Atlas Geophysics Report Number R2014078

Northern McArthur Basin Gravity Survey

Geoscience Australia

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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 17 years of 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 P2014078 required the acquisition and processing of **6,895** new regional gravity stations on behalf of Geoscience Australia (GA), funded by the Northern Territory Geological Survey (NTGS). The gravity survey, referred to as the "Northern McArthur Basin Gravity Survey" was assigned GA project number 201480.

The survey covered an area in Eastern Arnhem Land, in the north eastern corner of the Northern Territory (Figure 1). The survey was carried out from logistics bases at Bulman, Roper Bar and Gove.

Atlas Geophysics Pty Ltd completed the acquisition of the dataset using helicopter-borne gravity methods. The survey commenced on 16th September 2014 with survey cessation on 14th November 2014.

2.1 Location, Access and Terrain

The gravity survey spanned an area approximately 68,000 kilometres square (Figure 1) and covered parts of the following 1:250,000 map sheets in East Arnhem Land

- Katherine
- Roper River
- Mount Marumba
- Groote Eylandt
- Gove Peninsula
- Urapunga
- Mount Evelyn
- Blue Mud Bay
- Galiwinku
- Wessel Islands

Surveying of the south-western section of the grid was conducted out of Bulman Aboriginal Community which is located on the Central Arnhem Highway between Katherine and Nhulunbuy. The south-eastern section of the survey was conducted from the settlement of Roper Bar (*Yurlhbunji* to the local Ngalakgan people) approximately 310km east of Katherine, on the Roper River. The final, most northern part of the survey was acquired out of Nhulunbuy.

Access for the survey was very limited, with only the Central Arnhem Highway and Roper Highway, and Ngukurr- Numbulwar available for use. The Central Arnhem Road leaves the Stuart Highway 52 km south of Katherine. The first 30 km is sealed but from then on the road is corrugated, slippery with loose gravel and in some places heavy with bull dust. The Roper Highway is much the same, with badly rutted sections in parts. The lack of access necessitated careful daily planning, especially considering the prevalence of tall trees and thick vegetation.

Terrain was variable due to the large expanse covered by the survey. Typical Savannah woodlands dominated in the interior regions, but towards the coast the tree cover became more subdued as the crew encountered open flood plains and tidal flats, mangroves and deserted, beautiful, white beaches. Relief was reasonably flat in the west, but further east, ranges and small hills were prevalent. Crocodiles, water buffalo and abundant birdlife were often spotted in the many creeks, rivers and water-ways.

2.2 Survey Configuration

For most of the survey, gravity acquisition was conducted using a square grid configuration with stations spaced at 4km. Some sections of the survey areas were carried out using 1km and 2km square spacing, with some traverses in the south also collected at 1km spacing.

A number of stations were offset from their planned station location where helicopter landing was deemed risky e.g. heavily wooded areas, creek beds. Some stations were omitted from the survey where landing was impossible.

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

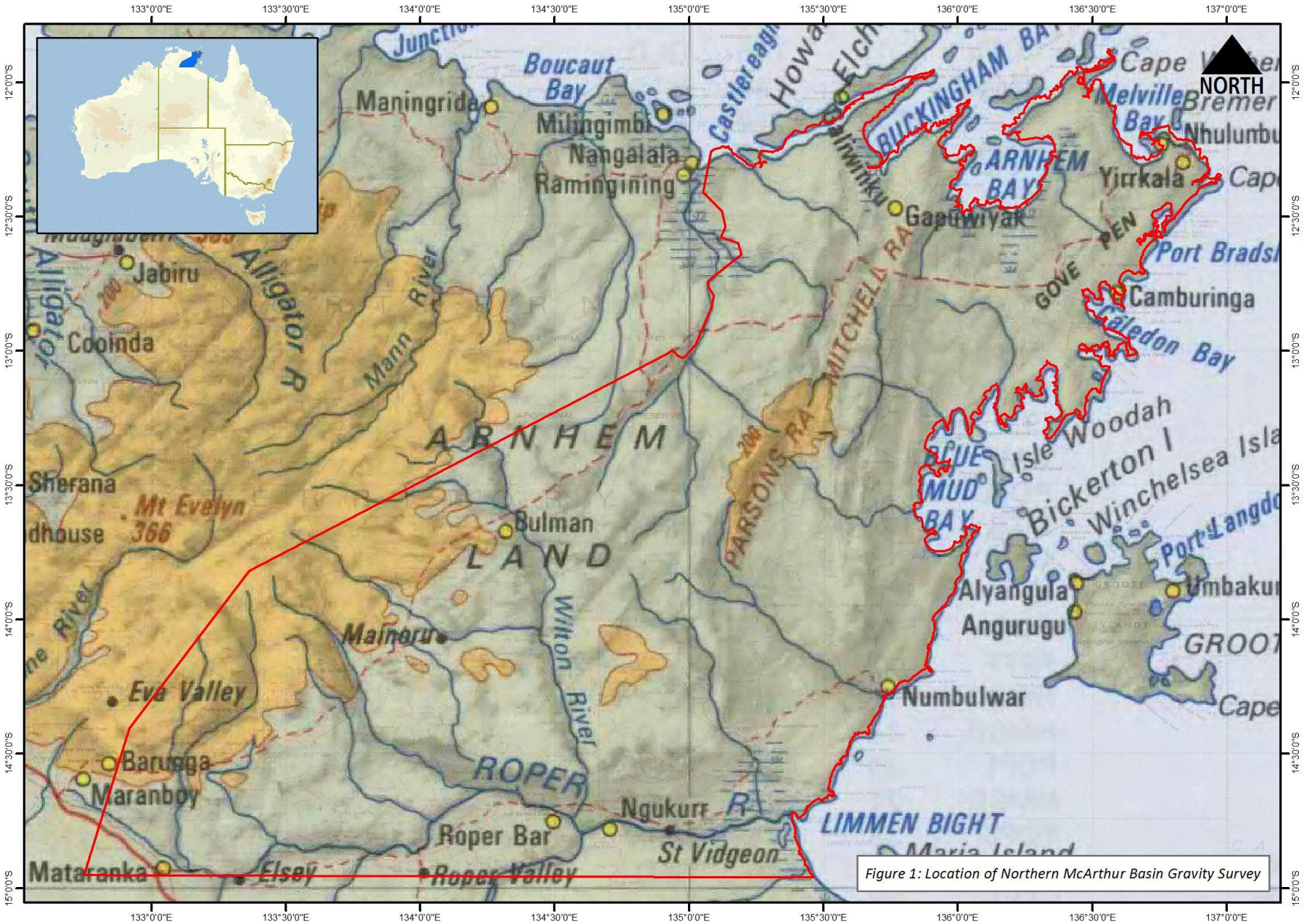


Figure 1: Location of Northern McArthur Basin Gravity Survey

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 of experience in the acquisition, processing and quality control 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 17 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 control of the gravity data on a daily basis.

All final data processing, QC, 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:

David Hanson	*Supervising Geophysical Technician*
Justin Fenwick	Geophysical Technician
Marc Camenzind	Geophysical Technician
Brian Maquire	Geophysical Technician
Barry Thompson	Pilot
Harry Dunkley	Pilot
Rene Theirry	Pilot
Alex Reid-Terry	Pilot
Sebastian Parker	Pilot
Darius Howard	Pilot
Ryan Jackett	Pilot

3.3 Subcontractors

Great Ocean Road Helicopters Pty Ltd and Airborne Solutions 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 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 CG-5	A2	40241
Scintrex CG-5	A6	40382

Table 1: Gravity meters used on the project

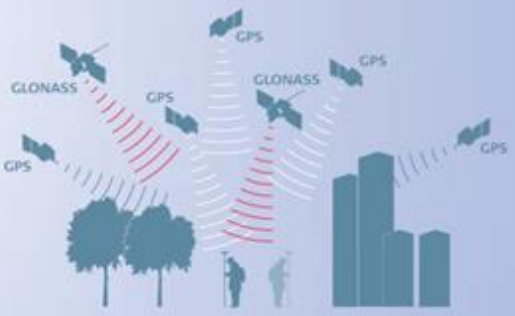
4.3 Other Equipment

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



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

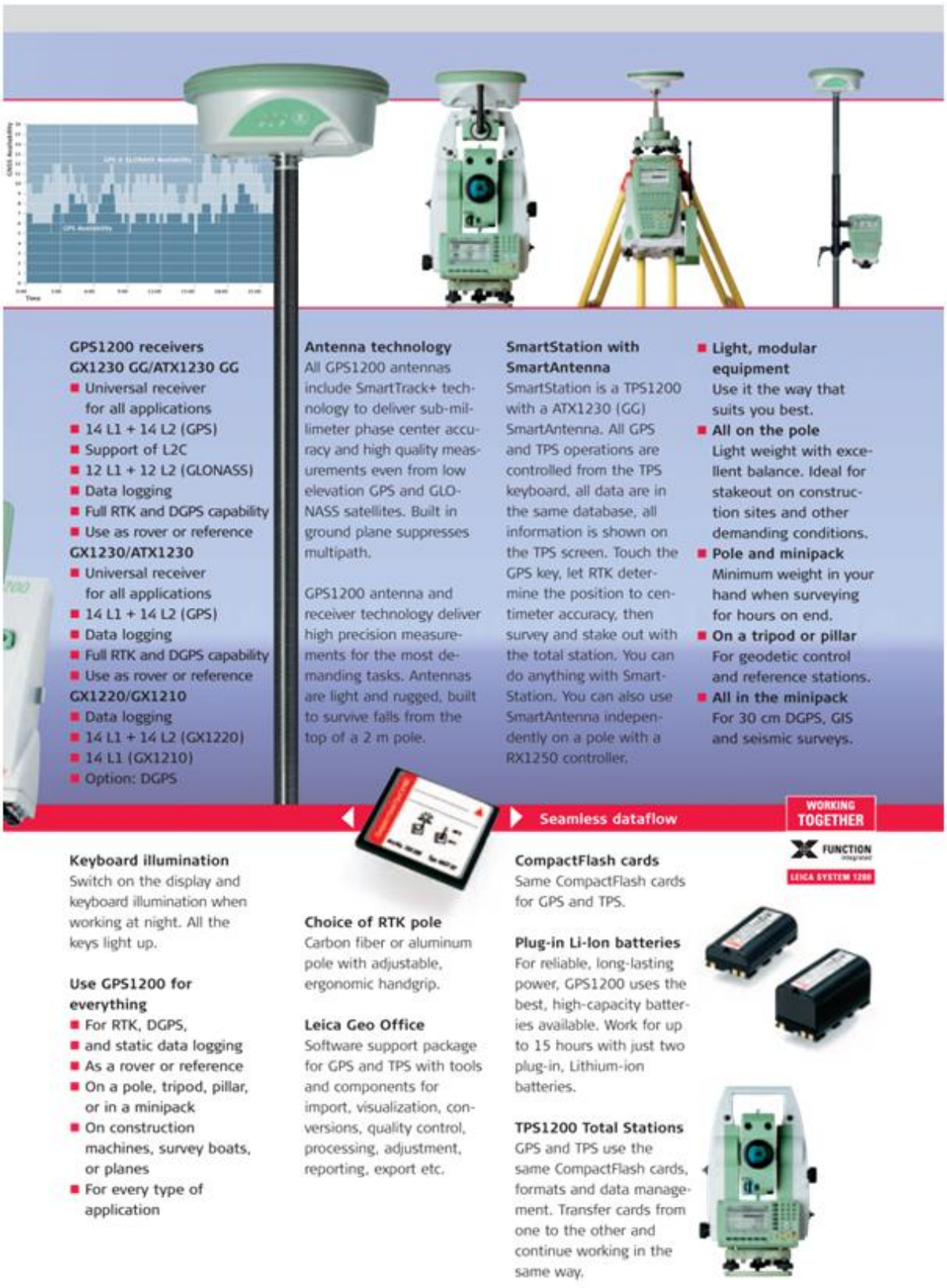


Figure 3: Leica GPS1200 product brochure

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, Consumption	Nominal 12 VDC. 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 Built in groundplane	SmartTrack AX1202 Built in groundplane	SmartTrack AX1202 Built in groundplane	SmartTrack AX1201 Built in goundplane	SmartTrack ATX1230 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 Same for GPS and TPS	Power receiver + controller + SmartTrack antenna 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

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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.

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* 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

Two Robinson R44 helicopters were supplied to the project (Photos 1 and 2). The helicopters were serviced in accordance with CASA specifications with 100 hourly services carried out in Katherine.

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: Gravity reading near the coast

Photo 2: Lake landing

6.0 Camping / Accommodation

The crews were accommodated and messed in Atlas Geophysics supplied mobile camps based at Bulman, Roper Bar and Nhulunbuy.

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 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

Three primary GPS and gravity control stations was established during this survey (Table 2).

At all primary control stations, 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 µm/s^2)
201407800001 (GA 20148000001) *Bulman Airstrip Base*	-13 40 7.3992 134 17 43.0109 190.592	9783001.49
201407800002 (GA 20148000002) *Roper Bar Airstrip Base*	-14 44 13.4781 134 31 43.0452 74.518	9783612.48
201407800004 (GA 20148000004) *Nhulunbuy Base*	-12 11 35.4806 136 46 25.5154 85.103	9782840.66

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

The details of this primary control station has been recorded on an Atlas Geophysics Pty Ltd control station summary sheet. This sheet includes the geodetic coordinates, observed gravity value, station description, locality sketch, locality map and a digital photo of the station. The sheet is contained in Appendix B.

Figure 6: Atlas Geophysics Pty Ltd survey witness plaque

8.1.1 GPS Control

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

Gravity control was established at Bulman, Roper Bar and Gove. 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 control station 201407800001 was established via three "ABA" ties with a project gravity meter to AFGN station 1980902318, '*Tindal Airport Carport, Katherine*'. Station 201407800002 was established via three "ABA" ties with a project gravity meter to AFGN station 2012999315, '*Airport Shelter, Ngukurr*'. Station 201407800004 was established via multiple "ABA" ties with a project gravity meter to AFGN station 1964910168 at Nhulubuy Airport and also previously established gravity station 201407800001, '*Bulman Airstrip*' for verification (repeated to 0.10 µm/s^2). 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 tie
201407800001 *(Bulman Airstrip)*	1980902318 'Tindal Airport Carport, Katherine'	13/09/2014 24/09/2014
201407800002 *(Roper Bar Airstrip)*	2012999315 'Airport Shelter, Ngukurr'	20/10/2014 22/10/2014
201407800004 (*Nhulunbuy Indoor Cricket Centre*)	1964910168 'Nhulunbuy Airport Runway' and 201407800001 'Bulman Airstrip'	06/11/2014 05/10/2014

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

8.2 GPS Data Acquisition, Processing and Quality Control

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 QC 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.

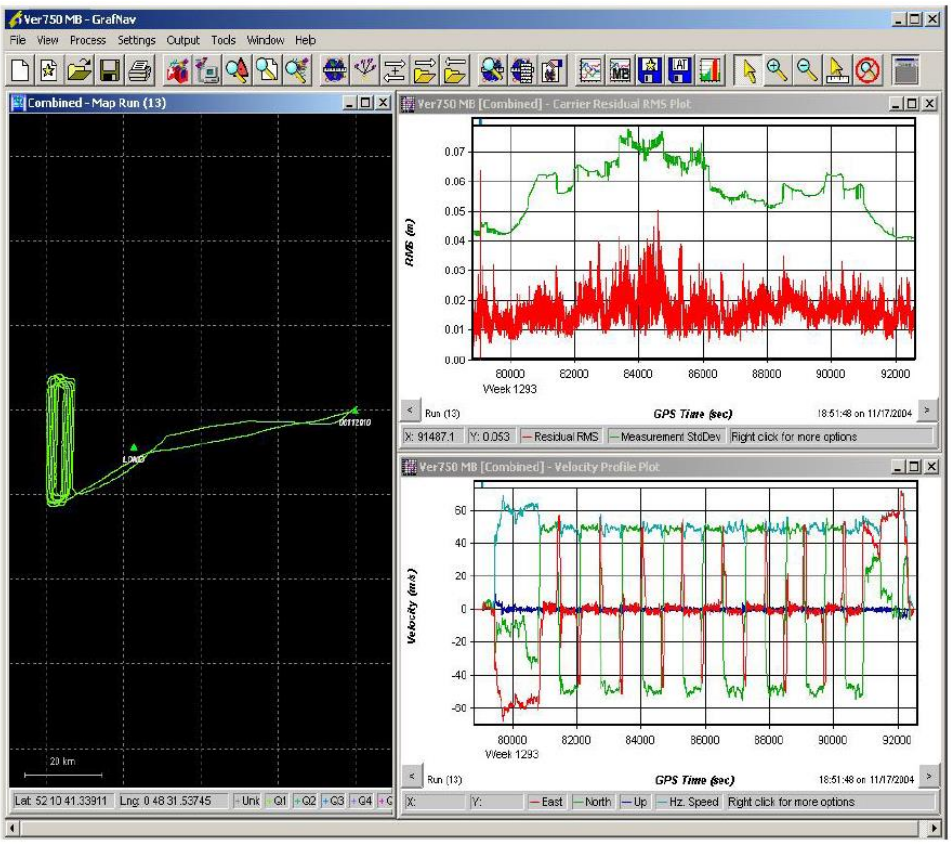


Figure 7: Waypoint Grafnav Processing Software

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/ausgeoid/nvalcomp.jsp. To obtain AHD elevation, the modelled N value is subtracted from the GPS derived WGS84/GRS80 ellipsoidal height (Figure 8).

