-0.44	17102013	152152	40241
20138101165	279625.0	8155852.2	0.100	-0.11	17102013	153836	40241
20138101164	279833.1	8159936.0	0.037	0.36	17102013	154308	40241
20138101147	283565.3	8160601.3	0.062	0.36	17102013	154730	40241
20138101070	299920.6	8119754.5	-0.050	-0.39	18102013	104850	40241
20138101308	319935.7	8119981.5	0.055	0.28	18102013	114004	40241
20138101306	327778.4	8119810.3	0.141	0.49	18102013	120908	40241
20138101302	335883.1	8125984.2	-0.018	0.89	18102013	140554	40241
20138101297	335943.5	8135939.2	-0.099	0.90	18102013	150746	40241
20138101296	336051.6	8138070.8	-0.036	0.75	18102013	152152	40241
20138101295	336116.7	8139974.4	-0.026	0.60	18102013	153252	40241
20138101294	336122.8	8141900.9	-0.185	0.88	18102013	153700	40241
20138101292	335697.8	8146146.4	-0.080	0.11	18102013	155844	40241
20138101290	336004.4	8149990.4	-0.085	0.30	18102013	161128	40241
20138101289	336172.4	8151860.7	-0.015	0.45	18102013	161927	40241
20138101288	336093.3	8154015.3	-0.125	0.10	18102013	162414	40241
20138101287	335942.6	8155922.2	-0.030	0.69	18102013	162946	40241
20138101286	335898.4	8157853.9	0.104	0.15	18102013	163418	40241
20138101285	336048.7	8159913.3	-0.171	-0.01	18102013	163812	40241
20138101277	336107.5	8177766.3	-0.158	0.12	18102013	172840	40241
20138101276	335754.9	8179766.6	-0.021	0.14	18102013	173356	40241
20138101275	335802.5	8181964.6	-0.098	0.00	18102013	173844	40241
20138101274	335955.9	8184145.7	-0.095	0.57	18102013	174246	40241
20138101273	336193.4	8185870.7	-0.105	0.83	18102013	174836	40241
20138101272	335871.8	8188099.0	-0.081	0.88	18102013	175148	40241
20138101271	335929.3	8189877.3	-0.096	0.15	18102013	175536	40241
20138101270	335692.2	8191984.4	-0.086	0.38	18102013	181138	40241
20138101269	335850.8	8194052.6	-0.118	0.03	18102013	181538	40241
20138101375	334263.9	8146162.9	0.090	0.20	19102013	081656	40241
20138101369	334091.8	8138046.9	0.036	0.67	19102013	084202	40241
20138101410	331994.6	8141455.0	-0.152	0.06	19102013	125526	40241
20138101485	317925.6	8141833.4	0.083	-0.08	19102013	153210	40241
20138101484	319924.2	8141953.7	-0.063	-0.18	19102013	155026	40241
20138101409	331369.9	8143611.3	-0.079	-0.74	19102013	162338	40241
20138101398	326069.3	8162142.8	-0.134	0.05	19102013	170926	40241
20138101002	327699.7	8181616.5	0.052	0.65	19102013	175538	40241

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s^2	DATE_DDMMYY	TIME_HHMMSS	METERSN
20138101393	333997.1	8189982.7	0.047	-0.23	20102013	062926	40241
20138101040	334348.7	8163933.9	0.093	-0.41	20102013	071444	40241
20138101042	332055.3	8162029.5	0.117	-0.78	20102013	072116	40241
20138101041	333961.9	8162021.2	-0.017	-0.55	20102013	072444	40241
20138101522	330129.7	8152107.2	0.171	0.36	20102013	075530	40241
20138101520	329933.4	8148159.7	0.135	0.06	20102013	080900	40241
20138101484	319924.4	8141961.6	0.137	0.37	20102013	083434	40241
20138101485	317924.9	8141839.3	0.167	0.14	20102013	083942	40241
20138101492	303919.1	8142011.8	0.176	0.79	20102013	090658	40241
20138101023	300012.3	8144143.5	-0.037	-0.02	20102013	091554	40241
20138101026	327966.6	8145977.9	0.007	-0.16	20102013	101648	40241
20138101050	319332.6	8146262.9	0.095	-0.07	20102013	103200	40241
20138101064	307981.3	8150341.5	0.018	-0.07	20102013	113742	40241
20138101060	313939.3	8148054.1	0.002	-0.54	20102013	115011	40241
20138101401	325970.6	8160082.7	0.082	0.11	20102013	123918	40241
20138105011	344017.9	8195921.1	-0.008	-0.12	20102013	063224	40382
20138105031	347802.9	8156284.5	0.088	0.19	20102013	074640	40382
20138105033	473738.4	8159771.5	0.140	-0.25	20102013	141758	40382
20138105104	464269.0	8160002.2	0.078	-0.05	20102013	142908	40382
20138105032	388840.7	8160111.7	-0.155	-0.19	20102013	161334	40382
20138105031	347802.7	8156284.7	-0.045	0.22	20102013	170110	40382
20138105061	348262.5	8123866.5	-0.130	0.12	20102013	173720	40382
20138105060	348122.0	8119979.6	-0.063	0.07	20102013	174142	40382
20138105049	343887.8	8151917.2	0.101	0.30	20102013	181754	40382
20138105048	344113.9	8155982.5	-0.064	-0.44	20102013	182146	40382
20138105043	340163.0	8171945.3	0.146	-0.35	20102013	183008	40382
20138101552	332026.1	8189940.6	-0.086	-0.27	21102013	061826	40241
20138101555	331779.9	8184068.8	-0.085	-0.16	21102013	063304	40241
20138101556	331907.1	8181882.3	-0.130	-0.34	21102013	063754	40241
20138101559	332087.1	8176080.8	-0.024	-0.42	21102013	065624	40241
20138101398	326070.8	8162148.0	0.066	-0.30	21102013	073716	40241
20138101401	325969.9	8160081.5	-0.075	-0.41	21102013	074130	40241
20138101633	322041.4	8150103.7	-0.011	0.71	21102013	080312	40241
20138101025	299930.5	8159625.3	-0.028	-0.64	21102013	104028	40241
20138101012	295842.9	8160406.8	-0.027	0.09	21102013	104646	40241
20138101762	317897.3	8161749.8	0.000	-0.16	21102013	125928	40241
20138101758	312232.7	8164064.1	0.046	0.00	21102013	131002	40241
20138101029	303793.6	8180214.5	0.117	0.31	21102013	135444	40241
20138101150	321456.9	8194081.3	0.068	0.04	21102013	151158	40241
20138105038	340013.7	8191850.4	0.014	-0.85	21102013	062136	40382
20138105039	340044.7	8187769.1	0.031	-0.12	21102013	062550	40382
20138105043	340162.8	8171939.3	-0.173	-0.50	21102013	063342	40382
20138105048	344119.1	8155984.1	-0.036	0.26	21102013	064232	40382
20138105031	347801.1	8156289.9	0.085	0.86	21102013	064645	40382
20138105049	343885.1	8151912.5	0.033	-0.69	21102013	065208	40382
20138105061	348266.4	8123862.1	0.112	0.67	21102013	071444	40382
20138105060	348127.5	8119977.9	0.128	-0.18	21102013	071840	40382

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s^2	DATE_DDMMYY	TIME_HHMMSS	METERSN
20138105069	376174.5	8120099.8	0.027	0.28	21102013	075528	40382
20138105071	384144.0	8119938.2	-0.096	0.05	21102013	080456	40382
20138105082	420229.4	8120004.1	0.029	0.85	21102013	085614	40382
20138105086	436006.3	8119866.4	-0.133	-0.13	21102013	091536	40382
20138105092	460111.3	8119841.3	-0.135	-0.40	21102013	094134	40382
20138105095	463750.0	8124175.9	-0.030	-0.09	21102013	094600	40382
20138105033	473738.5	8159771.7	-0.014	0.45	21102013	150226	40382
20138105103	463926.7	8156071.1	-0.043	0.05	21102013	154212	40382
20138105118	444271.8	8159969.4	0.048	-0.09	21102013	161132	40382
20138105122	427790.1	8160234.0	-0.016	0.13	21102013	163820	40382
20138105126	411734.0	8159898.1	0.081	-0.16	21102013	170314	40382
20138105032	388846.5	8160112.7	0.186	0.89	21102013	174026	40382
20138101774	307991.3	8165923.9	-0.080	0.49	22102013	074108	40241
20138101758	312235.1	8164068.8	0.028	-0.03	22102013	074530	40241
20138101861	306112.0	8169799.6	-0.099	0.16	22102013	090656	40241
20138101874	320075.1	8167995.5	-0.001	0.01	22102013	100744	40241
20138101872	321815.0	8169768.6	0.139	0.59	22102013	101128	40241
20138101895	320757.2	8173913.6	0.051	0.05	22102013	103648	40241
20138101850	307976.2	8189974.1	0.200	-0.15	22102013	113628	40241
20138101149	313329.6	8188287.8	0.105	-0.49	22102013	115126	40241
20138101844	318050.6	8191926.2	0.017	0.05	22102013	121216	40241
20138101537	325899.2	8178028.4	0.008	-0.65	22102013	131730	40241
20138101904	320237.1	8176119.0	0.112	-0.43	22102013	133102	40241
20138101908	311736.3	8175615.0	0.173	-0.10	22102013	135038	40241
20138101001	327748.6	8185867.4	0.046	-0.96	22102013	171240	40241
20138101808	325478.7	8195814.5	-0.039	0.21	22102013	175730	40241
20138105012	348201.9	8195361.5	0.118	0.54	22102013	062019	40382
20138105159	351819.8	8143772.5	0.082	0.14	22102013	073644	40382
20138105160	351900.4	8132037.8	0.071	-0.38	22102013	075116	40382
20138105169	387201.8	8127820.3	0.009	-0.72	22102013	085516	40382
20138105170	391974.0	8128142.3	0.031	0.21	22102013	090140	40382
20138105096	464074.0	8128324.7	0.075	0.84	22102013	102208	40382
20138105199	490065.3	8121630.5	0.125	0.26	22102013	111716	40382
20138105341	511757.3	8132096.0	-0.201	0.11	22102013	134918	40382
20138105217	515761.7	8132263.3	-0.143	-0.56	22102013	135404	40382
20138105201	491837.4	8123815.2	-0.039	-0.50	22102013	144658	40382
20138105200	490272.4	8124345.6	-0.059	-0.64	22102013	145024	40382
20138105188	468209.7	8123789.7	0.139	-0.03	22102013	152308	40382
20138105096	464073.6	8128324.4	-0.123	-0.93	22102013	152808	40382
20138105310	427922.7	8127996.9	0.008	-0.14	22102013	161026	40382
20138105170	391974.0	8128142.2	-0.075	-0.85	22102013	165312	40382
20138105169	387201.6	8127820.2	-0.021	-0.37	22102013	165712	40382
20138105298	368004.9	8131873.1	-0.016	-0.95	22102013	172428	40382
20138105160	351900.6	8132037.8	-0.131	-0.59	22102013	173943	40382
20138105159	351819.9	8143772.3	-0.129	-0.74	22102013	174722	40382
20138105049	343885.2	8151912.3	-0.079	-0.25	22102013	175346	40382
20138105043	340162.9	8171939.6	-0.093	-0.11	22102013	180350	40382