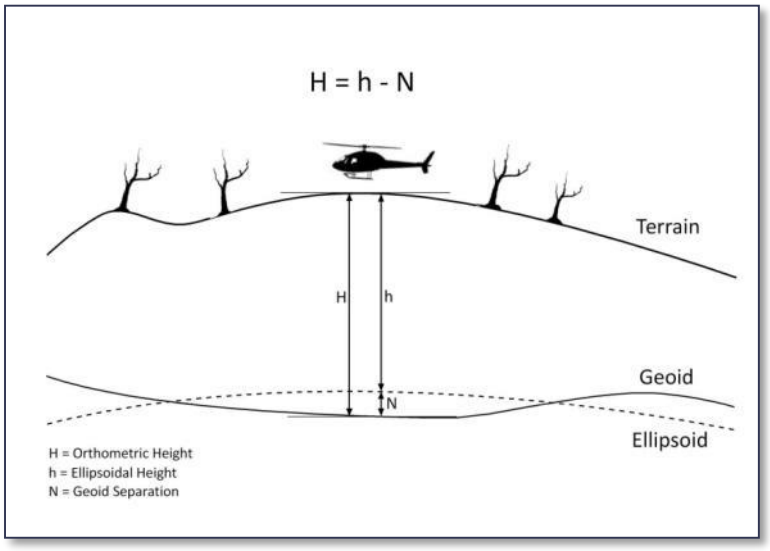


Figure 8: Geoid-Ellipsoid Separation

8.2.3 GPS/GNSS Quality Control

Rigorous quality control procedures were applied to the acquired GPS/GNSS data on a daily basis using Waypoint Grafnav's built in QC 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.

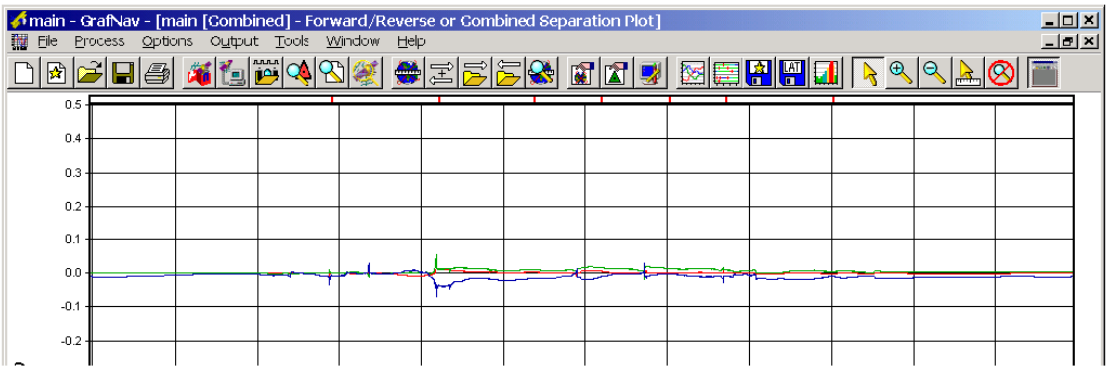


Figure 9: Combined Separation Plot

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.

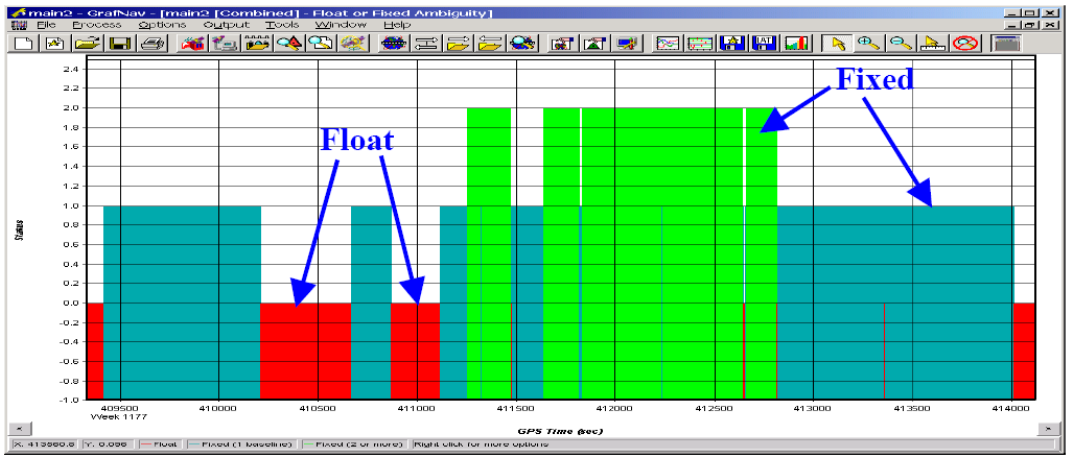


Figure 10: Float or Fixed Ambiguity Status Plot

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.

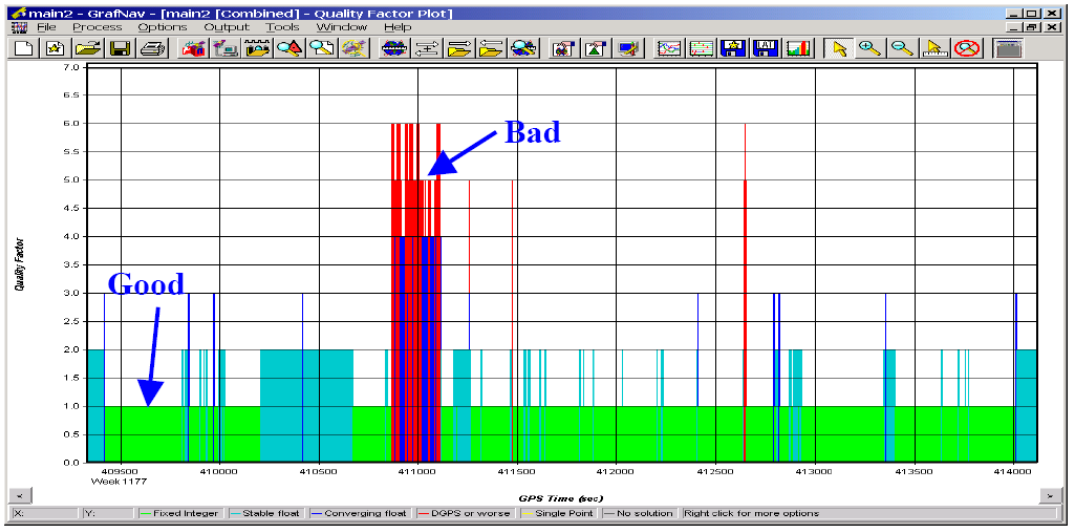


Figure 11: Quality factor plot

Complementing Waypoint GrafNav QC tools is the company's own in-house GPS quality control 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.

QC 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 Control

Gravity data were gained using the company's rapid acquisition, high accuracy helicopter-borne techniques. The company's own in-house reduction and QC 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 27/06/14 and 25/06/2014				
Meter Code	Meter SN	Calc 2010990217 AAGD07 (µm/s^2)	Diff (µm/s^2)	Scale
A2	40241	9794483.79	-0.06	0.999283
A6	40382	9794483.82	-0.03	1.000000

POST SURVEY CALIBRATION RUN 18/12/2014 and 20/01/2015				
Meter Code	Meter SN	Calc 2010990217 AAGD07 (µm/s^2)	Diff (µm/s^2)	Scale
A2	40241	9794483.80	-0.05	0.999283
A6	40382	9794483.91	0.05	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 CG-5 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 **10.12%** 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 control of the output dataset.

The software is capable of downloading Scintrex CG-3/CG-5 and Lacoste Romberg gravity data. Once downloaded, the gravity data is analysed for consistency and preliminary QC 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 = $6.67428\cdot10^{-11}$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.shtml

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 3.39 m and the standard deviation of the differences was 2.11 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

R_{MIN} was selected to enable correction for topography near to the gravity station and coincided with the grid cell size of the SRTM DEM. R_{MAX} was selected to allow for outer zone correction of severe topography at large distances from the gravity station. R_{MED} 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 USB 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 R_{MIN} to R_{MED}, 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 percent of terrain that was available (rounded to the nearest percent). 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 Control of the Processed Gravity data

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

QC 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 QC procedures is additional daily gridding, imaging and plotting of the elevation and gravity data. Once processed to Bouguer Anomaly and assessed for QC, 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

The Northern McArthur Basin Gravity Survey was the most difficult survey ever completed by Atlas. The tall trees, thick vegetation cover, extremely hot conditions and remoteness all contributed to the project being quite a dangerous, risky one. Nevertheless, the survey crew and helicopter pilots controlled the risks and with careful planning and persistence, an every gravity coverage was obtained over the whole area. Some larger sections of the survey were omitted where it was simply impossible to land, despite multiple attempts. Thankfully, the survey was completed ahead of the wet-season rains which allowed some welcomed fishing and recreation time before the crew demobilised.

A total of **6,895** 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 surveys crews began gravity data acquisition on 16th September 2014 and completed the survey on 14th November 2014. Some downtime was experienced due to logistical base moves, remote GPS base establishment, tyre issues with vehicles, and helicopter performance/maintenance issues. On the whole, production was consistent with an approximate total average of 160 stations per day.

A full production report can be found on the data USB (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 USB as Appendix J. Table 6 overleaf summarises the deliverables.

Final Delivered Data	Format	Data USB	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, **698** gravity and GPS repeat stations were collected and analysed. As a percentage, this equates to **10.12%** 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 **0.37 µm/s²** and the standard deviation of the GPS derived elevation repeat deviations was **0.066m**. These statistics confirm that the data has met and exceeded contract specifications.

	Elevation Repeat (mGRS80)	Gravity Repeat (µm/s²)
Mean	-0.003	0.01
Standard Error	0.002	0.01
Median	-0.003	0.00
Mode	-0.011	-0.03
Standard Deviation	0.066	0.37
Sample Variance	0.004	0.14
Kurtosis	0.709	0.26
Skewness	0.034	0.19
Range	0.412	2.07
Minimum	-0.207	-0.98
Maximum	0.205	1.09
Sum	-2.205	4.93
Count	698	698

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.

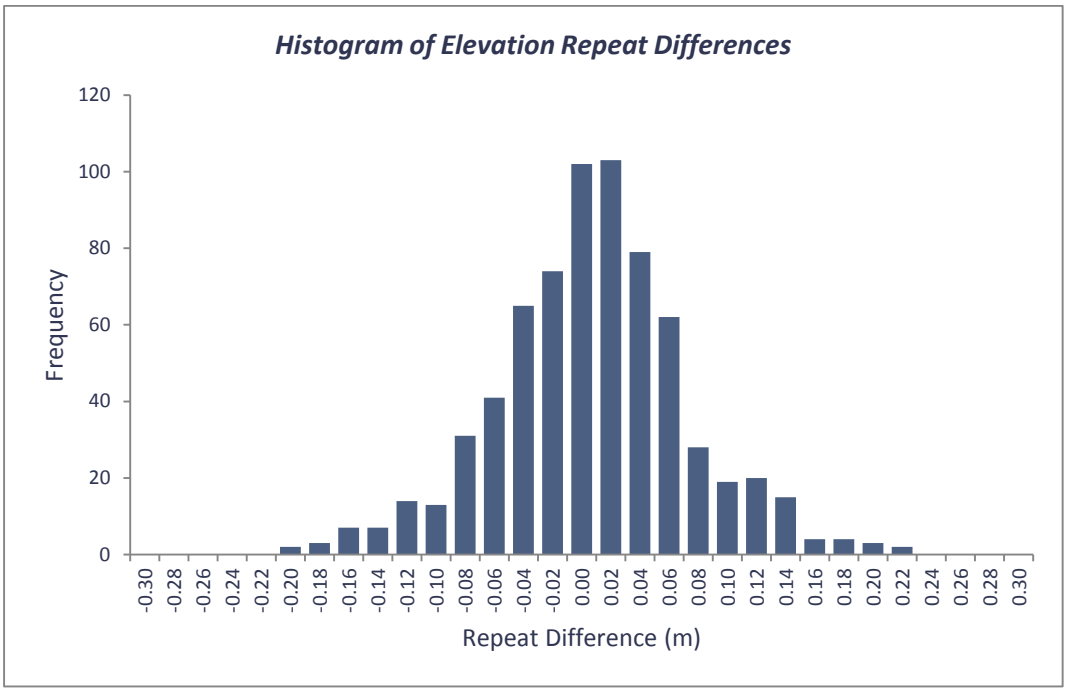


Figure 12: Histogram of GPS Repeat Differences

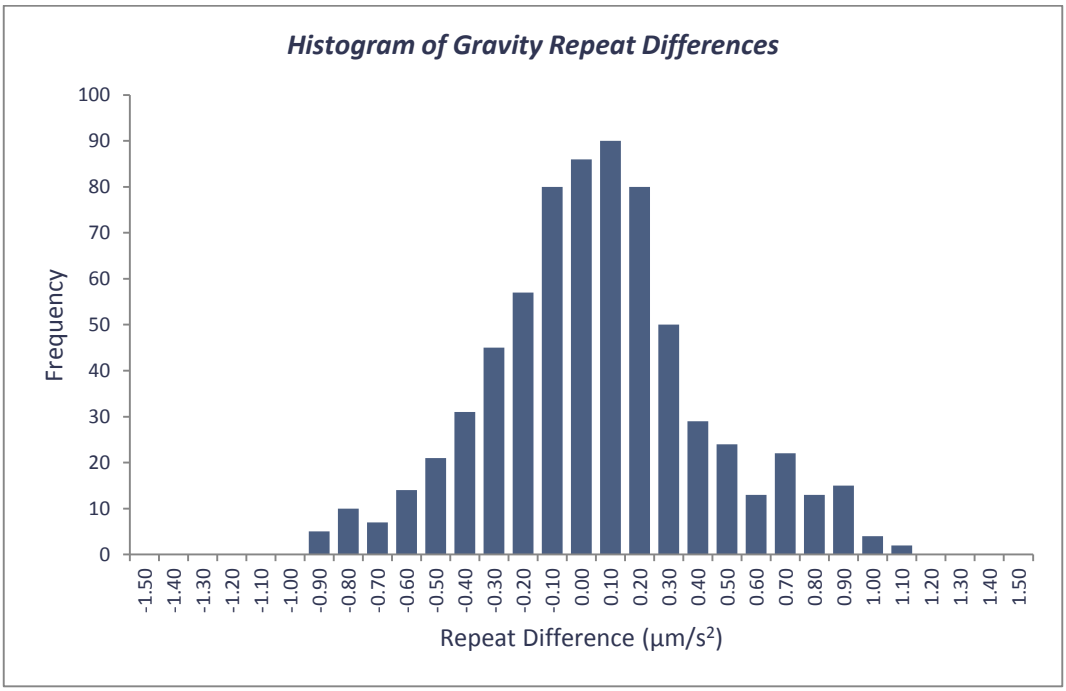


Figure 13: Histogram of Gravity Repeat Differences

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 **0.44µm/s²** and the standard deviation of the GPS derived elevation repeat deviations was **0.068m**. 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/s²)
Mean	0.000	0.00
Standard Error	0.009	0.15
Median	-0.003	0.16
Mode	-0.028	N/A
Standard Deviation	0.068	0.44
Sample Variance	0.005	0.19
Kurtosis	1.386	0.43
Skewness	0.121	-0.96
Range	0.379	1.36
Minimum	-0.183	-0.86
Maximum	0.196	0.50
Sum	-0.012	0.01
Count	63	9

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.

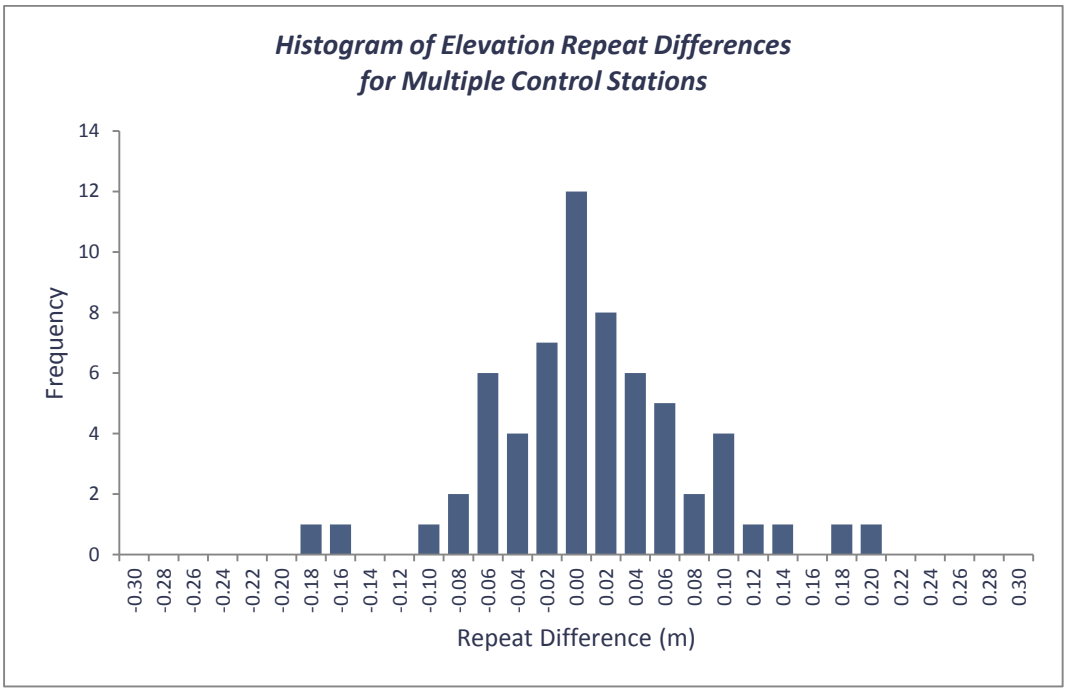


Figure 14: Histogram of GPS Repeat Differences

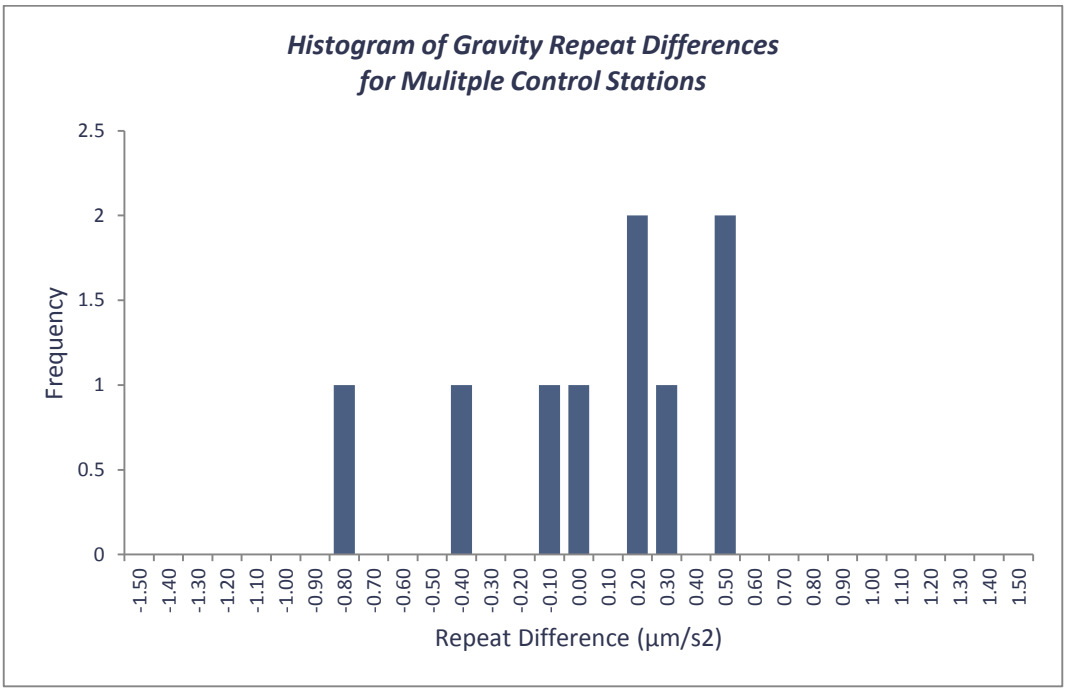


Figure 15: Histogram of Gravity Repeat Differences

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 500m.

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 USB 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.

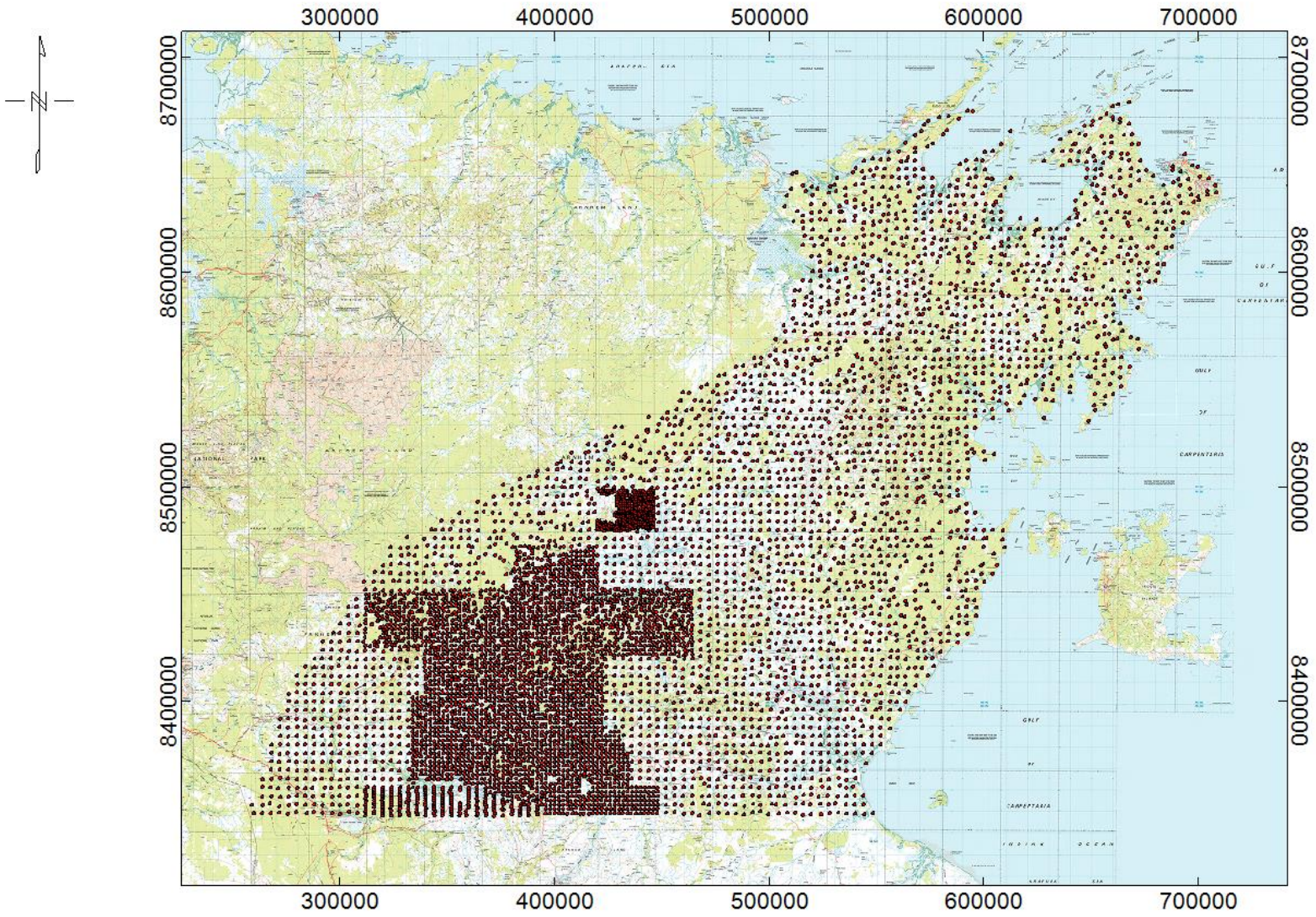
10.0 Conclusion

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 1:3000000

50000 0 50000 100000

(meters)

GDA94 / MGA zone 53

GEOSCIENCE AUSTRALIA

P2014078 GA NORTHERN MCARTHUR BASIN GRAVITY SURVEY

Plot of Gained Gravity Stations

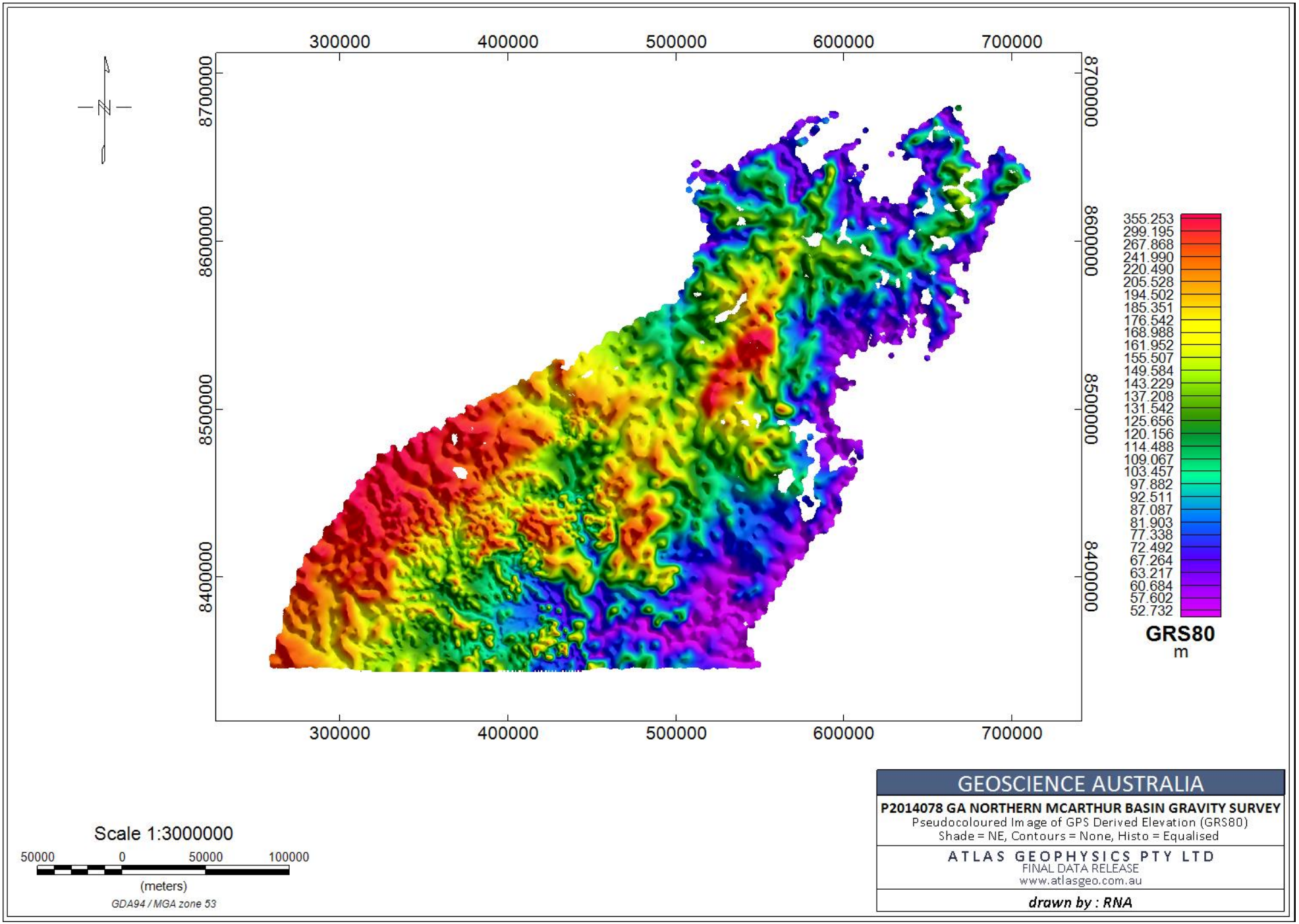
4km, 2km and 1km Square Grid Configurations