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s^2	DATE_DDMMYY	TIME_HHMMSS	METERSN
20138105039	340044.8	8187769.2	0.135	0.21	22102013	181154	40382
20138105038	340013.7	8191850.4	-0.017	-0.01	22102013	181600	40382
20138101980	320290.8	8203514.6	0.016	0.15	23102013	061702	40241
20138101981	316266.1	8203877.8	0.055	0.19	23102013	062148	40241
20138101252	291882.6	8188177.2	-0.032	-0.59	23102013	071858	40241
20138102054	279025.6	8267651.6	0.025	0.09	23102013	132548	40241
20138102046	284345.3	8244138.3	0.167	0.06	23102013	163152	40241
20138102045	283782.0	8239777.6	0.073	-0.04	23102013	163640	40241
20138102033	287851.6	8219628.9	0.008	0.12	23102013	170744	40241
20138105011	344018.7	8195921.2	-0.037	0.45	23102013	061832	40382
20138105013	347908.4	8192397.9	-0.067	0.87	23102013	062258	40382
20138105279	351842.4	8188081.9	0.087	0.52	23102013	062720	40382
20138105284	351860.9	8168005.8	0.036	-0.73	23102013	064340	40382
20138105139	359937.4	8159737.2	-0.077	0.32	23102013	065324	40382
20138105032	388841.0	8160111.8	-0.088	0.93	23102013	071402	40382
20138105126	411729.7	8159901.9	-0.016	-0.03	23102013	073552	40382
20138105122	427787.7	8160228.9	0.020	0.77	23102013	074704	40382
20138105118	444271.8	8159969.5	-0.041	0.87	23102013	080136	40382
20138105104	464269.2	8160002.0	-0.138	-0.20	23102013	082058	40382
20138105111	470061.1	8163906.5	-0.074	0.91	23102013	084001	40382
20138105033	473738.3	8159771.6	-0.024	-0.90	23102013	091632	40382
20138105200	490269.7	8124340.6	0.042	0.41	23102013	104258	40382
20138105201	491832.1	8123817.1	0.006	0.74	23102013	104552	40382
20138105459	500174.5	8125752.3	0.099	-0.23	23102013	114428	40382
20138105319	467858.5	8127937.8	0.100	-0.13	23102013	150720	40382
20138105249	467876.8	8157989.1	0.031	-0.93	23102013	153834	40382
20138105103	463926.7	8156071.2	-0.114	-0.25	23102013	154328	40382
20138105269	392073.9	8156058.3	-0.023	-0.79	23102013	171450	40382
20138105404	379774.3	8164024.8	0.051	-0.34	23102013	172720	40382
20138105403	368052.2	8164201.6	0.077	-0.33	23102013	173906	40382
20138105401	356212.8	8176196.2	0.013	-0.46	23102013	175718	40382
20138105400	356208.0	8184194.2	0.163	-0.58	23102013	180558	40382
20138101810	324121.6	8207979.0	-0.007	-0.05	24102013	061508	40241
20138102143	308022.7	8239924.0	-0.014	0.15	24102013	084438	40241
20138102130	308003.4	8219964.5	-0.035	0.22	24102013	091626	40241
20138102128	312182.9	8215963.9	0.027	0.22	24102013	092404	40241
20138102085	319837.7	8252291.9	0.010	-0.22	24102013	110358	40241
20138102084	320058.7	8256072.4	-0.080	-0.20	24102013	110804	40241
20138102081	319958.9	8260070.2	0.006	0.06	24102013	111136	40241
20138102083	324016.9	8256082.9	-0.027	-0.26	24102013	111606	40241
20138101818	324083.8	8232244.0	0.158	0.27	24102013	115016	40241
20138102196	339944.6	8215996.9	-0.006	0.26	24102013	170338	40241
20138101811	328089.7	8207852.4	-0.045	0.72	24102013	171536	40241
20138105549	347808.1	8200152.0	-0.067	0.38	24102013	065446	40382
20138105543	360088.0	8171690.5	-0.115	-0.33	24102013	075750	40382
20138105287	356015.5	8155973.7	-0.062	-0.41	24102013	082248	40382
20138105584	440097.9	8136022.7	-0.197	-0.10	24102013	151616	40382

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s^2	DATE_DDMMYY	TIME_HHMMSS	METERSN
20138105581	428022.3	8136020.5	0.092	0.33	24102013	153136	40382
20138105543	360088.1	8171690.9	-0.014	0.29	24102013	172600	40382
20138105550	360063.6	8196022.7	0.015	0.41	24102013	175810	40382
20138105551	359820.4	8192060.2	0.082	-0.17	24102013	180206	40382
20138102196	339944.1	8215996.5	-0.005	-0.33	25102013	062426	40241
20138102329	368090.6	8228148.4	0.021	-0.27	25102013	125408	40241
20138102315	371848.0	8279829.5	0.012	-0.27	25102013	134812	40241
20138102314	371746.4	8284181.5	0.033	0.22	25102013	135148	40241
20138102304	396252.6	8291956.6	-0.037	-0.11	25102013	142130	40241
20138102303	399785.2	8292363.9	-0.095	-0.09	25102013	142508	40241
20138102333	372023.4	8232521.8	-0.018	0.09	25102013	161450	40241
20138102328	368395.5	8232100.3	0.092	0.23	25102013	161828	40241
20138102329	368091.8	8228147.8	0.035	0.11	25102013	162154	40241
20138102330	367544.2	8224342.0	-0.033	-0.10	25102013	162512	40241
20138102331	363973.5	8220703.8	-0.048	0.09	25102013	162918	40241
20138102235	364344.3	8243832.2	0.041	-0.18	25102013	170050	40241
20138102236	359714.7	8243800.8	-0.022	-0.19	25102013	170508	40241
20138105039	340044.8	8187774.7	-0.059	-0.64	25102013	062432	40382
20138105043	340162.6	8171945.2	-0.125	0.48	25102013	063224	40382
20138105031	347803.2	8156284.7	-0.196	0.34	25102013	064106	40382
20138105561	356016.5	8147983.1	-0.094	0.75	25102013	064750	40382
20138105592	477916.5	8130083.2	-0.072	-0.65	25102013	091902	40382
20138105424	479848.6	8164351.9	-0.045	-0.27	25102013	123346	40382
20138105789	481878.1	8149987.2	0.022	0.94	25102013	142118	40382
20138105789	481877.9	8149987.2	-0.019	0.30	25102013	152830	40382
20138105403	368052.3	8164201.1	-0.070	-0.13	25102013	180454	40382
20138105543	360088.2	8171690.4	-0.047	0.30	25102013	181048	40382
20138105401	356212.9	8176196.2	-0.063	0.15	25102013	181530	40382
20138105039	340044.7	8187774.9	-0.077	0.73	25102013	182358	40382
20138102331	363972.9	8220703.3	0.055	-0.07	26102013	074008	40241
20138102330	367544.1	8224341.7	0.175	-0.02	26102013	074846	40241
20138102332	371951.8	8228039.3	0.066	-0.01	26102013	075714	40241
20138102367	380063.9	8268011.1	0.128	-0.30	26102013	085400	40241
20138102366	380015.3	8271939.2	0.115	-0.07	26102013	085812	40241
20138102427	399857.8	8280004.9	-0.196	0.04	26102013	114502	40241
20138102447	423554.9	8279773.3	-0.004	-0.11	26102013	140937	40241
20138102445	431633.1	8279618.1	0.013	0.16	26102013	142610	40241
20138102444	435985.1	8279971.2	-0.020	0.45	26102013	143006	40241
20138102443	439983.2	8279863.7	-0.165	0.03	26102013	143402	40241
20138102391	347503.5	8216068.7	0.039	0.20	26102013	170428	40241
20138105549	347807.6	8200152.2	-0.023	-0.34	26102013	062534	40382
20138105550	360063.2	8196022.1	0.016	-0.44	26102013	065106	40382
20138105111	470060.8	8163906.7	-0.002	-0.02	26102013	151556	40382
20138105110	467852.1	8167807.5	-0.052	0.66	26102013	152232	40382
20138105412	455472.1	8163890.9	0.052	-0.57	26102013	154616	40382
20138105118	444271.9	8159969.4	-0.092	0.12	26102013	160340	40382
20138105549	347807.8	8200152.1	-0.045	0.88	27102013	063450	40241