ATLAS GEOPHYSICS PTY LTD

FINAL DATA RELEASE

www.atlasgeo.com.au

drawn by : RNA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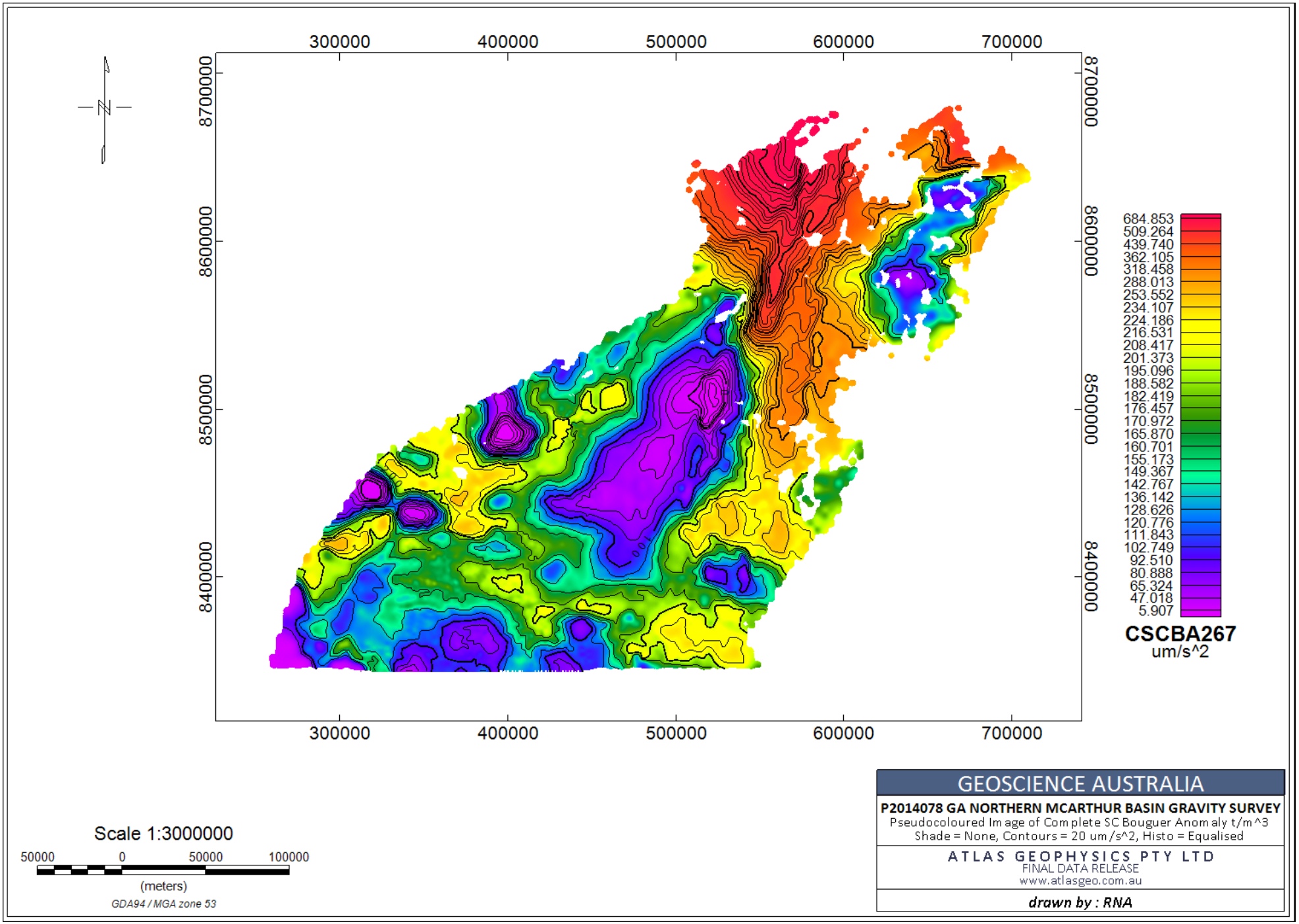
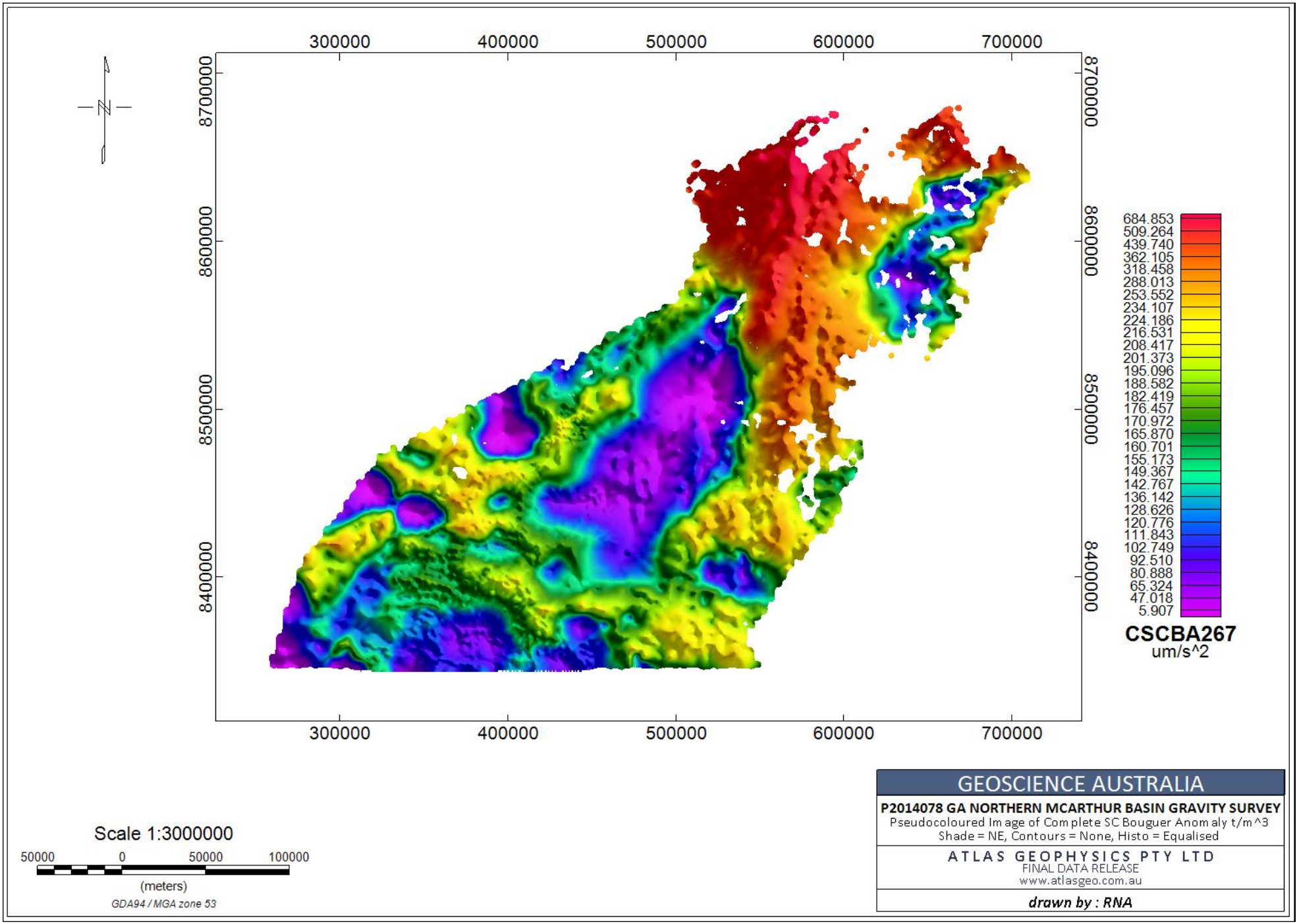
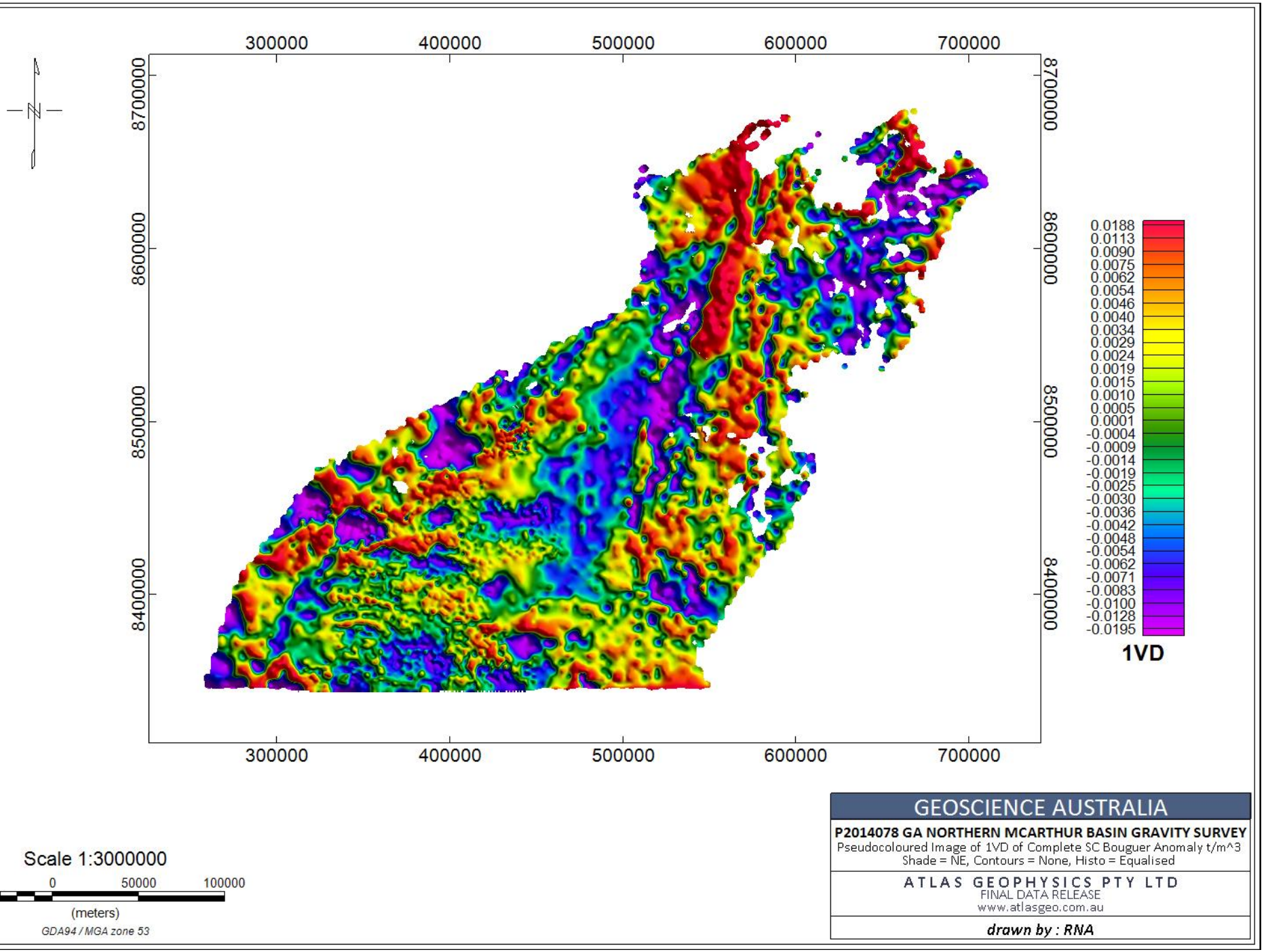
400000
500000
600000
700000
8700000
8600000
8500000
8400000
355.253
299.195
267.868
241.990
220.490
205.528
194.502
185.351
176.542
168.988
161.952
155.507
149.584
143.229
137.208
131.542
125.656
120.156
114.488
109.067
103.457
97.882
92.511
87.087
81.903
77.338
72.492
67.264
63.217
60.684
57.602
52.732
GRS80
m
Scale 1:3000000
50000
0
50000
100000
(meters)
GDA94 / MGA zone 53
GEOSCIENCE AUSTRALIA
P2014078 GA NORTHERN 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 : RNA


300000
400000
500000
600000
700000
8700000
8600000
8500000
8400000
684.853
509.264
439.740
362.105
318.458
288.013
253.552
234.107
224.186
216.531
208.417
201.373
195.096
188.582
182.419
176.457
170.972
165.870
160.701
155.173
149.367
142.767
136.142
128.626
120.776
111.843
102.749
92.510
80.888
65.324
47.018
5.907
CSCBA267
um/s^2
Scale 1:3000000
50000 0 50000 100000
(meters)
GDA94 / MGA zone 53
GEOSCIENCE AUSTRALIA
P2014078 GA NORTHERN 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 : RNA


300000
400000
500000
600000
700000
8700000
8600000
8500000
8400000
684.853
509.264
439.740
362.105
318.458
288.013
253.552
234.107
224.186
216.531
208.417
201.373
195.096
188.582
182.419
176.457
170.972
165.870
160.701
155.173
149.367
142.767
136.142
128.626
120.776
111.843
102.749
92.510
80.888
65.324
47.018
5.907
CSCBA267
um/s^2
Scale 1:3000000
50000 0 50000 100000
(meters)
GDA94 / MGA zone 53
GEOSCIENCE AUSTRALIA
P2014078 GA NORTHERN 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 : RNA



Scale 1:3000000

50000 0 50000 100000

(meters)

GDA94 / MGA zone 53

GEOSCIENCE AUSTRALIA

P2014078 GA NORTHERN 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 : RNA

APPENDIX B
Control Station Descriptions

201407800001 (GA 20148000001) – BULMAN A/S

GDA94/GRS80		MGA Z53		AMG Z53	
Latitude	-13 40 7.3992	***Easting***	423,787.356	***Easting***	423,658.123
Longitude	134 17 43.0109	***Northing***	8,488,800.139	***Northing***	8,488,632.539
Ellipsoidal Height	190.592	***Orthometric Height***	136.953	***Orthometric Height***	136.953

OBSERVED GRAVITY		Established 15/09/2014
AAGD07 µm/s²	9783001.49	

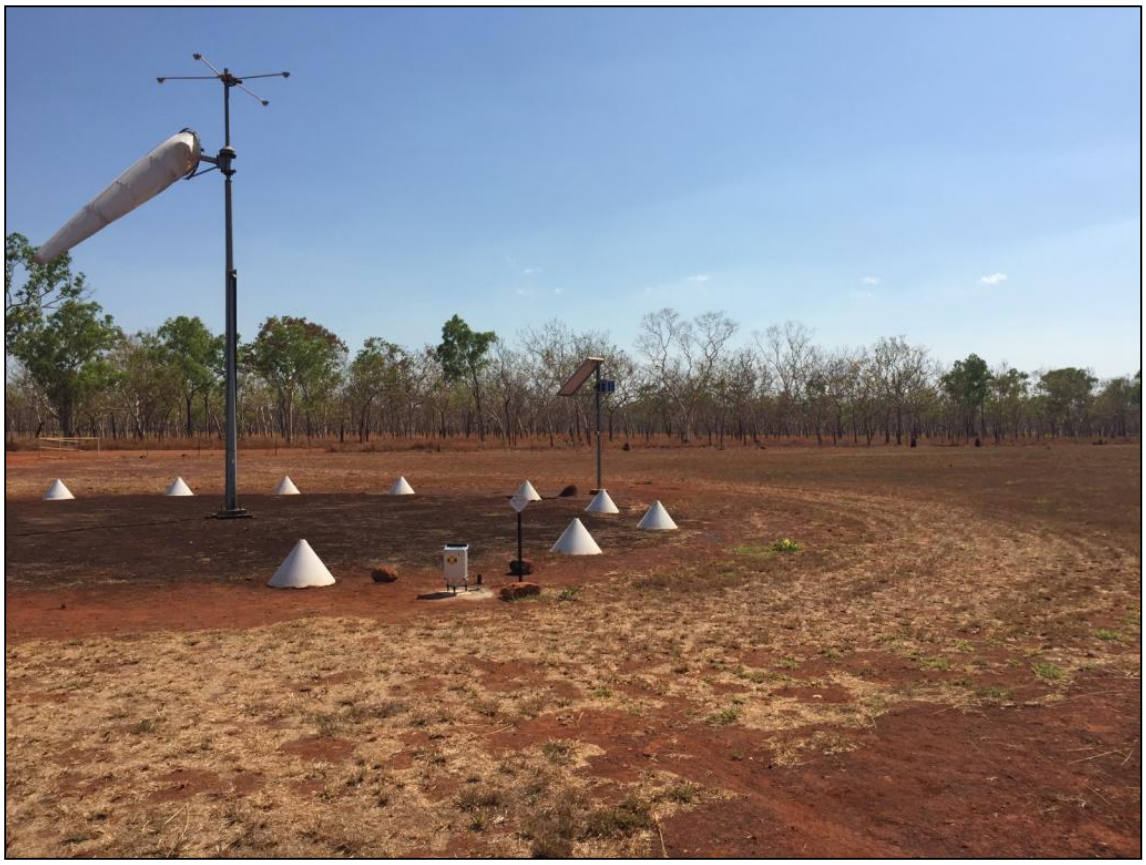
Occupation Method/Location Details

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.

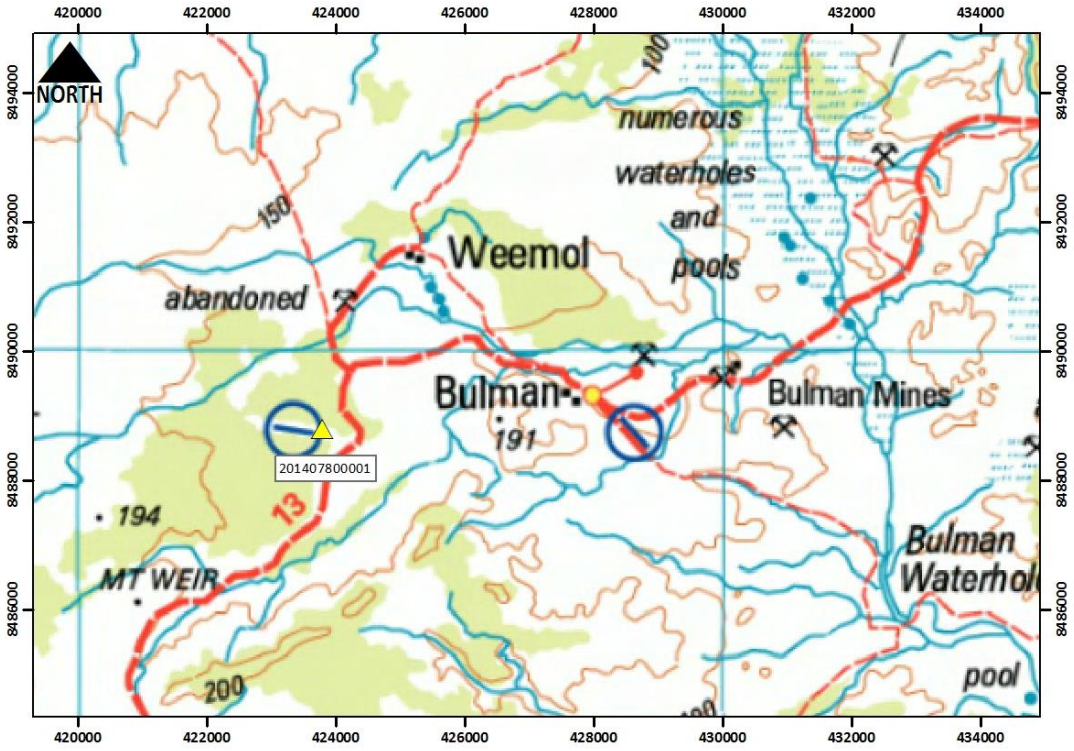
Gravity Control was established by Atlas Geophysics via three ABA loops with the project gravity meters to AFGN station 1980902318 'Tindal Airport Carport, Katherine' on 13/09/14 and 24/09/14 . Expected accuracy would be better than 0.1 µm/s^2.

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.

This station can be reached by travelling west from Bulman along the Central Arnhem highway towards the airstrip. After 5km the airstrip turnoff will appear on the right. After following this track for 300m the airstrip will be straight ahead. The control station is on the far side of the circular area around the windsock.