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s^2	DATE_DDMMYY	TIME_HHMMSS	METERSN
20138105876	364127.1	8200277.1	0.162	0.42	27102013	064336	40241
20138105877	368021.2	8196157.1	0.120	0.60	27102013	064820	40241
20138105886	400057.0	8199816.8	0.050	-0.16	27102013	072902	40241
20138105910	467955.5	8201963.8	0.104	0.57	27102013	091010	40241
20138105913	473941.4	8201962.3	0.045	0.24	27102013	092214	40241
20138105952	513936.6	8183867.1	0.112	-0.01	27102013	112156	40241
20138105953	513899.9	8181804.9	0.074	0.55	27102013	112724	40241
20138105971	508190.5	8152114.8	-0.099	0.90	27102013	124618	40241
20138102608	508086.7	8171962.0	-0.022	0.24	27102013	135652	40241
20138102606	510056.1	8174004.9	0.017	-0.09	27102013	140016	40241
20138102607	508004.9	8174065.7	0.007	0.05	27102013	140324	40241
20138102595	509799.9	8179964.7	0.026	0.04	27102013	141704	40241
20138102574	507986.2	8200019.5	0.080	0.28	27102013	145542	40241
20138102567	494039.8	8199955.1	0.111	-0.69	27102013	152038	40241
20138102550	462016.5	8197957.9	-0.091	-0.57	27102013	164822	40241
20138102549	460067.7	8197962.5	-0.029	-0.77	27102013	165812	40241
20138102541	435988.6	8195877.3	-0.031	-0.73	27102013	174524	40241
20138102539	427815.6	8195835.2	0.082	-0.46	27102013	175710	40241
20138105039	340045.1	8187774.4	-0.095	0.68	28102013	061118	40241
20138105543	360088.0	8171690.7	-0.014	0.46	28102013	062334	40241
20138105973	504276.0	8151951.6	-0.039	0.21	28102013	084928	40241
20138102606	510056.3	8174004.9	0.016	0.35	28102013	092848	40241
20138105954	516001.2	8181972.6	-0.025	0.73	28102013	095114	40241
20138105951	515982.9	8183949.6	-0.081	0.51	28102013	095802	40241
20138102775	447956.3	8183748.3	0.053	0.23	28102013	124736	40241
20138102774	448049.7	8188180.1	0.194	0.03	28102013	125150	40241
20138102755	484032.6	8193861.3	0.173	0.03	28102013	140242	40241
20138102795	481980.8	8191971.2	-0.076	0.17	28102013	155510	40241
20138102792	476056.8	8191989.5	-0.106	0.21	28102013	160840	40241
20138102787	465975.8	8192056.4	-0.170	-0.23	28102013	163304	40241
20138102782	457983.1	8190034.1	-0.136	-0.58	28102013	165142	40241
20138102780	453953.6	8190216.1	-0.174	0.82	28102013	170404	40241
20138101980	320290.0	8203515.1	-0.109	-0.55	28102013	061124	40382
20138101981	316266.3	8203878.2	0.011	-0.63	28102013	061702	40382
20138101811	328091.8	8207852.2	-0.009	-0.88	28102013	063208	40382
20138102389	339862.1	8211511.7	-0.001	-0.70	28102013	065152	40382
20138106031	400121.1	8259850.9	-0.063	0.00	28102013	101212	40382
20138102260	408148.5	8248325.1	-0.054	0.52	28102013	102630	40382
20138106017	367171.9	8212352.3	0.004	-0.17	28102013	112654	40382
20138106016	355690.1	8212631.7	0.041	-0.49	28102013	113330	40382
20138102389	339862.3	8211511.5	0.029	-0.28	28102013	114122	40382
20138105551	359820.8	8192060.1	-0.033	0.32	29102013	070554	40241
20138102534	408149.8	8195886.9	0.010	-0.79	29102013	074722	40241
20138102854	407940.5	8192095.5	-0.026	-0.58	29102013	075156	40241
20138102852	432069.9	8187968.5	0.048	-0.55	29102013	081802	40241
20138102775	447956.3	8183748.5	-0.043	-0.36	29102013	083644	40241
20138102846	454069.6	8188089.2	0.038	-0.52	29102013	084906	40241

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s^2	DATE_DDMMYY	TIME_HHMMSS	METERSN
20138102842	461968.8	8187838.3	-0.072	-0.38	29102013	090908	40241
20138102837	470017.9	8189960.0	0.045	-0.83	29102013	092240	40241
20138102834	475882.3	8189998.5	0.145	-0.21	29102013	093706	40241
20138102831	482049.4	8190032.1	-0.107	-0.24	29102013	095106	40241
20138102817	497977.8	8190041.8	0.011	-0.09	29102013	101842	40241
20138102607	508004.7	8174065.5	-0.013	-0.20	29102013	105954	40241
20138102606	510056.3	8174004.7	-0.037	-0.45	29102013	110248	40241
20138102608	508086.6	8171961.9	0.020	-0.27	29102013	112052	40241
20138105975	499671.3	8151909.4	0.112	0.39	29102013	120908	40241
20138105978	496219.3	8153946.7	-0.016	0.76	29102013	121316	40241
20138105984	489968.7	8159937.6	0.002	0.94	29102013	124406	40241
20138105988	485600.2	8164074.2	-0.130	0.84	29102013	130122	40241
20138105424	479853.3	8164346.1	0.045	0.45	29102013	130620	40241
20138105995	477877.9	8165892.0	-0.138	0.74	29102013	131020	40241
20138102938	491982.2	8159938.5	-0.080	0.46	29102013	143600	40241
20138102937	493954.0	8160029.6	-0.047	0.29	29102013	143930	40241
20138102936	495862.1	8160138.5	-0.139	0.12	29102013	144232	40241
20138105110	467852.8	8167807.7	-0.105	0.79	29102013	160618	40241
20138105551	359820.4	8192060.0	-0.119	0.61	29102013	175304	40241
20138102389	339861.8	8211511.0	0.042	-0.28	29102013	070936	40382
20138106016	355690.1	8212631.8	0.035	-0.09	29102013	071736	40382
20138106017	367171.5	8212352.0	0.008	0.29	29102013	072426	40382
20138106050	435685.0	8259670.5	0.180	0.57	29102013	142322	40382
20138102260	408148.4	8248325.3	0.075	-0.55	29102013	145850	40382
20138106071	383935.1	8219919.9	0.105	-0.16	29102013	174848	40382
20138106017	367171.4	8212351.5	-0.005	0.68	29102013	180352	40382
20138102389	339862.2	8211511.2	-0.106	0.56	29102013	181536	40382
20138102984	435811.6	8180215.6	0.056	0.59	30102013	070146	40241
20138102983	443822.3	8180356.0	0.021	0.73	30102013	070720	40241
20138102882	460093.4	8186007.2	0.084	0.02	30102013	072924	40241
20138102884	464129.7	8187964.7	0.077	0.69	30102013	073324	40241
20138102888	472117.2	8187796.0	-0.035	0.43	30102013	075110	40241
20138102892	480009.4	8187970.2	0.019	0.71	30102013	080850	40241
20138102968	489952.0	8170056.8	0.040	-0.31	30102013	093340	40241
20138103083	477807.8	8171772.0	-0.090	-0.31	30102013	124124	40241
20138102983	443822.4	8180355.8	0.073	-0.72	30102013	161334	40241
20138102984	435811.8	8180215.7	0.002	-0.23	30102013	162420	40241
20138103005	427862.5	8180075.5	0.061	-0.50	30102013	163220	40241
20138103002	407891.0	8183501.0	0.150	-0.45	30102013	165434	40241
20138103001	399766.4	8183815.6	0.065	-0.34	30102013	171256	40241
20138106016	355690.2	8212631.8	-0.118	0.11	30102013	060802	40382
20138106017	367171.4	8212351.3	0.025	-0.02	30102013	061526	40382
20138106092	435615.6	8208280.7	-0.044	-0.62	30102013	111822	40382
20138106085	408135.3	8208196.1	-0.112	0.02	30102013	115032	40382
20138106016	355690.7	8212631.9	-0.051	0.70	30102013	121242	40382
20138105550	360063.5	8196022.5	-0.072	0.87	31102013	121616	40241
20138103001	399766.0	8183815.4	-0.056	0.39	31102013	123914	40241