Photograph of Control Station 201407800001



Location of Control Station 201407800001

Aerial View of Control Station 201407800001

201407800002 (GA 20148000002) – ROPER BAR A/S

GDA94/GRS80		MGA Z53		AMG Z53	
Latitude	-14 44 13.4781	***Easting***	449,261.632	***Easting***	449,132.545
Longitude	134 31 43.0452	***Northing***	8,370,701.001	***Northing***	8,370,532.785
Ellipsoidal Height	74.518	***Orthometric Height***	24.778	***Orthometric Height***	24.778

OBSERVED GRAVITY		Established 20/10/2014
AAGD07 µm/s²	9783612.48	

Occupation Method/Location Details

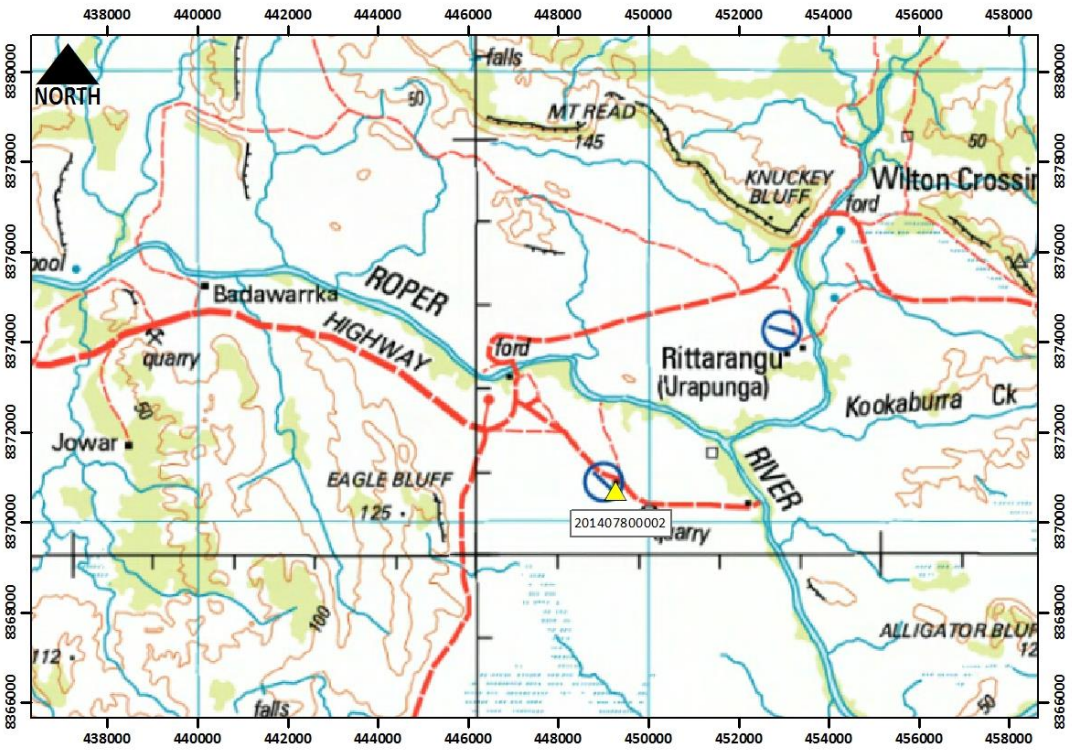
The GPS control point consists of a dumpy steel star picket driven into the ground to a height of 10cm above ground level. The gravity control point consists of a small concrete slab (30cm square) concreted into the ground, opposite the GPS control point. The control station is witnessed by an Atlas 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 three ABA loops with one of the project gravity meters to AFGN station 2012999315 'Airport Shelter, Ngukurr' on 20/10/14 and 22/10/14. 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.

This station can be reached by travelling to the Roper Bar Airstrip which is off the Roper Bar Road just south of where it crosses the Roper Bar River. The station is on the north side of the strip along the fence line.

Photograph of Control Station 201407800002



Location of Control Station 201407800002

Aerial View of Control Station 201407800002

201407800004 (GA 20148000004) – NHULUNBUY INDOOR CRICKET CENTRE

GDA94/GRS80		MGA Z53		AMG Z53	
Latitude	-12 11 35.4806	***Easting***	692,978.952	***Easting***	692,851.311
Longitude	136 46 25.5154	***Northing***	8,651,452.697	***Northing***	8,651,285.926
Ellipsoidal Height	85.103	***Orthometric Height***	24.054	***Orthometric Height***	24.054

OBSERVED GRAVITY		Established 05/10/2014
AAGD07 µm/s²	9782840.66	

Occupation Method/Location Details

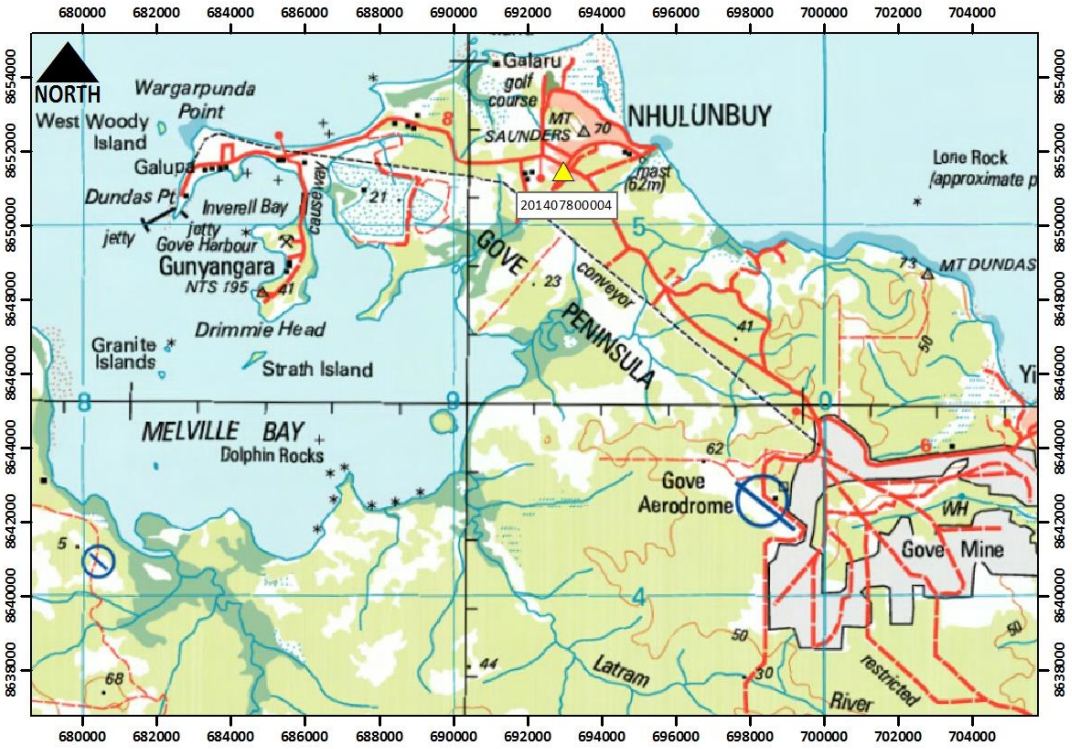
The GPS control point consists of a dumpy steel star picket driven into the ground to a height of 10cm above ground level. The gravity control point consists of a small concrete slab (30cm square) concreted into the ground, opposite the GPS control point. The control station is witnessed by an Atlas 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 one of the project gravity meters to station 1964910168 Nhulunbuy Airstrip Runway'. Expected accuracy would be better than 0.1 µm/s².

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.

This station is located at 9 Enalu Road in Nhulunbuy, in the yard next to the Indoor Cricket Centre building.

Photograph of Control Station 201407800004



Location of Control Station 201407800004

Aerial View of Control Station 201407800004

APPENDIX C
GPS Control Information

201407800001
DATA -13 40 07.39919 134 17 43.01094 190.592 136.953 GDA94
DATA -13 40 07.39926 134 17 43.01095 190.597 136.958 GDA94
DATA -13 40 07.39908 134 17 43.01076 190.587 136.948 GDA94

GDA94AVE
-13 40 7.3992
134 17 43.0109

-13.66872200
134.29528081

GRS80HT
190.592

AHDHT
136.953

N
53.639

MGA53
423787.356
8488800.139

AMG53
423658.123
8488632.539

201407800002
1410 -14 44 13.47812 134 31 43.04515 74.520 24.780 GDA94
1410 -14 44 13.47814 134 31 43.04520 74.523 24.783 GDA94
1410 -14 44 13.47816 134 31 43.04529 74.512 24.772 GDA94

GDA94AVE
-14 44 13.4781
134 31 43.0452

-14.73707725
134.52862367

GRS80HT
74.518

AHDHT
24.778

N
49.740

MGA53
449261.632
8370701.001

AMG53
449132.545
8370532.785

201407800004
DATA -12 11 35.48051 136 46 25.51540 85.095 24.046 GDA94
DATA -12 11 35.48056 136 46 25.51541 85.103 24.054 GDA94
DATA -12 11 35.48059 136 46 25.51532 85.110 24.061 GDA94

GDA94AVE
-12 11 35.4806
136 46 25.5154

-12.19318906
136.77375428

GRS80HT
85.103

AHDHT
24.054

N
61.049

MGA53
692978.952
8651452.697

AMG53
692851.311
8651285.926

201407800101
1409 -13 55 49.13071 134 06 45.07113 210.221 157.558 GDA94
1409 -13 55 49.13065 134 06 45.07104 210.198 157.535 GDA94
1409 -13 55 49.13065 134 06 45.07103 210.204 157.541 GDA94

GDA94AVE
-13 55 49.1307
134 6 45.0711

-13.93031408
134.11251975

GRS80HT
210.208

AHDHT
157.545

N
52.663

MGA53
404128.096
8459801.827

AMG53
403998.762
8459634.065

201407800102
1410 -13 55 57.96993 134 49 03.80317 142.344 89.370 GDA94
1410 -13 55 57.96976 134 49 03.80317 142.319 89.345 GDA94
1410 -13 55 57.96976 134 49 03.80317 142.325 89.351 GDA94

GDA94AVE
-13 55 57.9698
134 49 3.8032

-13.93276939
134.81772311

GRS80HT
142.329

AHDHT
89.355

N
52.974

MGA53
480310.038
8459701.503

AMG53
480181.109
8459533.748

201407800103
1410 -14 02 52.35891 135 35 15.25671 94.915 40.974 GDA94
1410 -14 02 52.35881 135 35 15.25683 94.920 40.979 GDA94
1410 -14 02 52.35882 135 35 15.25680 94.922 40.981 GDA94

GDA94AVE
-14 2 52.3588
135 35 15.2568

-14.04787744
135.58757133

GRS80HT
94.919

AHDHT
40.978

N
53.941

MGA53
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8446899.715

AMG53
563311.621
8446731.874

201407800104
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1409 -14 36 25.30614 133 08 36.38100 198.517 150.019 GDA94
1409 -14 36 25.30615 133 08 36.38095 198.526 150.028 GDA94

GDA94AVE
-14 36 25.3062
133 8 36.3810

-14.60702950
133.14343917

GRS80HT
198.524

AHDHT
150.026

N
48.498

MGA53
300015.251
8384320.231

AMG53
299885.408
8384152.030

201407800105
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1409 -14 37 07.77190 133 52 45.70785 158.895 109.483 GDA94
1409 -14 37 07.77194 133 52 45.70784 158.882 109.470 GDA94

GDA94AVE
-14 37 7.7719
133 52 45.7078

-14.61882553
133.87936328

GRS80HT
158.893

AHDHT
109.481

N
49.412

MGA53
379305.657
8383534.970

AMG53
379176.216
8383366.804

201407800107
1410 -14 37 02.85222 135 17 47.87434 52.224 0.855 GDA94
1410 -14 37 02.85218 135 17 47.87432 52.229 0.860 GDA94
1410 -14 37 02.85210 135 17 47.87447 52.223 0.854 GDA94

GDA94AVE
-14 37 2.8522
135 17 47.8744

-14.61745894
135.29663178

GRS80HT
52.225

AHDHT
0.856

N
51.369

MGA53
531946.244
8383963.171

AMG53
531817.571
8383795.015

201407800108
1410 -13 14 17.81285 134 56 15.15337 114.561 59.066 GDA94
1410 -13 14 17.81293 134 56 15.15336 114.564 59.069 GDA94
1410 -13 14 17.81283 134 56 15.15343 114.577 59.082 GDA94

GDA94AVE
-13 14 17.8129
134 56 15.1534

-13.23828136
134.93754261

GRS80HT
114.567

AHDHT
59.072

N
55.495

MGA53
493233.554
8536512.553

AMG53
493104.703
8536345.217

201407800109
1410 -13 14 59.47827 135 37 06.15072 97.394 40.437 GDA94
1410 -13 14 59.47835 135 37 06.15054 97.397 40.440 GDA94
1410 -13 14 59.47827 135 37 06.15060 97.385 40.428 GDA94

GDA94AVE
-13 14 59.4783
135 37 6.1506

-13.24985508
135.61837517

GRS80HT
97.392

AHDHT
40.435

N
56.957

MGA53
566990.901
8535150.620

AMG53
566862.461
8534983.257

201407800110
1410 -12 36 32.45155 135 28 12.60285 90.310 30.957 GDA94
1410 -12 36 32.45159 135 28 12.60296 90.300 30.947 GDA94
1410 -12 36 32.45149 135 28 12.60296 90.306 30.953 GDA94

GDA94AVE
-12 36 32.4515
135 28 12.6029

-12.60901431
135.47016747

GRS80HT
90.305

AHDHT
30.952

N
59.353

MGA53
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8606055.532

AMG53
550936.251
8605888.581

201407800111
1411 -12 52 53.85729 136 19 20.54806 75.732 17.463 GDA94
1411 -12 52 53.85686 136 19 20.54402 75.719 17.450 GDA94
1411 -12 52 53.85696 136 19 20.54388 75.710 17.441 GDA94

GDA94AVE
-12 52 53.8570
136 19 20.5453

-12.88162694
136.32237369

GRS80HT
75.720

AHDHT
17.451

N
58.269

MGA53
643479.212
8575585.476

AMG53
643351.223
8575418.300

201407800112
1410 -12 19 28.83364 135 42 12.47129 63.414 2.627 GDA94
1410 -12 19 28.83342 135 42 12.47110 63.406 2.618 GDA94
1410 -12 19 28.83337 135 42 12.47121 63.412 2.624 GDA94

GDA94AVE
-12 19 28.8335
135 42 12.4712

-12.32467597
135.70346422

GRS80HT
63.411

AHDHT
2.623

N
60.788

MGA53
576487.364
8637443.683

AMG53
576359.022
8637276.908

201407800113
1410 -12 17 24.10677 136 23 04.07031 63.141 2.777 GDA94
1410 -12 17 24.10676 136 23 04.07044 63.149 2.785 GDA94
1410 -12 17 24.10679 136 23 04.07040 63.150 2.786 GDA94

GDA94AVE
-12 17 24.1068
136 23 4.0704

-12.29002967
136.38446400

GRS80HT
63.147

AHDHT
2.783

N
60.364

MGA53
650561.866
8640987.859

AMG53
650433.965
8640821.060

APPENDIX D
Gravity Control Processing and Information

201407800001 GRAVITY CONTROL TIE

1 = 201407800001 BULMAN A/S
2318 = 1980902318 TINDAL A/S CARPORT
Tie carried out by vehicle

METER A2

station	gda94_longitude_dd	gda94_latitude_dd	date_ddmmyyyy	time_hhmmss	dialrdng_mgal	etc_mgal	aagd07_mgal	metersn
1	134.295000	-13.669000	13/09/2014	07:44:10	3516.345	-0.055	980000.000	40241
1	134.295000	-13.669000	13/09/2014	07:45:16	3516.347	-0.056	980000.002	40241
2318	132.364000	-14.513000	13/09/2014	11:39:07	3540.796	0.020	980024.548	40241
2318	132.364000	-14.513000	13/09/2014	11:40:13	3540.794	0.021	980024.547	40241
1	134.295000	-13.669000	13/09/2014	21:59:07	3516.186	-0.038	980000.001	40241
1	134.295000	-13.669000	13/09/2014	22:00:13	3516.185	-0.038	980000.000	40241
1	134.295000	-13.669000	24/09/2014	12:03:13	3520.112	0.159	980000.000	40241
1	134.295000	-13.669000	24/09/2014	12:04:19	3520.110	0.160	979999.998	40241
2318	132.364000	-14.513000	24/09/2014	16:18:25	3544.811	-0.013	980024.528	40241
2318	132.364000	-14.513000	24/09/2014	16:19:31	3544.811	-0.014	980024.527	40241
1	134.295000	-13.669000	24/09/2014	22:51:52	3520.111	0.109	979999.998	40241
1	134.295000	-13.669000	24/09/2014	22:52:58	3520.112	0.110	980000.000	40241