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s^2	DATE_DDMMYY	TIME_HHMMSS	METERSN
20138102981	451991.7	8171895.0	-0.079	0.44	31102013	134840	40241
20138102776	447871.8	8179885.8	-0.015	0.36	31102013	144304	40241
20138105033	473738.5	8159771.9	-0.004	0.96	31102013	180442	40241
20138103005	427862.5	8180075.9	0.022	-0.05	31102013	183448	40241
20138102331	363972.9	8220703.3	-0.012	-0.17	01112013	070740	40241
20138102260	408148.1	8248325.2	0.019	-0.26	01112013	075026	40241
20138106102	475947.7	8255584.3	-0.087	0.07	01112013	092606	40241
20138106101	475810.1	8252129.6	-0.061	0.69	01112013	114254	40241
20138103320	500180.0	8256079.0	-0.020	0.02	01112013	140910	40241
20138103316	512060.8	8256037.4	-0.031	0.22	01112013	142522	40241
20138103309	516092.5	8255795.2	0.046	0.20	01112013	143008	40241
20138106016	355690.2	8212631.9	-0.013	0.43	01112013	065324	40382
20138106017	367171.3	8212351.5	-0.001	-0.54	01112013	070048	40382
20138106085	408135.1	8208196.3	0.030	0.99	01112013	072240	40382
20138106092	435615.7	8208280.9	0.022	0.27	01112013	073710	40382
20138106243	439907.1	8212309.8	-0.059	-0.11	01112013	074148	40382
20138106277	494030.1	8208056.3	-0.078	-0.14	01112013	103100	40382
20138106267	474077.5	8208002.4	-0.011	-0.13	01112013	110524	40382
20138106256	455617.2	8211672.5	-0.005	-0.33	01112013	113240	40382
20138106256	455617.0	8211672.3	0.178	0.86	01112013	132052	40382
20138106290	514074.5	8212074.9	0.104	-0.28	01112013	150606	40382
20138106296	503901.7	8210036.0	-0.005	-0.59	01112013	155606	40382
20138106307	482151.8	8209923.6	-0.057	0.17	01112013	163722	40382
20138106256	455616.8	8211672.1	-0.081	0.01	01112013	172326	40382
20138106243	439907.0	8212309.7	-0.003	0.42	01112013	173300	40382
20138106092	435615.7	8208280.6	0.006	0.37	01112013	173718	40382
20138106085	408135.2	8208196.0	0.002	0.52	01112013	174808	40382
20138106255	392027.4	8212015.7	0.048	-0.36	01112013	175654	40382
20138106017	367171.5	8212351.7	0.030	0.21	01112013	180708	40382
20138106016	355690.5	8212631.9	-0.037	-0.12	01112013	181506	40382
20138103391	340149.6	8199373.7	0.061	-0.61	02112013	061146	40241
20138103390	351297.8	8202986.8	0.049	0.16	02112013	061854	40241
20138103389	364415.5	8207169.9	0.079	0.07	02112013	062646	40241
20138103388	371474.7	8212040.2	0.194	-0.29	02112013	063220	40241
20138103387	379780.1	8211778.9	-0.123	0.11	02112013	063802	40241
20138103386	387710.0	8211814.0	-0.114	-0.17	02112013	064408	40241
20138103385	395769.7	8211827.3	-0.120	-0.17	02112013	064940	40241
20138103383	411478.7	8216257.3	0.099	-0.21	02112013	070048	40241
20138103382	411961.5	8224491.8	0.011	-0.29	02112013	070650	40241
20138103381	411780.9	8231799.7	0.017	-0.29	02112013	071254	40241
20138103407	463865.8	8231712.0	0.086	-0.13	02112013	084048	40241
20138103398	427857.7	8232284.8	-0.160	-0.06	02112013	122022	40241
20138103396	420352.3	8231873.9	0.042	-0.23	02112013	131306	40241
20138103488	487853.2	8227980.4	-0.037	0.27	02112013	164440	40241
20138103383	411474.6	8216260.9	-0.049	0.12	02112013	174948	40241
20138103387	379780.8	8211779.5	0.043	0.28	02112013	180240	40241
20138106016	355690.2	8212631.9	0.071	-0.11	02112013	061722	40382

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s^2	DATE_DDMMYY	TIME_HHMMSS	METERSN
20138106017	367171.5	8212351.4	-0.063	-0.56	02112013	062422	40382
20138103387	379775.3	8211781.7	-0.032	-0.17	02112013	063120	40382
20138106255	392026.6	8212015.5	-0.039	-0.17	02112013	063822	40382
20138106085	408134.9	8208196.0	-0.030	-0.60	02112013	065356	40382
20138106321	456110.8	8216158.4	-0.070	-0.55	02112013	073534	40382
20138106256	455617.0	8211672.2	-0.078	-0.69	02112013	110552	40382
20138106321	456110.0	8216157.9	0.052	0.09	02112013	110958	40382
20138106478	429931.1	8225821.2	-0.030	0.08	02112013	131908	40382
20138106322	454081.9	8223823.6	0.014	-0.33	02112013	164508	40382
20138106478	429931.2	8225821.2	0.163	0.71	02112013	171546	40382
20138106255	392026.4	8212015.0	0.105	0.67	02112013	173818	40382
20138103387	379775.5	8211781.5	0.025	-0.29	02112013	174456	40382
20138106017	367172.1	8212352.2	-0.026	0.37	02112013	175152	40382
20138106016	355689.8	8212631.9	0.043	0.39	02112013	175832	40382
20138106016	355689.9	8212631.8	0.054	0.54	03112013	063131	40241
20138103387	379775.1	8211781.3	-0.069	0.38	03112013	065106	40241
20138106255	392027.1	8212015.7	-0.094	-0.04	03112013	071508	40241
20138103385	395768.6	8211832.8	-0.016	-0.06	03112013	072044	40241
20138106390	404239.7	8212211.8	-0.114	0.41	03112013	073050	40241
20138106391	416158.7	8216301.9	0.002	0.64	03112013	074032	40241
20138106392	427928.7	8215867.3	-0.076	0.06	03112013	075308	40241
20138106393	439939.7	8216102.4	0.104	-0.42	03112013	083440	40241
20138106472	437943.1	8221823.0	-0.022	0.01	03112013	085538	40241
20138106478	429931.1	8225821.5	-0.068	0.98	03112013	092954	40241
20138106480	423818.7	8227783.5	0.033	0.13	03112013	095346	40241
20138106085	408134.7	8208196.3	0.034	0.32	03112013	105354	40241
20138106322	454082.0	8223823.7	0.002	0.12	03112013	131304	40241
20138103528	459906.1	8226084.7	-0.074	-0.28	03112013	132138	40241
20138106096	476095.1	8231624.2	0.085	0.71	03112013	164938	40241
20138105549	347807.4	8200152.3	-0.097	-0.95	03112013	063440	40382
20138103390	351292.5	8202987.9	0.086	-0.73	03112013	063946	40382
20138105886	400056.5	8199817.0	-0.046	0.32	03112013	075326	40382
20138102532	400048.6	8196360.3	-0.110	-0.41	03112013	075904	40382
20138103001	399765.9	8183815.5	-0.014	-0.56	03112013	080716	40382
20138105408	420042.8	8164126.3	-0.081	0.01	03112013	090416	40382
20138101030	387999.5	8164237.2	-0.082	-0.61	03112013	094120	40382
20138101030	387999.5	8164237.1	-0.069	-0.69	03112013	112343	40382
20138105032	388840.9	8160111.5	-0.132	-0.59	03112013	134152	40382
20138103389	364409.6	8207169.7	-0.090	-0.51	03112013	142514	40382
20138103390	351292.5	8202987.6	-0.091	-0.10	03112013	151102	40382
20138106654	299333.1	8288135.1	-0.054	0.27	04112013	133214	40382
20138106649	299998.3	8308088.7	-0.142	-0.26	04112013	141748	40382
20138106649	299998.6	8308088.3	-0.057	0.20	04112013	150046	40382
20138106648	344018.3	8304049.0	0.075	0.13	05112013	091038	40241
20138103757	344087.0	8280031.6	0.015	0.06	05112013	112238	40241
20138103754	343730.9	8284399.9	0.027	-0.23	05112013	112742	40241
20138103755	347953.1	8283841.7	0.031	0.06	05112013	113220	40241

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20138103756	347792.8	8280087.9	-0.080	-0.08	05112013	113550	40241
20138103755	347952.6	8283841.9	-0.053	-0.10	05112013	121030	40241
20138106676	304057.8	8292088.7	-0.052	0.12	05112013	133824	40241
20138106638	384040.9	8303979.1	0.094	0.30	05112013	165626	40241
20138103802	347953.6	8300176.9	-0.182	0.04	05112013	172752	40241
20138106648	344018.6	8304049.4	-0.029	0.09	05112013	173234	40241
20138103748	343871.1	8312191.3	-0.078	-0.02	05112013	174156	40241
20138103745	343973.9	8323996.6	-0.013	0.08	05112013	174836	40241
20138103743	344012.1	8331697.3	-0.068	0.15	05112013	175404	40241
20138103739	331916.7	8343805.6	0.113	0.09	05112013	180200	40241
20138103738	323653.7	8343723.4	0.072	0.25	05112013	180716	40241
20138103737	315065.0	8343574.7	-0.074	0.24	05112013	181254	40241
20138103735	299693.6	8343563.6	0.155	0.23	05112013	181952	40241
20138106667	315977.6	8268243.0	0.145	-0.73	05112013	105644	40382
20138106676	304057.8	8292089.0	0.087	-0.36	05112013	125746	40382
20138106679	304070.2	8304201.7	0.143	-0.55	05112013	130428	40382
20138106649	299998.5	8308087.9	0.128	-0.75	05112013	130922	40382
20138106690	288454.5	8343506.0	-0.002	0.95	05112013	175238	40382
20138103736	308013.6	8344013.9	-0.048	-0.05	06112013	070232	40241
20138103748	343871.3	8312191.4	0.123	0.15	06112013	073156	40241
20138106638	384041.4	8303979.1	0.040	0.49	06112013	081528	40241
20138103845	384016.3	8299850.2	-0.019	0.34	06112013	081928	40241
20138103844	391832.5	8299930.8	0.014	0.13	06112013	082708	40241
20138102304	396257.5	8291949.2	0.058	0.23	06112013	083924	40241
20138102303	399782.7	8292363.1	0.149	0.11	06112013	084404	40241
20138103843	399827.6	8300133.6	-0.092	0.25	06112013	085218	40241
20138103842	408029.4	8300033.4	-0.050	0.45	06112013	090048	40241
20138103840	424170.5	8299898.7	-0.159	-0.27	06112013	091428	40241
20138106102	475947.5	8255583.8	0.020	0.48	06112013	105152	40241
20138103305	504363.9	8260059.3	0.069	0.58	06112013	112510	40241
20138103306	507846.2	8259704.9	0.091	0.57	06112013	113132	40241
20138103666	468233.6	8303885.4	0.004	0.27	06112013	134158	40241
20138103736	308013.0	8344014.1	-0.122	0.04	06112013	164944	40241
20138103735	299693.5	8343563.7	-0.125	-0.13	06112013	165436	40241
20138103735	299693.5	8343563.6	-0.053	-0.04	06112013	070452	40382
20138103686	510850.5	8339856.1	0.159	0.58	06112013	103640	40382
20138103682	511802.3	8324093.9	-0.026	-0.20	06112013	110346	40382
20138106800	379800.4	8340180.1	0.035	0.13	06112013	155452	40382
20138106799	368089.2	8340098.1	-0.074	0.09	06112013	160756	40382
20138106798	364088.8	8340372.9	0.028	-0.08	06112013	161144	40382
20138106797	355991.3	8340010.4	-0.020	0.37	06112013	161946	40382
20138106796	348025.8	8339721.3	-0.030	0.27	06112013	162720	40382
20138106795	340247.4	8339811.5	-0.042	0.50	06112013	163322	40382
20138103735	299693.7	8343563.5	-0.073	-0.01	06112013	170348	40382
20138103748	343871.7	8312191.8	-0.078	-0.08	07112013	063340	40241
20138106638	384041.0	8303978.8	-0.010	0.10	07112013	070544	40241
20138103666	468233.0	8303885.7	-0.030	0.02	07112013	081012	40241

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20138103930	492157.7	8295492.3	0.014	0.20	07112013	085408	40241
20138103989	491881.0	8291718.9	0.088	-0.33	07112013	123428	40241
20138103930	492157.7	8295491.9	-0.073	-0.03	07112013	124102	40241
20138106894	320179.7	8344334.8	-0.028	0.07	07112013	061526	40382
20138106891	336046.7	8340142.4	0.032	0.15	07112013	062400	40382
20138106796	348025.4	8339721.3	-0.047	0.10	07112013	063054	40382
20138106798	364088.4	8340372.9	-0.071	0.22	07112013	063930	40382
20138106800	379800.1	8340180.5	-0.054	0.00	07112013	064736	40382
20138106875	423910.7	8336089.4	-0.150	0.14	07112013	071432	40382
20138106869	447834.3	8336033.6	0.090	-0.18	07112013	072812	40382
20138106859	471984.1	8331969.3	0.004	0.19	07112013	074634	40382
20138106851	488022.4	8328031.5	-0.027	-0.06	07112013	080433	40382
20138106842	500319.1	8308047.0	-0.022	-0.63	07112013	090508	40382
20138106844	495880.4	8312390.5	0.114	0.18	07112013	090936	40382
20138106843	500062.0	8311807.3	0.129	-0.06	07112013	091400	40382
20138106848	491653.3	8316202.8	0.035	0.48	07112013	095742	40382
20138106860	472148.0	8328178.6	0.034	0.14	07112013	115224	40382
20138106861	471618.2	8323843.4	0.021	0.08	07112013	115754	40382
20138106859	471983.7	8331969.3	0.027	0.14	07112013	121038	40382
20138106902	460098.3	8332249.5	0.013	-0.13	07112013	124508	40382
20138106902	460098.3	8332249.4	0.041	0.17	07112013	141146	40382
20138106875	423910.4	8336089.6	-0.046	0.16	07112013	145134	40382
20138106774	272204.6	8299457.2	-0.055	0.13	08112013	071726	40241
20138102054	279023.9	8267650.5	0.157	0.12	08112013	081332	40241
20138106681	296038.3	8304093.0	0.130	0.57	08112013	120238	40241
20138106649	299998.6	8308088.2	0.049	0.71	08112013	121108	40241
20138106900	391936.6	8331974.4	0.102	0.34	08112013	072302	40382
20138106987	423678.7	8332041.6	0.003	0.88	08112013	074453	40382
20138106901	408094.3	8331560.5	0.160	0.34	08112013	153742	40382
20138106900	391936.7	8331974.6	0.083	-0.34	08112013	160152	40382
20138106989	379716.5	8332083.5	0.130	-0.09	08112013	163544	40382
20138106992	355994.4	8335992.6	0.058	-0.14	08112013	170546	40382
20138103735	299693.6	8343563.2	-0.090	-0.10	08112013	180934	40382
20138103735	299693.7	8343563.3	-0.076	0.09	09112013	055714	40241
20138103816	319609.4	8312219.3	0.061	0.16	09112013	095646	40241
20138103818	332031.8	8296313.8	-0.018	0.33	09112013	104932	40241
20138103813	320087.6	8296255.9	0.176	0.48	09112013	110022	40241
20138103812	307772.0	8295953.0	0.033	-0.24	09112013	122826	40241
20138106649	299998.6	8308088.0	0.068	0.07	09112013	145736	40241
20138107103	308130.0	8339879.5	-0.143	-0.91	09112013	060754	40382
20138107090	360133.6	8331998.4	-0.090	0.42	09112013	062812	40382
20138107084	384330.1	8328683.4	-0.013	0.37	09112013	063938	40382
20138107017	447947.6	8308065.3	0.062	-0.27	09112013	091238	40382
20138103666	468233.3	8303885.8	0.142	0.03	09112013	103244	40382
20138103974	372168.0	8311891.2	0.094	0.13	09112013	145414	40382
20138103845	384017.1	8299850.2	-0.102	-0.36	09112013	151428	40382
20138106638	384040.6	8303979.6	-0.036	-0.12	09112013	151834	40382

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20138106649	299998.4	8308088.1	0.032	0.23	10112013	135616	40241
20138103309	516092.2	8255794.9	-0.096	-0.14	12112013	141234	40382
20138103308	515952.1	8259767.5	-0.177	-0.60	12112013	141634	40382
20138103682	511802.2	8324093.8	0.012	0.25	12112013	153254	40382
20138103686	510846.5	8339863.2	-0.154	-0.69	12112013	160216	40382
20138107283	519848.2	8228226.4	0.100	1.00	12112013	171902	40382
20138104445	723484.8	8220196.4	0.042	-0.12	13112013	093500	40241
20138104441	715486.8	8227318.8	-0.018	-0.11	13112013	105856	40241
20138104435	664257.5	8220133.0	0.125	-0.56	13112013	133946	40241
20138104475	712086.0	8228033.5	0.057	-0.52	13112013	155316	40241
20138104441	715486.8	8227318.6	-0.034	-0.18	13112013	155750	40241
20138104490	656384.8	8223487.6	0.027	-0.03	13112013	173320	40241
20138104491	652722.6	8223510.9	0.060	0.02	13112013	173800	40241
20138104492	647721.0	8224031.0	0.051	-0.11	13112013	175322	40241
20138104342	559424.5	8240625.3	-0.061	-0.13	13112013	072824	40382
20138107402	536203.5	8307780.1	0.013	0.21	13112013	164606	40382
20138107348	532049.0	8279597.6	0.088	0.03	13112013	170518	40382
20138107347	532042.4	8264075.5	-0.098	0.36	13112013	171236	40382
20138107346	531942.9	8247891.7	-0.026	-0.27	13112013	171948	40382
20138107343	536468.2	8235880.3	-0.021	0.25	13112013	172632	40382
20138107342	552253.6	8235783.7	-0.043	0.48	13112013	173514	40382
20138107341	563843.9	8236147.3	-0.011	0.07	13112013	174304	40382
20138107340	580221.8	8235997.1	0.094	0.75	13112013	175206	40382
20138107337	604250.8	8224003.7	-0.026	0.15	13112013	180408	40382
20138107336	615796.8	8223956.9	0.037	0.24	13112013	181116	40382
20138107335	627926.2	8223776.1	-0.001	0.58	13112013	181830	40382
20138104492	647719.1	8224035.5	0.059	0.15	14112013	061258	40241
20138104491	652717.8	8223510.9	0.130	0.18	14112013	061740	40241
20138104490	656379.9	8223489.6	0.124	0.17	14112013	062424	40241
20138104527	664109.9	8232429.0	0.178	0.30	14112013	063512	40241
20138104524	667116.0	8231678.2	0.104	0.46	14112013	064132	40241
20138104525	667718.1	8236788.8	0.003	0.05	14112013	083002	40241
20138104526	663927.9	8235574.4	0.017	-0.01	14112013	083524	40241
20138104560	663759.3	8240239.8	-0.142	0.04	14112013	114526	40241
20138104526	663928.1	8235574.8	-0.062	-0.05	14112013	115016	40241
20138104599	660175.9	8239839.5	-0.132	0.11	14112013	115504	40241
20138104607	639911.8	8228412.8	-0.075	0.17	14112013	131900	40241
20138104606	640250.7	8232075.2	-0.004	0.25	14112013	132400	40241
20138104601	660262.3	8235568.3	0.151	-0.42	14112013	135022	40241
20138104526	663927.9	8235574.5	0.014	0.01	14112013	135412	40241
20138104525	667718.2	8236788.4	0.091	0.04	14112013	135808	40241
20138104560	663758.3	8240239.5	0.083	0.03	14112013	140316	40241
20138104597	660106.9	8248312.4	-0.038	-0.26	14112013	142234	40241
20138104606	640250.5	8232074.8	0.004	0.20	14112013	165242	40241
20138104607	639912.1	8228411.9	0.028	0.06	14112013	165804	40241
20138107335	627926.3	8223776.1	-0.022	-0.23	14112013	061718	40382
20138107336	615796.7	8223957.0	-0.003	0.05	14112013	062936	40382