METER A6

1	134.295000	-13.669000	24/09/2014	12:04:20	2488.758	0.160	980000.000	40382
1	134.295000	-13.669000	24/09/2014	12:05:26	2488.766	0.160	980000.008	40382
2318	132.364000	-14.513000	24/09/2014	16:18:24	2513.433	-0.013	980024.519	40382
2318	132.364000	-14.513000	24/09/2014	16:19:30	2513.434	-0.014	980024.519	40382
1	134.295000	-13.669000	24/09/2014	22:51:11	2488.763	0.109	979999.997	40382
1	134.295000	-13.669000	24/09/2014	22:52:17	2488.765	0.110	980000.000	40382

AVG 2318	980024.531	
DIFF 1_2318	24.531	
KNOWN 2318	978324.680	
CALC 1	978300.149	mGal AAGD07
	9783001.49	**µm/s² AAGD07**

201407800002 GRAVITY CONTROL TIE						

2 = 201407800002 ROPER BAR A/S
315 = 2012999315 NGUKURR A/S SHELTER
Tie carried out by vehicle

METER A6

station	gda94_longitude_dd	gda94_latitude_dd	date_ddmmyyyy	time_hhmmss	dialrdng_mgal	etc_mgal	aagd07_mgal	metersn
2	134.529000	-14.737000	22/10/2014	10:43:08	2558.218	0.156	980000.000	40382
2	134.529000	-14.737000	22/10/2014	10:44:14	2558.217	0.157	979999.999	40382
315	134.747000	-14.725000	22/10/2014	11:41:03	2564.753	0.162	980006.541	40382
315	134.747000	-14.725000	22/10/2014	11:42:09	2564.752	0.161	980006.540	40382
2	134.529000	-14.737000	22/10/2014	12:44:08	2558.237	0.135	980000.000	40382
2	134.529000	-14.737000	22/10/2014	12:45:14	2558.238	0.134	980000.000	40382
2	134.529000	-14.737000	22/10/2014	12:45:14	2558.238	0.134	980000.000	40382
315	134.747000	-14.725000	22/10/2014	13:54:29	2564.834	0.074	980006.536	40382
315	134.747000	-14.725000	22/10/2014	13:55:35	2564.834	0.073	980006.535	40382
2	134.529000	-14.737000	22/10/2014	14:55:00	2558.358	0.013	980000.000	40382
2	134.529000	-14.737000	22/10/2014	14:56:06	2558.359	0.012	980000.000	40382
2	134.529000	-14.737000	20/10/2014	11:42:40	2557.622	0.107	980000.000	40382
2	134.529000	-14.737000	20/10/2014	11:43:46	2557.622	0.106	980000.000	40382
315	134.747000	-14.725000	20/10/2014	12:08:18	2564.162	0.092	980006.530	40382
315	134.747000	-14.725000	20/10/2014	12:09:24	2564.160	0.091	980006.528	40382
2	134.529000	-14.737000	20/10/2014	12:29:02	2557.638	0.079	979999.998	40382
2	134.529000	-14.737000	20/10/2014	12:30:08	2557.641	0.078	980000.000	40382

AVG 2318	980006.535	
DIFF 1_315	6.535	
KNOWN 315	978367.783	
CALC 2	978361.248	mGal AAGD07
	9783612.48	**µm/s² AAGD07**

201407800004 GRAVITY CONTROL TIE					

4 = 201407800004 NHULUNBUY INDOOR CRICKET CENTRE
5 = 201407800005 SECONDARY STATION AT NHULUNBUY AIRPORT TERMINAL
168 = 1964910168 NHULUNBUY A/S RUNWAY
Tie carried out by vehicle

METER
A2

station	gda94_longitude_dd	gda94_latitude_dd	date_ddmmyyyy	time_hhmmss	dialrdng_mgal	etc_mgal	aagd07_mgal	metersn
4	136.774000	-12.193000	06/11/2014	08:11:45	3518.366	0.029	980000.000	40241
4	136.774000	-12.193000	06/11/2014	08:12:51	3518.364	0.030	980000.000	40241
168	136.824000	-12.273000	06/11/2014	10:08:50	3500.879	0.156	979982.690	40241
168	136.824000	-12.273000	06/11/2014	10:10:01	3500.874	0.157	979982.686	40241
5	136.824000	-12.273000	06/11/2014	10:22:03	3502.399	0.166	979984.223	40241
5	136.824000	-12.273000	06/11/2014	10:23:09	3502.398	0.166	979984.223	40241
4	136.774000	-12.193000	06/11/2014	10:45:00	3518.163	0.180	979999.997	40241
4	136.774000	-12.193000	06/11/2014	10:46:06	3518.165	0.180	980000.000	40241
4	136.774000	-12.193000	06/11/2014	10:46:06	3518.165	0.180	980000.000	40241
168	136.824000	-12.273000	06/11/2014	11:18:43	3500.842	0.192	979982.704	40241
168	136.824000	-12.273000	06/11/2014	11:19:49	3500.842	0.192	979982.704	40241
5	136.824000	-12.273000	06/11/2014	11:32:39	3502.362	0.194	979984.226	40241
5	136.824000	-12.273000	06/11/2014	11:33:45	3502.361	0.194	979984.225	40241
4	136.774000	-12.193000	06/11/2014	11:51:58	3518.148	0.193	980000.002	40241
4	136.774000	-12.193000	06/11/2014	11:53:04	3518.146	0.193	980000.000	40241

AVE 168	979982.696	
AVE 5	979984.224	
diff 168_4	-17.304	
diff 5_4	-15.776	
KNOWN 168	978266.76	
CALC 4	978284.066	mGal AAGD07
	9782840.660	**µm/s² AAGD07**
CALC 5	978299.842	mGal AAGD07
	9782998.418	**µm/s² AAGD07**

APPENDIX E
Gravity Meter Calibration Data

P2014078_GA_NORTHERN_MCARTHUR_BASIN_GRAVITY

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**

STATION	MGAE	MGAN	DATE	TIME	OBSGAAD07_µm/s2	DRIFT_µm/s2	SERIAL
A2 METER							
1	420754.17	6464380.51	27/06/2014	10:17:19	9793899.63	0.24	40241
1	420754.17	6464380.51	27/06/2014	10:18:25	9793899.65	0.24	40241
2	417649.82	6460586.82	27/06/2014	10:46:05	9794483.77	0.24	40241
2	417649.82	6460586.82	27/06/2014	10:47:11	9794483.79	0.24	40241
1	420754.17	6464380.51	27/06/2014	11:11:15	9793899.61	0.24	40241
1	420754.17	6464380.51	27/06/2014	11:12:21	9793899.63	0.24	40241
1	420754.17	6464380.51	27/06/2014	11:12:21	9793899.63	0.19	40241
2	417649.82	6460586.82	27/06/2014	11:39:49	9794483.77	0.19	40241
2	417649.82	6460586.82	27/06/2014	11:40:55	9794483.72	0.19	40241
1	420754.17	6464380.51	27/06/2014	12:05:35	9793899.62	0.19	40241
1	420754.17	6464380.51	27/06/2014	12:06:41	9793899.63	0.19	40241
1	420754.17	6464380.51	27/06/2014	12:06:41	9793899.63	0.34	40241
2	417649.82	6460586.82	27/06/2014	12:33:08	9794483.80	0.34	40241
2	417649.82	6460586.82	27/06/2014	12:34:14	9794483.89	0.34	40241
1	420754.17	6464380.51	27/06/2014	13:00:18	9793899.60	0.34	40241
1	420754.17	6464380.51	27/06/2014	13:01:24	9793899.63	0.34	40241
				AVG2	**9794483.79**		
A6 METER							
1	420754.17	6464380.51	25/06/2014	10:14:32	9793899.63	0.14	40382
1	420754.17	6464380.51	25/06/2014	10:15:38	9793899.62	0.14	40382
2	417649.82	6460586.82	25/06/2014	10:57:26	9794483.84	0.14	40382
2	417649.82	6460586.82	25/06/2014	10:58:32	9794483.79	0.14	40382
1	420754.17	6464380.51	25/06/2014	11:31:39	9793899.62	0.14	40382
1	420754.17	6464380.51	25/06/2014	11:32:45	9793899.63	0.14	40382
1	420754.17	6464380.51	25/06/2014	11:32:45	9793899.63	0.04	40382
2	417649.82	6460586.82	25/06/2014	12:05:46	9794483.81	0.04	40382
2	417649.82	6460586.82	25/06/2014	12:06:52	9794483.84	0.04	40382
1	420754.17	6464380.51	25/06/2014	12:37:35	9793899.67	0.04	40382
1	420754.17	6464380.51	25/06/2014	12:38:41	9793899.63	0.04	40382
				AVG2	**9794483.82**		

P2014078_GA_NORTHERN_MCARTHUR_BASIN_GRAVITY

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**

STATION	MGAE	MGAN	DATE	TIME	OBSGAAD07_µm/s2	DRIFT_µm/s2	SERIAL
A2 METER							
1	420754.17	6464380.51	18/12/2014	14:36:04	9793899.63	0.06	40241
1	420754.17	6464380.51	18/12/2014	14:37:10	9793899.64	0.06	40241
2	417649.82	6460586.82	18/12/2014	15:00:46	9794483.71	0.06	40241
2	417649.82	6460586.82	18/12/2014	15:01:52	9794483.72	0.06	40241
1	420754.17	6464380.51	18/12/2014	15:23:29	9793899.63	0.06	40241
1	420754.17	6464380.51	18/12/2014	15:23:29	9793899.63	-0.04	40241
2	417649.82	6460586.82	18/12/2014	15:48:12	9794483.88	-0.04	40241
2	417649.82	6460586.82	18/12/2014	15:49:18	9794483.90	-0.04	40241
1	420754.17	6464380.51	18/12/2014	16:11:20	9793899.62	-0.04	40241
1	420754.17	6464380.51	18/12/2014	16:12:26	9793899.63	-0.04	40241
				AVG2	**9794483.80**		
A6 METER							
1	420754.17	6464380.51	20/01/2015	11:07:36	9793899.63	-0.02	40382
1	420754.17	6464380.51	20/01/2015	11:08:42	9793899.60	-0.02	40382
2	417649.82	6460586.82	20/01/2015	11:36:43	9794483.91	-0.02	40382
2	417649.82	6460586.82	20/01/2015	11:37:49	9794483.90	-0.02	40382
1	420754.17	6464380.51	20/01/2015	12:06:26	9793899.64	-0.02	40382
1	420754.17	6464380.51	20/01/2015	12:07:32	9793899.63	-0.02	40382
1	420754.17	6464380.51	20/01/2015	12:07:32	9793899.63	-0.03	40382
2	417649.82	6460586.82	20/01/2015	12:35:13	9794483.89	-0.03	40382
2	417649.82	6460586.82	20/01/2015	12:36:19	9794483.91	-0.03	40382
1	420754.17	6464380.51	20/01/2015	13:04:34	9793899.58	-0.03	40382
1	420754.17	6464380.51	20/01/2015	13:05:40	9793899.63	-0.03	40382
1	420754.17	6464380.51	20/01/2015	13:05:40	9793899.63	0.00	40382
2	417649.82	6460586.82	20/01/2015	13:36:04	9794483.91	0.00	40382
2	417649.82	6460586.82	20/01/2015	13:37:10	9794483.91	0.00	40382
1	420754.17	6464380.51	20/01/2015	14:08:02	9793899.58	0.00	40382
1	420754.17	6464380.51	20/01/2015	14:09:08	9793899.63	0.00	40382
				AVG2	**9794483.91**		

APPENDIX F
Repeat Listing: All Observations

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s²	DATE_DDMMYY	TIME_HHMMSS	METERSN
20148001002	411732.8	8472930.1	0.048	-0.15	16092014	180026	40382
20148001011	404114.7	8459800.5	0.011	0.00	17092014	074534	40382
20148001056	387715.1	8430044.3	-0.065	0.08	17092014	122750	40382
20148001055	388030.1	8431982.8	-0.054	0.05	17092014	123228	40382
20148001078	379954.1	8416140.5	0.055	0.12	17092014	141532	40382
20148001092	384288.8	8435811.0	-0.010	-0.16	17092014	150402	40382
20148001017	386042.0	8472443.8	0.003	0.83	17092014	164616	40382
20148007002	328696.8	8468130.8	-0.069	0.59	18092014	082356	40241
20148007001	328229.8	8464348.6	-0.037	0.62	18092014	082806	40241
20148007000	328373.0	8459402.3	0.009	-0.24	18092014	083308	40241
20148007048	304238.8	8436132.0	0.054	-0.86	18092014	144534	40241
20148007049	304063.4	8431989.4	-0.047	-0.94	18092014	145134	40241
20148007000	328373.0	8459401.8	-0.003	-0.31	18092014	164140	40241
20148001002	411732.7	8472930.7	-0.057	0.05	18092014	064304	40382
20148001161	415936.7	8422266.9	-0.017	0.07	18092014	115804	40382
20148001159	415896.7	8431989.3	-0.017	-0.01	18092014	121630	40382
20148001157	416176.5	8447934.1	0.004	-0.13	18092014	124558	40382
20148001047	396142.6	8439923.9	-0.018	-0.48	18092014	133602	40382
20148001048	393897.3	8439887.1	-0.146	0.00	18092014	133914	40382
20148001055	388028.4	8431982.7	-0.094	-0.21	18092014	134548	40382
20148001056	387715.5	8430044.0	-0.061	-0.13	18092014	134942	40382
20148001079	379840.7	8418583.3	-0.154	0.22	18092014	135808	40382
20148001078	379954.5	8416141.1	-0.140	-0.20	18092014	140210	40382
20148001062	379296.2	8383547.7	-0.056	-0.20	18092014	150238	40382
20148001105	378019.2	8415797.5	-0.175	-0.73	18092014	160904	40382
20148007114	268129.4	8364042.7	-0.057	-0.18	19092014	114229	40241
20148007107	276008.6	8383853.6	0.026	0.03	19092014	121532	40241
20148007106	275824.5	8387915.4	0.078	0.02	19092014	121910	40241
20148007096	283837.8	8416323.7	0.108	0.09	19092014	124440	40241
20148007163	284074.8	8375830.3	-0.073	-0.15	19092014	170157	40241
20148007161	288198.6	8380235.1	-0.077	0.24	19092014	170652	40241
20148007059	303582.0	8396089.0	0.006	-0.23	19092014	171849	40241
20148001334	409803.6	8353861.9	-0.094	0.03	19092014	110556	40382
20148001328	410034.5	8366021.9	-0.083	-0.02	19092014	111330	40382
20148001089	385817.4	8440183.4	0.128	-0.15	19092014	123538	40382
20148001364	397957.0	8427642.9	-0.048	-0.52	19092014	132942	40382
20148001302	410060.8	8409957.3	0.102	-0.06	19092014	134054	40382
20148001305	409901.9	8407750.2	-0.007	0.15	19092014	134458	40382
20148001363	409644.1	8398001.6	0.012	-0.03	19092014	140454	40382
20148001297	411981.4	8417615.6	-0.011	0.22	19092014	173904	40382
20148007067	300664.5	8423902.6	-0.057	0.85	20092014	071150	40241
20148007066	299895.5	8419971.5	-0.010	1.00	20092014	072628	40241
20148007067	300663.9	8423902.9	0.009	-0.48	20092014	081630	40241
20148007066	299895.2	8419971.2	-0.002	-0.15	20092014	082642	40241
20148007196	296113.3	8415772.4	0.024	0.13	20092014	083120	40241
20148007152	288106.6	8400147.9	-0.053	-0.44	20092014	090616	40241
20148007160	283731.9	8379964.1	0.009	0.39	20092014	093645	40241