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s^2	DATE_DDMMYY	TIME_HHMMSS	METERSN
20138107337	604250.8	8224003.6	0.016	0.07	14112013	064118	40382
20138107341	563844.2	8236147.5	-0.014	-0.36	14112013	071822	40382
20138107342	552253.5	8235783.8	-0.033	0.10	14112013	072638	40382
20138107343	536468.2	8235880.2	0.023	-0.02	14112013	073512	40382
20138107346	531942.9	8247891.8	-0.009	0.08	14112013	074218	40382
20138107347	532042.0	8264075.1	0.069	-0.56	14112013	075354	40382
20138107348	532048.5	8279597.8	-0.057	-0.06	14112013	080156	40382
20138107402	536203.4	8307780.1	-0.089	-0.02	14112013	082134	40382
20138107402	536203.7	8307780.2	-0.015	-0.17	14112013	123850	40382
20138107230	560086.1	8304525.2	0.034	0.48	14112013	133542	40382
20138107518	551368.4	8304626.8	0.008	-0.12	14112013	161630	40382
20138107515	543985.5	8303809.2	0.001	0.57	14112013	162804	40382
20138107516	539576.1	8304340.1	-0.048	0.41	14112013	163234	40382
20138107468	536168.8	8296161.5	-0.049	0.00	14112013	164212	40382
20138107335	627926.0	8223775.4	0.069	0.47	14112013	180548	40382
20138104607	639911.8	8228412.6	-0.007	-0.06	15112013	061040	40241
20138104642	631934.7	8247859.4	-0.093	-0.02	15112013	062726	40241
20138104636	631905.7	8255243.6	0.015	-0.04	15112013	063254	40241
20138107244	620991.0	8292295.2	-0.140	0.28	15112013	102740	40241
20138104667	631702.1	8276658.9	-0.130	0.36	15112013	123712	40241
20138104572	643763.1	8271818.6	-0.092	0.35	15112013	132100	40241
20138104667	631702.2	8276659.2	-0.003	0.23	15112013	133018	40241
20138104668	631987.6	8279786.6	-0.065	0.50	15112013	133512	40241
20138104709	628246.3	8280116.1	-0.097	0.51	15112013	133902	40241
20138107335	627926.3	8223775.9	-0.006	-0.74	15112013	061056	40382
20138107336	615796.8	8223957.1	0.025	-0.01	15112013	061824	40382
20138107337	604251.0	8224003.7	-0.006	0.16	15112013	062600	40382
20138107559	603820.0	8236202.6	0.110	0.27	15112013	063252	40382
20138107558	595876.6	8243611.0	-0.151	-0.24	15112013	063858	40382
20138107557	587551.7	8252795.3	-0.088	0.31	15112013	064606	40382
20138107556	580539.6	8259787.9	-0.108	0.45	15112013	065222	40382
20138107555	572304.6	8268221.8	-0.033	0.34	15112013	073116	40382
20138107554	556216.0	8279812.2	-0.058	-0.05	15112013	090804	40382
20138107230	560086.6	8304525.0	0.001	0.57	15112013	092904	40382
20138107468	536168.7	8296161.7	0.110	0.30	15112013	103650	40382
20138107553	547646.7	8287704.8	-0.179	0.58	15112013	114736	40382
20138107341	563844.1	8236148.0	0.004	0.06	15112013	174046	40382
20138107340	580221.1	8235996.7	-0.024	0.13	15112013	175110	40382
20138107337	604250.8	8224004.0	0.049	0.08	15112013	180312	40382
20138107336	615797.1	8223957.1	-0.026	0.16	15112013	181014	40382
20138107335	627926.6	8223775.8	0.014	0.75	15112013	181732	40382
20138104607	639912.3	8228412.3	0.050	-0.18	16112013	101056	40241
20138104606	640250.4	8232075.0	-0.012	-0.36	16112013	101414	40241
20138104610	640360.6	8223808.7	-0.049	0.21	16112013	145510	40241
20138104607	639911.8	8228412.8	-0.003	-0.16	16112013	150022	40241
20138104643	631843.9	8244197.2	-0.181	-0.39	16112013	155704	40241
20138104642	631935.7	8247859.5	0.160	-0.08	16112013	160116	40241

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s^2	DATE_DDMMYY	TIME_HHMMSS	METERSN
20138104637	632445.9	8251463.5	-0.120	-0.10	16112013	161724	40241
20138104636	631905.4	8255243.1	-0.153	-0.16	16112013	162134	40241
20138104667	631702.5	8276659.2	0.071	-0.32	16112013	170908	40241
20138104668	631989.2	8279781.6	0.020	-0.29	16112013	171406	40241
20138104713	620312.6	8284233.5	0.020	0.17	16112013	172730	40241
20138107244	620991.1	8292294.5	-0.160	0.24	16112013	174122	40241
20138107335	627926.2	8223776.0	-0.005	-0.39	16112013	063148	40382
20138107336	615797.2	8223957.2	-0.010	-0.06	16112013	063936	40382
20138107342	552253.6	8235784.1	0.058	-0.31	16112013	080134	40382
20138107343	536468.5	8235880.0	0.001	-0.29	16112013	082512	40382
20138107230	560086.4	8304525.1	0.024	-0.11	16112013	105556	40382
20138107340	580221.5	8235997.2	0.011	-0.43	16112013	120858	40382
20138107559	603820.3	8236203.3	-0.198	-0.10	16112013	134042	40382
20138104342	559424.6	8240624.9	-0.035	-0.15	16112013	164144	40382
20138107559	603820.5	8236203.6	-0.040	-0.62	16112013	171154	40382
20138107336	615796.9	8223957.1	-0.006	-0.47	16112013	172014	40382
20138107335	627926.1	8223775.3	0.027	-0.25	16112013	172724	40382

APPENDIX G
Repeat Listing: Multiple Control Station Observations

STATION	MGA94EAST	MGA94NORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s^2	DATE_DDMMYY	TIME_HHMMSS	METERSN	GRVBASE	GPSBASE
20138101252	291882.853	8188177.035			17102013	174514	40241	20138100001	20138100110
20138101252	291882.625	8188177.170	-0.032		23102013	071858	40241	20138100001	20138100001
20138101285	336048.785	8159911.483			18102013	081030	40241	20138100001	20138100001
20138101285	336048.692	8159913.314	-0.171		18102013	163812	40241	20138100001	20138100110
20138101286	335898.191	8157853.880			18102013	081544	40241	20138100001	20138100001
20138101286	335898.442	8157853.855	0.104		18102013	163418	40241	20138100001	20138100110
20138101287	335946.951	8155920.590			18102013	082336	40241	20138100001	20138100001
20138101287	335942.619	8155922.203	-0.030		18102013	162946	40241	20138100001	20138100110
20138101818	324083.844	8232244.126			21102013	163626	40241	20138100001	20138100001
20138101818	324083.815	8232244.002	0.158		24102013	115016	40241	20138100001	20138100106
20138102054	279030.267	8267652.876			23102013	121850	40241	20138100001	20138100106
20138102054	279025.558	8267651.605	0.025	0.09	23102013	132548	40241	20138100001	20138100106
20138102054	279023.914	8267650.491	0.157	0.12	08112013	081332	40241	20138100002	20138100101
20138102235	364344.197	8243832.382			24102013	153534	40241	20138100001	20138100106
20138102235	364344.300	8243832.155	0.041	-0.18	25102013	170050	40241	20138100001	20138100113
20138102303	399785.340	8292364.028			25102013	101942	40241	20138100001	20138100113
20138102303	399785.151	8292363.867	-0.095	-0.09	25102013	142508	40241	20138100001	20138100113
20138102303	399782.724	8292363.109	0.149	0.11	06112013	084404	40241	20138100002	20138100102
20138102304	396252.649	8291956.167			25102013	102412	40241	20138100001	20138100113
20138102304	396252.579	8291956.630	-0.037	-0.11	25102013	142130	40241	20138100001	20138100113
20138102304	396257.506	8291949.197	0.058	0.23	06112013	083924	40241	20138100002	20138100102
20138102776	447871.806	8179886.039			30102013	160942	40241	20138100001	20138100112
20138102776	447871.764	8179885.783	-0.015		31102013	144304	40241	20138100001	20138100107
20138102981	451991.625	8171895.109			29102013	163102	40241	20138100001	20138100112
20138102981	451991.681	8171894.969	-0.079		31102013	134840	40241	20138100001	20138100111
20138103005	427862.457	8180075.933			30102013	065608	40241	20138100001	20138100111
20138103005	427862.481	8180075.536	0.061		30102013	163220	40241	20138100001	20138100111
20138103005	427862.498	8180075.927	0.022		31102013	183448	40241	20138100001	20138100107
20138103305	504363.494	8260059.107			01112013	100600	40241	20138100001	20138100107

STATION	MGA94EAST	MGA94NORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s^2	DATE_DDMMYY	TIME_HHMMSS	METERSN	GRVBASE	GPSBASE
20138103305	504363.867	8260059.261	0.069	0.58	06112013	112510	40241	20138100002	20138100103
20138103306	507846.173	8259705.318			01112013	100958	40241	20138100001	20138100107
20138103306	507846.176	8259704.936	0.091	0.57	06112013	113132	40241	20138100002	20138100103
20138103308	515952.243	8259767.168			01112013	101910	40241	20138100001	20138100107
20138103308	515952.062	8259767.548	-0.177	-0.60	12112013	141634	40382	GRVGPS0068	20138100108
20138103309	516092.214	8255795.086			01112013	102328	40241	20138100001	20138100107
20138103309	516092.494	8255795.210	0.046	0.20	01112013	143008	40241	20138100001	20138100107
20138103309	516092.233	8255794.912	-0.096	-0.14	12112013	141234	40382	GRVGPS0068	20138100108
20138103381	411786.249	8231802.560			01112013	165940	40241	20138100001	20138100107
20138103381	411780.949	8231799.718	0.017		02112013	071254	40241	20138100001	20138100101
20138103382	411963.094	8224497.401			01112013	170518	40241	20138100001	20138100107
20138103382	411961.539	8224491.831	0.011		02112013	070650	40241	20138100001	20138100101
20138103383	411474.466	8216261.393			01112013	171250	40241	20138100001	20138100111
20138103383	411478.669	8216257.341	0.099		02112013	070048	40241	20138100001	20138100101
20138103383	411474.551	8216260.925	-0.049		02112013	174948	40241	20138100001	20138100113
20138103385	395768.745	8211832.951			01112013	172746	40241	20138100001	20138100111
20138103385	395769.719	8211827.287	-0.120		02112013	064940	40241	20138100001	20138100101
20138103385	395768.550	8211832.840	-0.016		03112013	072044	40241	20138100001	20138100113
20138103386	387706.488	8211818.891			01112013	173352	40241	20138100001	20138100111
20138103386	387709.997	8211814.032	-0.114		02112013	064408	40241	20138100001	20138100101
20138103388	371468.621	8212039.898			01112013	174510	40241	20138100001	20138100001
20138103388	371474.695	8212040.205	0.194		02112013	063220	40241	20138100001	20138100101
20138103391	340146.569	8199378.692			01112013	180434	40241	20138100001	20138100001
20138103391	340149.630	8199373.727	0.061		02112013	061146	40241	20138100001	20138100101
20138103682	511804.398	8324093.657			04112013	112450	40241	20138100001	20138100102
20138103682	511802.348	8324093.865	-0.026	-0.20	06112013	110346	40382	20138100002	20138100103
20138103682	511802.192	8324093.764	0.012	0.25	12112013	153254	40382	GRVGPS0068	20138100104
20138103686	510849.246	8339857.723			04112013	114332	40241	20138100001	20138100102
20138103686	510850.503	8339856.105	0.159	0.58	06112013	103640	40382	20138100002	20138100103

STATION	MGA94EAST	MGA94NORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s^2	DATE_DDMMYY	TIME_HHMMSS	METERSN	GRVBASE	GPSBASE
20138103686	510846.530	8339863.207	-0.154	-0.69	12112013	160216	40382	GRVGPS0068	20138100104
20138103840	424170.376	8299898.891			05112013	162156	40241	20138100002	20138100103
20138103840	424170.463	8299898.702	-0.159		06112013	091428	40241	20138100002	20138100102
20138103842	408026.909	8300033.169			05112013	163310	40241	20138100002	20138100103
20138103842	408029.448	8300033.396	-0.050		06112013	090048	40241	20138100002	20138100102
20138103843	399827.308	8300134.170			05112013	164116	40241	20138100002	20138100103
20138103843	399827.573	8300133.645	-0.092		06112013	085218	40241	20138100002	20138100102
20138103844	391832.448	8299930.400			05112013	164622	40241	20138100002	20138100103
20138103844	391832.528	8299930.752	0.014		06112013	082708	40241	20138100002	20138100102
20138105033	473743.843	8159772.406			19102013	172236	40382	20138100001	20138100110
20138105033	473738.355	8159771.469	0.140		20102013	141758	40382	20138100001	20138100112
20138105033	473738.501	8159771.705	-0.014		21102013	150226	40382	20138100001	20138100112
20138105033	473738.287	8159771.624	-0.024		23102013	091632	40382	20138100001	20138100112
20138105033	473738.531	8159771.948	-0.004		31102013	180442	40241	20138100001	20138100107
20138105217	515761.872	8132263.428			21102013	120508	40382	20138100001	20138100111
20138105217	515761.696	8132263.305	-0.143		22102013	135404	40382	20138100001	20138100112
20138105403	368052.159	8164201.249			23102013	065900	40382	20138100001	20138100111
20138105403	368052.227	8164201.619	0.077		23102013	173906	40382	20138100001	20138100111
20138105403	368052.345	8164201.139	-0.070		25102013	180454	40382	20138100001	20138100001
20138105561	356016.394	8147982.951			24102013	083042	40382	20138100001	20138100111
20138105561	356016.453	8147983.116	-0.094		25102013	064750	40382	20138100001	20138100001
20138105592	477916.185	8130083.345			24102013	111622	40382	20138100001	20138100112
20138105592	477916.494	8130083.206	-0.072		25102013	091902	40382	20138100001	20138100001
20138106096	476094.947	8231624.411			29102013	124708	40382	20138100001	20138100113
20138106096	476095.074	8231624.167	0.085		03112013	164938	40241	20138100001	20138100107
20138106102	475947.436	8255583.684			29102013	133256	40382	20138100001	20138100107
20138106102	475947.660	8255584.305	-0.087	0.07	01112013	092606	40241	20138100001	20138100107
20138106102	475947.504	8255583.780	0.020	0.48	06112013	105152	40241	20138100002	20138100103
20138106667	315977.843	8268244.716			04112013	130048	40382	20138100001	20138100001

STATION	MGA94EAST	MGA94NORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s^2	DATE_DDMMYY	TIME_HHMMSS	METERSN	GRVBASE	GPSBASE
20138106667	315977.567	8268243.040	0.145	-0.73	05112013	105644	40382	20138100002	20138100101
20138106679	304070.168	8304201.744			04112013	135706	40382	20138100001	20138100102
20138106679	304070.157	8304201.654	0.143	-0.55	05112013	130428	40382	20138100002	20138100101
20138106681	296039.883	8304092.142			04112013	142540	40382	20138100001	20138100102
20138106681	296038.300	8304092.952	0.130	0.57	08112013	120238	40241	20138100002	20138100101
20138106796	348025.705	8339721.285			06112013	073602	40382	20138100002	20138100102
20138106796	348025.750	8339721.305	-0.030		06112013	162720	40382	20138100002	20138100102
20138106796	348025.446	8339721.274	-0.047		07112013	063054	40382	20138100002	20138100103
20138106798	364088.985	8340372.994			06112013	074858	40382	20138100002	20138100102
20138106798	364088.840	8340372.861	0.028		06112013	161144	40382	20138100002	20138100102
20138106798	364088.447	8340372.931	-0.071		07112013	063930	40382	20138100002	20138100103
20138106800	379800.103	8340180.081			06112013	080056	40382	20138100002	20138100102
20138106800	379800.396	8340180.142	0.035		06112013	155452	40382	20138100002	20138100102
20138106800	379800.056	8340180.482	-0.054		07112013	064736	40382	20138100002	20138100103
20138107244	620986.982	8292296.838			11112013	141442	40382	20138100002	20138100104
20138107244	620991.013	8292295.183	-0.140	0.28	15112013	102740	40241	GRVGPS0068	20138100105
20138107244	620991.092	8292294.548	-0.160	0.24	16112013	174122	40241	GRVGPS0068	GRVGPS0068

APPENDIX H
Longman's Earth Tide Correction Formula

```
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*8399.7092 99+4.72002 3434+(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*0.030005 26416+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)*0.1097 9944)
dolm=(dolm1+sin((ds-dp)*2.0)*0.00376 7474+sin(ds-
dh*2.0+dp)*0.0154002+sin((ds-dh)*2.0)*0.00769395)
dha=((dTime*15.0-180)*0.01745329 2519 9+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-
```