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s²	DATE_DDMMYY	TIME_HHMMSS	METERSN
20148007163	284074.7	8375830.4	0.023	0.33	20092014	094100	40241
20148007162	287671.1	8376106.1	0.014	0.34	20092014	094500	40241
20148007162	287671.0	8376106.1	-0.026	-0.17	20092014	121240	40241
20148007161	288198.6	8380235.0	0.017	0.04	20092014	121700	40241
20148007054	304127.4	8383810.3	0.024	-0.50	20092014	133156	40241
20148007255	308546.8	8383619.2	-0.011	-0.10	20092014	162624	40241
20148007054	304127.2	8383810.4	0.011	-0.55	20092014	163112	40241
20148007051	300023.9	8384339.9	-0.053	0.49	20092014	163516	40241
20148007059	303582.1	8396088.5	-0.003	-0.88	20092014	170020	40241
20148001011	404114.6	8459800.5	0.001	-0.32	20092014	064120	40382
20148001040	404044.0	8448068.9	0.040	-0.10	20092014	064944	40382
20148001041	403951.3	8445968.4	0.084	-0.10	20092014	065356	40382
20148001161	415936.9	8422266.9	0.001	-0.01	20092014	071048	40382
20148001297	411981.4	8417616.0	0.016	0.12	20092014	071736	40382
20148001302	410061.1	8409957.9	-0.007	0.01	20092014	072515	40382
20148001305	409904.2	8407753.7	0.043	-0.26	20092014	072838	40382
20148001303	407971.3	8410127.9	0.111	-0.07	20092014	073252	40382
20148001303	407971.1	8410127.9	0.036	-0.05	20092014	125624	40382
20148001364	397955.5	8427643.3	-0.043	-0.43	20092014	131506	40382
20148001062	379295.6	8383547.6	0.004	-0.20	20092014	153732	40382
20148007001	328230.2	8464349.1	0.018	0.32	21092014	151304	40241
20148007000	328373.0	8459402.2	0.062	-0.25	21092014	151744	40241
20148007090	335557.6	8459613.0	0.125	0.02	21092014	160800	40241
20148007311	356399.0	8476001.9	0.071	-0.50	21092014	170158	40241
20148007310	360291.0	8476044.3	0.184	0.71	21092014	170626	40241
20148007302	388990.4	8483719.5	0.033	-0.14	21092014	174406	40241
20148007300	395848.1	8483458.2	0.006	-0.12	21092014	174946	40241
20148001596	408212.6	8495955.9	-0.076	0.14	21092014	163504	40382
20148007196	296113.3	8415772.1	-0.048	0.19	22092014	071004	40241
20148007250	291643.4	8391948.5	-0.054	0.62	22092014	073934	40241
20148007251	295944.1	8391779.9	0.039	0.68	22092014	074346	40241
20148007059	303582.0	8396088.1	-0.050	0.26	22092014	075344	40241
20148007345	307981.6	8404078.7	0.109	-0.46	22092014	090038	40241
20148007293	320189.6	8379737.4	0.066	0.22	22092014	095644	40241
20148007292	320177.7	8376198.3	0.073	1.02	22092014	101148	40241
20148007372	323954.2	8376285.6	-0.039	-0.37	22092014	121814	40241
20148007371	323898.8	8380136.6	-0.102	-0.31	22092014	122206	40241
20148007420	334056.0	8387975.3	-0.065	-0.02	22092014	164622	40241
20148007419	334084.5	8390093.3	-0.050	0.27	22092014	165000	40241
20148007418	333586.3	8391920.5	-0.017	0.27	22092014	165408	40241
20148007411	328298.7	8412202.2	-0.005	-0.24	22092014	170910	40241
20148007410	324374.7	8411932.0	-0.026	0.08	22092014	171310	40241
20148001002	411732.4	8472931.1	0.029	0.17	22092014	062644	40382
20148001011	404114.1	8459800.1	0.026	-0.01	22092014	063506	40382
20148001040	404044.3	8448068.7	0.045	-0.01	22092014	064244	40382
20148001303	407971.3	8410128.3	-0.131	0.01	22092014	070529	40382
20148001500	400602.4	8388040.2	-0.124	0.89	22092014	071654	40382

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s²	DATE_DDMMYY	TIME_HHMMSS	METERSN
20148001497	399826.4	8385896.3	-0.123	-0.01	22092014	072026	40382
20148001481	400032.3	8358105.9	0.023	-0.01	22092014	080058	40382
20148001480	397782.9	8358054.0	0.045	0.46	22092014	080408	40382
20148001479	398058.9	8356109.1	0.038	0.16	22092014	080730	40382
20148001478	399868.9	8356125.3	0.015	0.20	22092014	081028	40382
20148001652	347790.8	8346901.9	-0.181	0.07	22092014	114544	40382
20148001479	398058.8	8356109.0	0.050	-0.35	22092014	160630	40382
20148001478	399868.7	8356124.9	0.071	-0.43	22092014	161014	40382
20148001481	400032.5	8358106.1	0.035	-0.11	22092014	161302	40382
20148001480	397783.2	8358053.9	0.075	-0.53	22092014	161702	40382
20148001498	397902.4	8385952.4	-0.054	-0.08	22092014	165530	40382
20148001499	398720.1	8387921.0	-0.054	-0.01	22092014	165900	40382
20148001513	403870.8	8412063.3	-0.142	0.12	22092014	171614	40382
20148007487	337911.2	8380218.3	-0.084	0.20	23092014	130600	40241
20148007486	338262.8	8381911.0	-0.082	0.24	23092014	131818	40241
20148007481	337636.1	8388373.7	-0.147	0.30	23092014	133612	40241
20148007418	333586.4	8391920.5	-0.011	-0.18	23092014	134756	40241
20148007480	337901.9	8389952.7	-0.091	0.15	23092014	135558	40241
20148007471	339916.1	8402046.9	0.002	-0.07	23092014	142028	40241
20148007470	340132.4	8404340.9	0.110	0.30	23092014	142426	40241
20148007410	324374.7	8411931.2	0.010	0.16	23092014	143338	40241
20148007411	328298.7	8412202.2	-0.090	0.33	23092014	145850	40241
20148007475	337808.1	8396424.3	0.046	0.38	23092014	154938	40241
20148007474	338175.3	8397903.2	0.066	0.45	23092014	155304	40241
20148001828	353906.3	8369994.2	0.027	-0.18	23092014	113452	40382
20148001827	352087.0	8369911.6	0.011	0.19	23092014	113750	40382
20148001807	369959.9	8363922.5	-0.007	0.20	23092014	130504	40382
20148001879	366123.3	8377846.9	-0.011	-0.31	23092014	144026	40382
20148001859	359854.8	8373992.4	-0.160	0.08	23092014	150234	40382
20148001858	357728.2	8374203.8	-0.017	-0.39	23092014	150610	40382
20148007411	328299.1	8412202.2	-0.004	-0.36	26092014	085516	40382
20148007410	324375.5	8411931.9	-0.033	-0.40	26092014	085926	40382
20148001931	328257.5	8424112.9	-0.207	0.24	26092014	103200	40382
20148001514	389774.3	8441874.3	-0.102	-0.07	26092014	120608	40382
20148001514	389776.8	8441873.9	-0.022	-0.07	26092014	154836	40382
20148001879	366122.9	8377847.1	-0.004	-0.03	28092014	092956	40382
20148001645	375942.0	8346876.5	-0.131	0.46	28092014	112935	40382
20148002122	386226.0	8356496.7	0.073	0.02	28092014	131548	40382
20148001062	379295.6	8383547.1	0.148	0.07	28092014	145809	40382
20148001056	387715.1	8430043.9	0.072	0.11	28092014	163500	40382
20148001055	388030.8	8431985.3	0.087	0.12	28092014	163824	40382
20148001092	384289.4	8435811.0	0.044	0.18	28092014	164358	40382
20148001514	389777.0	8441873.8	0.065	0.12	28092014	165206	40382
20148001126	384242.0	8450286.7	-0.028	-0.26	28092014	170155	40382
20148001127	383819.0	8452307.8	-0.067	-0.31	28092014	170658	40382
20148001011	404124.2	8459813.0	0.004	-0.03	28092014	171947	40382
20148007300	395848.9	8483457.2	-0.014	0.03	29092014	062532	40241

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20148007302	388986.2	8483718.9	-0.083	0.06	29092014	063152	40241
20148007303	385049.6	8483715.8	-0.040	-0.04	29092014	063640	40241
20148001929	360010.8	8472472.1	-0.112	0.34	29092014	070130	40241
20148007090	335558.0	8459613.3	-0.062	-0.04	29092014	073130	40241
20148007000	328373.2	8459401.8	-0.183	-0.34	29092014	074110	40241
20148007611	316061.3	8427828.7	-0.019	0.41	29092014	105234	40241
20148007608	316203.2	8426211.5	-0.032	0.62	29092014	105752	40241
20148007609	317439.6	8425811.3	0.151	-0.29	29092014	110732	40241
20148007610	317967.2	8427848.2	0.059	0.28	29092014	111112	40241
20148007091	344250.2	8460008.0	-0.015	0.72	29092014	163524	40241
20148007706	394090.6	8369924.2	-0.001	0.03	30092014	090838	40241
20148007705	394184.5	8371482.9	0.066	-0.26	30092014	091200	40241
20148001750	391934.2	8355884.3	0.113	0.09	30092014	094356	40241
20148002122	386225.0	8356496.7	-0.016	-0.05	30092014	110008	40241
20148007764	382248.4	8364105.4	-0.059	-0.09	30092014	132406	40241
20148007763	379722.8	8364099.2	0.111	0.67	30092014	132746	40241
20148007762	378243.3	8363947.9	-0.076	0.03	30092014	133132	40241
20148007761	377969.8	8366154.3	-0.021	-0.03	30092014	133506	40241
20148007760	379964.2	8365813.0	0.008	0.05	30092014	133802	40241
20148007759	382155.8	8366170.9	-0.062	0.10	30092014	134106	40241
20148007688	397985.1	8397927.4	-0.006	-0.02	30092014	160008	40241
20148007687	398280.9	8400189.8	0.065	0.13	30092014	160330	40241
20148001513	403871.2	8412062.3	0.028	0.00	30092014	162804	40241
20148001011	404114.5	8459800.6	-0.028	-0.57	01102014	073934	40241
20148001514	389776.8	8441873.7	-0.024	0.48	01102014	081304	40241
20148001563	377930.0	8438156.0	0.154	-0.25	01102014	082120	40241
20148001562	377754.5	8435740.7	0.005	0.20	01102014	082718	40241
20148001554	374002.6	8406259.2	-0.130	0.92	01102014	093930	40241
20148001553	374297.2	8404384.6	0.085	0.84	01102014	094702	40241
20148007872	348211.8	8409952.3	0.108	0.17	01102014	132500	40241
20148007871	347710.2	8405235.7	-0.029	-0.35	01102014	133238	40241
20148007870	347700.5	8401216.3	0.139	-0.33	01102014	133944	40241
20148007856	357976.7	8381752.0	0.023	0.90	01102014	145116	40241
20148007855	359881.3	8382047.5	-0.045	0.86	01102014	145722	40241
20148007843	374036.6	8392023.4	-0.013	-0.72	01102014	154354	40241
20148007842	373888.4	8394232.3	-0.102	-0.76	01102014	154748	40241
20148001092	384288.9	8435811.1	-0.068	0.02	01102014	164932	40241
20148001514	389777.1	8441873.8	0.008	0.56	01102014	165520	40241
20148007822	398369.6	8442368.5	0.024	0.43	01102014	171946	40241
20148007821	402227.6	8444082.8	-0.194	-0.10	01102014	173024	40241
20148007820	402068.2	8451779.2	-0.168	0.25	01102014	174448	40241
20148007819	402521.8	8454079.7	0.007	0.94	01102014	174814	40241
20148001011	404114.7	8459800.4	0.016	0.75	01102014	180118	40241
20148007000	328372.8	8459401.9	-0.006	0.64	02102014	063426	40241
20148007938	328006.5	8446284.0	-0.019	0.07	02102014	085254	40241
20148007938	328006.6	8446283.7	0.012	0.02	02102014	095056	40241
20148007939	325823.2	8445541.7	-0.013	0.12	02102014	095436	40241

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s²	DATE_DDMMYY	TIME_HHMMSS	METERSN
20148007000	328372.8	8459401.8	-0.019	0.48	02102014	100626	40241
20148007976	331945.1	8432120.5	0.001	-0.42	02102014	112810	40241
20148007642	343739.7	8427734.5	0.000	-0.16	02102014	131512	40241
20148007883	351907.0	8399995.8	0.022	-0.13	02102014	151600	40241
20148007884	354046.6	8399885.3	0.062	-0.13	02102014	152032	40241
20148007885	354048.0	8398566.1	-0.028	-0.05	02102014	152434	40241
20148007886	351905.2	8398035.3	-0.123	-0.52	02102014	152858	40241
20148001062	379295.7	8383547.2	-0.030	-0.19	02102014	163952	40241
20148001514	389777.2	8441874.1	0.040	-0.52	02102014	174126	40241
20148001011	404114.4	8459800.5	0.040	0.22	02102014	180732	40241
20148008052	399757.9	8451578.4	0.000	-0.07	03102014	064657	40241
20148008051	393248.7	8443241.8	0.016	-0.31	03102014	070228	40241
20148001514	389777.5	8441873.8	0.021	-0.53	03102014	070628	40241
20148008050	385787.1	8443458.3	0.016	-0.30	03102014	071248	40241
20148008049	376241.9	8437501.1	-0.033	0.03	03102014	074644	40241
20148008048	375461.4	8428744.8	0.059	-0.66	03102014	080730	40241
20148008046	370073.3	8411635.4	0.030	-0.15	03102014	083720	40241
20148008045	369804.3	8406184.4	0.040	0.19	03102014	084904	40241
20148008044	371381.6	8396903.6	-0.012	-0.37	03102014	090802	40241
20148007885	354048.1	8398565.8	0.036	-0.19	03102014	103304	40241
20148008015	343798.4	8430366.9	0.122	0.31	03102014	130608	40241
20148008053	405728.0	8467468.2	0.025	-0.07	04102014	062058	40241
20148008054	406253.1	8465606.6	0.001	0.09	04102014	062418	40241
20148001011	404115.1	8459799.7	-0.018	-0.31	04102014	063342	40241
20148008052	399758.5	8451577.8	-0.017	0.02	04102014	064318	40241
20148008060	399972.5	8444226.0	0.024	0.19	04102014	065712	40241
20148008051	393249.5	8443241.9	-0.032	0.02	04102014	070712	40241
20148001514	389777.2	8441873.8	0.038	0.34	04102014	071746	40241
20148008091	364416.9	8387929.2	-0.078	0.40	04102014	094628	40241
20148008092	362101.0	8387824.9	-0.014	0.63	04102014	094958	40241
20148008115	355542.9	8405974.6	-0.068	0.01	04102014	104138	40241
20148008116	355994.9	8407512.0	-0.076	0.05	04102014	104432	40241
20148008122	353936.5	8414075.4	0.009	-0.09	04102014	105724	40241
20148008123	353844.0	8415787.3	-0.081	-0.10	04102014	110038	40241
20148008171	365893.3	8404023.7	-0.002	-0.41	04102014	142434	40241
20148008168	366039.2	8405959.1	0.051	-0.31	04102014	142856	40241
20148008218	355902.3	8421740.8	0.015	0.07	04102014	150640	40241
20148003253	341893.1	8448036.6	0.061	0.28	08102014	075348	40241
20148003250	339760.2	8451598.8	-0.105	0.03	08102014	080144	40241
20148003249	343636.9	8451608.5	0.030	-0.09	08102014	080536	40241
20148003263	345958.2	8435824.4	0.031	0.00	08102014	085256	40241
20148003262	345601.3	8434155.6	0.023	-0.18	08102014	085934	40241
20148003274	348151.3	8447691.8	0.092	0.24	08102014	093628	40241
20148003273	347842.7	8450042.4	-0.030	0.23	08102014	094132	40241
20148003248	348342.5	8451438.3	-0.054	-0.14	08102014	094428	40241
20148003306	353756.2	8432207.9	0.019	-0.26	08102014	115654	40241
20148008169	364154.5	8405982.6	-0.014	-0.29	08102014	153508	40241