APPENDIX I
Data Formats and Metadata

```
DEFN   ST=RECD,RT=COMM;RT:A4;COMMENTS:A76
DEFN 1 ST=RECD,RT=;PROJECT:F7.0:NULL=-9999.,UNIT=None,NAME=PROJECT
DEFN 2 ST=RECD,RT=;STATION:F12.0:NULL=-999999999.,UNIT=None,NAME=STATION
DEFN 3 ST=RECD,RT=;LATITUDE:F11.6:NULL=-99.999999,UNIT=Decimal Degrees,NAME=LATITUDE
DEFN 4 ST=RECD,RT=;LONGITUDE:F12.6:NULL=-999.999999,UNIT=Decimal Degrees,NAME=LONGITUDE
DEFN 5 ST=RECD,RT=;EASTING:F9.1:NULL=-99999.9,UNIT=metres,NAME=EASTING
DEFN 6 ST=RECD,RT=;NORTHING:F10.1:NULL=-999999.9,UNIT=metres,NAME=NORTHING
DEFN 7 ST=RECD,RT=;ELLIPSHTGRS80:F9.3:NULL=-999.999,UNIT=metres,NAME=ELLIPSHTGRS80
DEFN 8 ST=RECD,RT=;NAG09:F9.3:NULL=-999.999,UNIT=metres,NAME=NAG09
DEFN 9 ST=RECD,RT=;GRNDELEVATION:F9.3:NULL=-999.999,UNIT=metres,NAME=GRNDELEVATION
DEFN 10 ST=RECD,RT=;OBSGAAGD07:F12.2:NULL=-9999999.99,UNIT=µm/s^2,NAME=OBSGAAGD07
DEFN 11 ST=RECD,RT=;HTGM:F9.3:NULL=-999.999,UNIT=metres,NAME=HTGM
DEFN 12 ST=RECD,RT=;TCINNER:F7.2:NULL=-99.99,UNIT=µm/s^2,NAME=TCINNER
DEFN 13 ST=RECD,RT=;TCQFINNER:I4:NULL=-99,UNIT=None,NAME=TCQFINNER
DEFN 14 ST=RECD,RT=;TCOUTER:F7.2:NULL=-99.99,UNIT=µm/s^2,NAME=TCOUTER
DEFN 15 ST=RECD,RT=;TCQFOUTER:I4:NULL=-99,UNIT=None,NAME=TCQFOUTER
DEFN 16 ST=RECD,RT=;TCTOTAL:F7.2:NULL=-99.99,UNIT=µm/s^2,NAME=TCTOTAL
DEFN 17 ST=RECD,RT=;EFAA:F10.2:NULL=-99999.99,UNIT=µm/s^2,NAME=EFAA
DEFN 18 ST=RECD,RT=;SCBA267:F10.2:NULL=-99999.99,UNIT=µm/s^2,NAME=SCBA267
DEFN 29 ST=RECD,RT=;CSCBA267:F10.2:NULL=-99999.99,UNIT=µm/s^2,NAME=CSCBA267
DEFN 20 ST=RECD,RT=;HORIZDIST:F9.2:NULL=-9999.99,UNIT=metres,NAME=HORIZDIST
DEFN 21 ST=RECD,RT=;GRVBASE:F13.0:NULL=-9999999999.,UNIT=None,NAME=GRVBASE
DEFN 22 ST=RECD,RT=;GPSBASE:F13.0:NULL=-9999999999.,UNIT=None,NAME=GPSBASE
DEFN 23 ST=RECD,RT=;TIME:A9:,UNIT=None,NAME=TIME
DEFN 24 ST=RECD,RT=;DATE:A9:,UNIT=None,NAME=DATE
DEFN 25 ST=RECD,RT=;MGAZONE:F4.0:NULL=-9.,UNIT=None,NAME=MGAZONE
DEFN 26 ST=RECD,RT=;GMTYPESN:A30:,UNIT=None,NAME=GMTYPESN
DEFN 27 ST=RECD,RT=;STATIONDESC:F20.0:NULL=-99.,UNIT=None,NAME=STATIONDESC;END DEFN
DEFN 29 ST=RECD,RT=;COMMENTS:F20.0:NULL=-99.,NAME=COMMENTS;END DEFN
DEFN 1 ST=RECD,RT=PROJ; RT:A4
DEFN 2 ST=RECD,RT=PROJ; PROJNAME:A30: COMMENT=GDA94 / MGA zone 53
DEFN 3 ST=RECD,RT=PROJ; ELLPSNAM:A30: COMMENT=GRS 1980
DEFN 4 ST=RECD,RT=PROJ; MAJ_AXIS: D12.1: UNIT=m, COMMENT=6378137.000000
DEFN 5 ST=RECD,RT=PROJ; ECCENT: D12.9: COMMENT=298.257222
DEFN 6 ST=RECD,RT=PROJ; PRIMEMER: F10.1: UNIT=deg, COMMENT=0.000000
DEFN 7 ST=RECD,RT=PROJ; PROJMETH: A30: COMMENT=Transverse Mercator
DEFN 8 ST=RECD,RT=PROJ; PARAM1: D14.0: COMMENT=      0.000000
DEFN 9 ST=RECD,RT=PROJ; PARAM2: D14.0: COMMENT=    135.000000
DEFN 10 ST=RECD,RT=PROJ; PARAM3: D14.0: COMMENT=      0.999600
DEFN 11 ST=RECD,RT=PROJ; PARAM4: D14.0: COMMENT= 500000.000000
DEFN 12 ST=RECD,RT=PROJ; PARAM5: D14.0: COMMENT=10000000.00000
DEFN 13 ST=RECD,RT=PROJ; PARAM6: D14.0:
DEFN 14 ST=RECD,RT=PROJ; PARAM7: D14.0:
DEFN 15 ST=RECD,RT=PROJ; END DEFN
```

```
COMM ATLAS GEOPHYSICS PTY LTD ASEG-GDF2 FORMAT FILE
COMM WWW.ATLASGEO.COM.AU
COMM INFO@ATLASGEO.COM.AU
COMM
COMM ATLAS PROJECT NUMBER              P2013046
COMM GA PROJECT NUMBER                 201381
COMM CLIENT                            GA
COMM PROJECT AREA                      SOUTH MCARTHUR RIVER BASIN GRAVITY
COMM START DATE                        15102013
COMM END DATE                          16112013
COMM PROCESSED BY                      LR MATHEWS
COMM
COMM VESSEL                            HELICOPTER ROBINSON R44
COMM OPERATORS                         GEOSCIENCE AUSTRALIA / NTGS
COMM OBSERVERS                         CR, TW, BV, MD, TR, JG
COMM
COMM MIN SPACING                       2000m
COMM MAX SPACING                       4000m
COMM LAYOUT                            CELL CENTRE
COMM
COMM GRAVITY STATIONS                  6275
COMM
COMM GEODETIC DATUM                    GDA94
COMM PROJECTION                        MGA53
COMM HORIZ ACCURACY                    0.05 m
COMM
COMM VERTICAL DATUM                    GRS80
COMM VERTICAL ACCURACY                 0.05 m
COMM
COMM GRAVITY DATUM                     AAGD07
COMM GRAVITY ACCURACY                  0.4 µm/s^2
COMM
COMM GRAVITY INSTRUMENT                SCINTREX CG5
COMM GRAVITY SN                        40241,40382
COMM GPS INSTRUMENT                    LEICA GPS1200
COMM GPS METHOD                        PPK
COMM
COMM GPS BASE                          20138100001, 20138100002, 20138100068, 201381000101-113
COMM GRV BASE                          20138100001, 20138100002, 20138100068
COMM CTRL TIE STATION                  1964910133
COMM
COMM PROCESSING
COMM DRIFT CORRECTION
COMM ETC CORRECTION                    LONGMAN
COMM NORMAL GRAVITY                    9780326.7715*((1+0.001931851353*(SIN(B3*(PI()/180)))^2)/(SQRT(1-0.0066943800229*(SIN(B3*(PI()/180)))^2)))
COMM ATMOSPHERIC CORRECTION            8.74-0.00099*F3+0.0000000356*F3^2
COMM FREE AIR CORRECTION               -(3.087691-0.004398*SIN(LAT)^2)*ELLIPSHT+0.00000072125*ELLIPSHT^2
COMM SCAP BOUGUER CORRECTION           2*PI*Gp((1+µ)*ELLIPSHT-LAMBDA*R) for p=2.67 t/m^3
COMM TERRAIN CORRECTION METHOD         RASTERTC
COMM
COMM SOFTWARE                          AGRIS(IN HOUSE), WAYPOINT850, CHRISDBF, ERMAPPER, RASTERTC
COMM
COMM
COMM DETAILED COLUMN DESCRIPTIONS
COMM COLUMN NAME                       COLUMN DESCRIPTION                                           UNITS
COMM
COMM PROJECT                           GA PROJECT NUMBER                                            NONE
COMM STATION                           GA STATION NUMBER                                            NONE
COMM LATITUDE                          COORDINATE LATITUDE GDA94                                    DECIMAL DEGREES
COMM LONGITUDE                         COORDINATE LONGITUDE GDA94                                   DECIMAL DEGREES
COMM EASTING                           COORDINATE EASTING MGA/GDA94                                 M
COMM NORTHING                          COORDINATE NORTHING MGA/GDA94                                M
COMM ELLIPSHTGRS80                     COORDINATE ELEVATION ELLIPSOIDAL GRS80                       M
COMM NAG09                             GEOID ELLIPSOID SEPARATION AUSGEOID09                        M
COMM GRNDELEVATION                     GROUND LEVEL ELEVATION                                       M
COMM OBSGAAGD07GU                      OBSERVED GRAVITY AAGD07                                      µm/s^2
COMM HTGM                              STATION HEIGHT OF GRAVITY METER                              M
COMM TCINNER267                        INNER ZONE TERRAIN CORRECTION 2.67 t/m^3                     µm/s^2
COMM TCINNER230                        INNER ZONE TERRAIN CORRECTION 2.30 t/m^3                     µm/s^2
COMM TCQFINNER                         QUALITY FACTOR OF INNER ZONE TERRAIN CORRECTION              NONE
COMM TCOUTER267                        OUTER ZONE TERRAIN CORRECTION 2.67 t/m^3                     µm/s^2
COMM TCOUTER230                        OUTER ZONE TERRAIN CORRECTION 2.30 t/m^3                     µm/s^2
COMM TCQFOUTER                         QUALITY FACTOR OF OUTER ZONE TERRAIN CORRECTION              NONE
COMM TCTOTAL267                        TOTAL TERRAIN CORRECTION  2.67 t/m^3                         µm/s^2
COMM EFAA                              ELLIPSOIDAL FREE AIR ANOMALY                                 µm/s^2
COMM SCBA267                           SPHERICAL CAP BOUGUER ANOMALY 2.67 t/m^3                     µm/s^2
COMM CSCBA267                          COMPLETE SPHERICAL CAP BOUGUER ANOMALY 2.67 t/m^3            µm/s^2
COMM HORIZDIST                         HORIZONTAL DISTANCE FROM PROGRAMMED STATION                  M
COMM GRVBASE                           GRAVITY BASE STATION REFERENCED TO                           NONE
COMM GPSBASE                           GPS BASE STATION REFERENCED TO                               NONE
COMM TIME                              TIME OF GRAVITY OBSERVATION                                  NONE
COMM DATE                              DATE OF GRAVITY OBSERVATION                                  NONE
COMM MGAZONE                           MGA ZONE NUMBER                                              NONE
COMM GMTYPESN                          GRAVITY METER TYPE SERIAL                                    NONE
COMM STATIONDESC                       STATION DESC                                                 NONE
COMM COMMENTS                          COMMENTS                                                     NONE
```