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20148008153	371970.2	8434003.9	0.029	-0.19	08102014	171750	40241
20148008152	371599.3	8436317.9	0.019	-0.03	08102014	172110	40241
20148008062	376995.6	8442708.8	0.040	-0.07	08102014	174646	40241
20148008050	385787.6	8443458.0	-0.008	0.21	08102014	175419	40241
20148008149	389913.9	8443999.0	-0.083	0.09	08102014	180030	40241
20148008051	393249.1	8443241.6	-0.028	0.20	08102014	180416	40241
20148003387	394009.7	8409844.8	0.089	0.06	09102014	101542	40241
20148003386	393942.8	8412058.1	-0.059	-0.27	09102014	101848	40241
20148003373	407799.3	8420087.3	0.021	-0.35	09102014	105254	40241
20148003372	407866.7	8421691.3	-0.040	-0.10	09102014	105548	40241
20148001514	389777.1	8441873.8	-0.002	0.09	09102014	113924	40241
20148001047	396143.8	8439919.1	-0.139	0.25	09102014	122940	40241
20148001514	389777.3	8441874.0	0.001	-0.75	09102014	125544	40241
20148001563	377935.4	8438150.9	0.088	0.75	09102014	132626	40241
20148008152	371600.0	8436318.2	-0.010	-0.03	09102014	133154	40241
20148008153	371966.8	8434002.0	0.003	-0.62	09102014	133512	40241
20148007000	328372.9	8459402.2	0.019	0.10	09102014	152914	40241
20148003537	442012.5	8497226.2	-0.042	-0.12	10102014	151004	40241
20148003538	441389.7	8497991.0	0.096	-0.22	10102014	151517	40241
20148003534	440955.8	8497909.0	-0.005	-0.34	10102014	151802	40241
20148003536	440885.6	8496997.9	-0.068	0.27	10102014	152046	40241
20148003535	440084.8	8496793.7	0.075	-0.14	10102014	152358	40241
20148003556	429145.5	8494985.3	-0.078	-0.11	10102014	165322	40241
20148003556	429145.3	8494985.0	0.091	0.15	10102014	181738	40241
20148003557	429099.0	8494062.7	0.073	-0.37	10102014	182016	40241
20148003492	364229.2	8460104.1	-0.001	-0.21	11102014	062602	40241
20148003293	354189.7	8449300.7	-0.033	-0.24	11102014	080220	40241
20148003292	353476.1	8451811.3	0.008	-0.15	11102014	080546	40241
20148007000	328372.8	8459401.7	0.043	0.69	11102014	081826	40241
20148008152	371597.1	8436318.3	-0.018	0.07	11102014	085814	40241
20148001514	389776.4	8441873.4	0.019	0.65	11102014	094134	40241
20148008062	376996.9	8442710.7	-0.036	0.56	11102014	100326	40241
20148008062	376995.9	8442709.7	-0.068	-0.06	11102014	122414	40241
20148003557	429101.3	8494057.4	0.003	0.30	11102014	135240	40241
20148003579	435695.4	8493933.0	0.033	0.33	11102014	143616	40241
20148003567	436988.6	8494269.5	0.059	0.51	11102014	144018	40241
20148003566	437205.5	8495004.0	-0.117	0.71	11102014	144250	40241
20148003566	437205.6	8495004.1	0.054	-0.55	11102014	153858	40241
20148003567	436988.7	8494269.5	0.039	-0.03	11102014	154152	40241
20148003568	437243.3	8492861.8	-0.048	-0.18	11102014	163800	40241
20148003578	436001.7	8493367.6	-0.093	-0.06	11102014	164116	40241
20148003387	394010.4	8409844.6	-0.036	-0.42	12102014	074052	40241
20148001062	379300.9	8383546.4	-0.039	0.26	12102014	091908	40241
20148003705	406534.0	8420587.3	-0.041	-0.64	12102014	094600	40241
20148003449	398045.6	8422095.0	0.000	0.62	12102014	102818	40241
20148003450	395824.2	8421721.2	0.086	0.61	12102014	103142	40241
20148001364	397955.9	8427643.5	0.110	1.09	12102014	104530	40241

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20148001514	389776.8	8441873.7	-0.097	0.19	12102014	120628	40241
20148008149	389915.5	8443996.3	-0.020	-0.05	12102014	125238	40241
20148008054	406253.1	8465606.8	-0.024	0.41	12102014	135708	40241
20148008053	405729.1	8467464.4	-0.023	0.18	12102014	140056	40241
20148003777	390543.9	8445631.8	0.120	-0.08	12102014	160148	40241
20148008149	389917.9	8443992.2	0.086	0.02	12102014	160546	40241
20148001514	389777.3	8441874.3	0.120	0.01	12102014	160908	40241
20148003842	417888.0	8455916.8	-0.061	0.03	13102014	094716	40241
20148001011	404114.5	8459800.3	-0.007	-0.24	13102014	102240	40241
20148003915	404304.2	8432101.4	-0.104	-0.85	13102014	121332	40241
20148003914	403947.7	8433970.0	-0.067	-0.58	13102014	121658	40241
20148003913	404498.4	8435991.7	0.127	-0.40	13102014	121950	40241
20148003912	404117.0	8438157.5	-0.006	-0.01	13102014	122232	40241
20148003910	406360.6	8439839.2	-0.035	-0.44	13102014	122904	40241
20148003909	406150.5	8442558.2	-0.027	-0.14	13102014	123208	40241
20148003908	406146.2	8443736.7	-0.025	-0.31	13102014	123428	40241
20148003909	406150.6	8442557.9	0.000	-0.63	13102014	130002	40241
20148003910	406360.5	8439838.8	0.016	-0.33	13102014	130322	40241
20148003911	405753.5	8438156.7	0.026	-0.85	13102014	130654	40241
20148003912	404117.0	8438157.5	0.003	0.19	13102014	131034	40241
20148003883	420311.4	8430501.2	-0.138	0.23	13102014	134814	40241
20148003882	419732.2	8428420.7	0.203	0.80	13102014	135156	40241
20148003881	419727.5	8425678.8	-0.051	0.87	13102014	135540	40241
20148003883	420311.2	8430501.4	0.205	-0.03	13102014	150926	40241
20148001159	415896.8	8431989.5	0.016	0.35	13102014	151356	40241
20148003931	408167.4	8432137.7	-0.091	-0.90	13102014	153006	40241
20148003887	420316.4	8439653.2	0.028	0.25	13102014	164152	40241
20148003886	420196.6	8437615.7	0.004	-0.11	13102014	172044	40241
20148003887	420316.7	8439653.2	-0.006	0.23	13102014	172348	40241
20148003888	419801.6	8442303.2	0.016	0.37	13102014	172702	40241
20148003889	419872.5	8443307.2	-0.030	-0.35	13102014	172946	40241
20148003890	420162.6	8446006.4	-0.029	0.55	13102014	173346	40241
20148003891	419832.3	8447720.5	-0.031	0.35	13102014	173706	40241
20148003892	420063.7	8450055.2	-0.056	0.13	13102014	174008	40241
20148003893	419902.1	8451713.1	-0.061	-0.26	13102014	174456	40241
20148003895	419965.5	8455780.0	-0.055	-0.46	13102014	175104	40241
20148003895	419965.8	8455780.6	0.008	0.74	14102014	065852	40241
20148003894	419943.9	8453742.8	-0.026	0.14	14102014	070358	40241
20148003893	419902.3	8451713.6	0.032	-0.01	14102014	070710	40241
20148003892	420063.2	8450056.0	0.007	0.16	14102014	071118	40241
20148003891	419832.1	8447721.3	-0.042	-0.44	14102014	071428	40241
20148003890	420161.9	8446006.5	-0.049	-0.62	14102014	071720	40241
20148003889	419872.2	8443307.2	0.051	-0.20	14102014	072048	40241
20148003888	419801.5	8442303.8	-0.015	-0.59	14102014	072318	40241
20148003887	420316.3	8439652.9	-0.014	-0.64	14102014	072652	40241
20148003886	420196.4	8437615.9	-0.023	-0.12	14102014	072958	40241
20148003895	419965.5	8455780.5	0.042	-0.04	14102014	102738	40241

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s²	DATE_DDMMYY	TIME_HHMMSS	METERSN
20148003894	419944.3	8453742.4	0.022	-0.17	14102014	103340	40241
20148003893	419902.4	8451713.2	0.010	-0.29	14102014	103734	40241
20148003892	420063.5	8450055.7	0.047	-0.08	14102014	104436	40241
20148003891	419832.1	8447720.9	0.050	0.03	14102014	104748	40241
20148003890	420161.6	8446006.3	0.047	-0.13	14102014	105052	40241
20148003889	419872.2	8443307.1	0.006	-0.04	14102014	105448	40241
20148004010	422092.1	8444752.8	0.022	0.29	14102014	105912	40241
20148004007	426069.4	8442428.5	-0.134	-0.07	14102014	110828	40241
20148004006	426037.8	8440455.4	-0.046	-0.36	14102014	111208	40241
20148004005	428618.4	8439847.4	-0.022	-0.55	14102014	111548	40241
20148004011	422294.9	8445799.0	-0.128	0.93	14102014	130702	40241
20148003890	420161.9	8446006.2	-0.043	-0.38	14102014	131014	40241
20148003908	406145.8	8443737.3	0.032	-0.07	14102014	133520	40241
20148004043	413762.1	8446471.7	-0.025	-0.51	14102014	143140	40241
20148003908	406145.8	8443737.3	-0.011	-0.06	14102014	162228	40241
20148004085	439566.0	8456147.7	0.112	0.19	15102014	061948	40241
20148004084	435852.4	8456404.6	0.047	-0.06	15102014	062330	40241
20148004012	421914.1	8447571.4	-0.030	0.87	15102014	082056	40241
20148003891	419832.0	8447721.2	-0.005	0.15	15102014	082440	40241
20148001157	416177.3	8447937.4	-0.009	0.46	15102014	082824	40241
20148003898	411870.6	8456035.3	0.027	0.90	15102014	083420	40241
20148003899	410279.9	8456018.6	0.021	0.90	15102014	083812	40241
20148001011	404114.1	8459800.3	-0.013	0.49	15102014	084952	40241
20148004080	419917.8	8457893.9	-0.031	0.63	15102014	102510	40241
20148004084	435852.0	8456404.7	-0.008	0.42	15102014	105100	40241
20148004085	439566.0	8456148.6	-0.049	0.50	15102014	105504	40241
20148004174	423898.1	8480215.6	-0.046	-0.11	15102014	152922	40241
20148004171	423783.8	8483621.2	0.050	0.20	15102014	162002	40241
20148004172	423987.9	8482680.2	-0.105	-0.23	15102014	162258	40241
20148004173	423734.0	8481257.2	-0.058	-0.38	15102014	162624	40241
20148004171	423784.2	8483621.3	-0.006	0.01	15102014	172412	40241
20148004211	422927.3	8483488.5	0.011	0.02	15102014	172809	40241
20148004210	423093.1	8483329.2	-0.056	0.21	15102014	173040	40241
20148004209	422570.7	8482052.1	-0.063	-0.28	15102014	173352	40241
20148004245	437308.4	8481762.3	-0.027	-0.48	16102014	080310	40241
20148004246	435879.4	8482011.1	0.012	-0.40	16102014	080650	40241
20148004243	435852.0	8482801.2	-0.033	-0.32	16102014	080958	40241
20148004244	437056.7	8483068.5	-0.005	-0.27	16102014	081306	40241
20148004241	437003.1	8483969.7	-0.008	-0.02	16102014	090956	40241
20148004242	435708.0	8484206.5	-0.019	-0.25	16102014	091316	40241
20148004239	435901.9	8484884.8	0.008	-0.17	16102014	091608	40241
20148004240	436963.1	8484963.4	0.006	-0.05	16102014	091920	40241
20148004237	436924.1	8486389.5	-0.067	-0.10	16102014	101910	40241
20148004238	436308.8	8485800.6	-0.012	-0.40	16102014	102244	40241
20148004235	436613.0	8486771.8	-0.018	-0.16	16102014	102546	40241
20148004236	437366.0	8487160.4	-0.015	-0.16	16102014	102854	40241
20148003573	437088.3	8488036.9	-0.073	-0.08	16102014	112746	40241

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s²	DATE_DDMMYY	TIME_HHMMSS	METERSN
20148003574	435864.5	8488338.4	-0.078	-0.03	16102014	113104	40241
20148003575	436026.0	8488878.6	-0.163	0.02	16102014	113512	40241
20148003572	437115.2	8489112.3	-0.072	-0.12	16102014	113854	40241
20148096234	429203.9	8492017.0	0.019	-0.03	16102014	133824	40241
20148003569	436936.0	8491520.7	-0.109	0.70	16102014	140011	40241
20148003570	437051.8	8490745.6	-0.087	0.62	16102014	143440	40241
20148003571	437111.8	8490153.9	0.037	0.61	16102014	143736	40241
20148003572	437115.2	8489112.4	0.006	0.15	16102014	144024	40241
20148003573	437086.8	8488036.4	0.011	0.52	16102014	144332	40241
20148004237	436924.1	8486389.5	0.119	-0.39	16102014	144750	40241
20148004240	436962.7	8484962.6	0.040	-0.26	16102014	145118	40241
20148004241	437003.4	8483969.3	0.033	-0.55	16102014	145540	40241
20148004244	437057.3	8483066.8	0.043	-0.21	16102014	145920	40241
20148004247	436142.4	8481350.4	-0.039	-0.87	16102014	150359	40241
20148004242	435708.1	8484206.8	-0.016	-0.16	16102014	161340	40241
20148004240	436962.7	8484962.6	0.015	-0.09	16102014	161726	40241
20148004239	435901.6	8484884.5	0.004	-0.21	16102014	162030	40241
20148004092	432630.5	8485784.3	0.043	-0.62	16102014	170908	40241
20148004238	436308.5	8485800.8	-0.045	0.17	16102014	171918	40241
20148004237	436924.2	8486389.6	-0.064	-0.11	16102014	172244	40241
20148004236	437365.4	8487160.0	0.028	-0.12	16102014	172550	40241
20148004235	436613.0	8486771.4	0.031	-0.17	16102014	172906	40241
20148003574	435863.8	8488337.7	-0.065	-0.01	16102014	180046	40241
20148003573	437087.0	8488036.4	-0.021	-0.61	16102014	180344	40241
20148003572	437115.0	8489112.8	-0.043	0.15	16102014	180710	40241
20148003575	436026.2	8488878.3	-0.107	0.09	16102014	181014	40241
20148004441	533272.3	8571235.1	-0.094	0.02	17102014	115834	40241
20148004435	556054.6	8571334.0	0.032	-0.36	17102014	121050	40241
20148004434	561152.8	8571455.9	-0.009	-0.05	17102014	122142	40241
20148004466	595604.9	8516036.8	-0.001	0.60	17102014	144544	40241
20148003557	429101.0	8494058.0	-0.091	0.39	17102014	172128	40241
20148096234	429203.4	8492017.3	0.026	0.38	17102014	172604	40241
20148096201	429252.4	8491219.2	0.004	0.88	17102014	172814	40241
20148096202	429983.7	8490975.1	0.010	0.51	17102014	173048	40241
20148096184	430052.9	8490129.4	-0.026	0.13	17102014	175752	40241
20148004405	493228.1	8536533.0	0.009	-0.02	18102014	062144	40241
20148004415	566989.0	8535131.2	-0.014	0.71	18102014	081134	40241
20148004416	570467.9	8535811.2	0.010	0.45	18102014	082042	40241
20148004418	580133.2	8536549.5	0.026	-0.34	18102014	083718	40241
20148004427	583565.0	8569533.4	-0.029	0.45	18102014	103526	40241
20148004435	556052.4	8571331.0	-0.069	0.40	18102014	104738	40241
20148004434	561151.0	8571459.0	0.067	0.22	18102014	105352	40241
20148004560	555567.8	8568383.9	0.082	-0.27	18102014	124046	40241
20148004556	560953.8	8564916.8	0.000	-0.02	18102014	124848	40241
20148004555	559965.8	8569165.8	0.042	-0.39	18102014	125348	40241
20148004427	583565.1	8569533.0	0.033	-0.11	18102014	131818	40241
20148004426	583609.5	8563511.6	0.028	0.33	18102014	132330	40241

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20148004421	583707.3	8544025.7	0.045	0.09	18102014	140706	40241
20148004419	584273.8	8536209.3	0.013	0.01	18102014	141334	40241
20148004418	580133.6	8536549.9	0.052	-0.71	18102014	141834	40241
20148004533	580514.3	8532195.4	-0.099	-0.20	18102014	142250	40241
20148004534	583412.1	8531802.2	-0.018	-0.56	18102014	143806	40241
20148004471	592361.4	8513067.7	-0.032	-0.23	18102014	151612	40241
20148004472	592888.6	8507922.2	-0.093	-0.32	18102014	152252	40241
20148004473	592367.6	8504320.1	-0.042	-0.07	18102014	152728	40241
20148004615	456609.6	8500342.7	-0.078	0.16	19102014	061700	40241
20148004585	583691.2	8507859.8	0.132	0.22	19102014	090330	40241
20148004534	583413.0	8531802.5	-0.004	-0.05	19102014	092950	40241
20148004419	584273.9	8536209.7	-0.033	0.28	19102014	093410	40241
20148004421	583707.7	8544025.8	-0.042	0.16	19102014	093910	40241
20148004422	584713.2	8549368.4	-0.057	0.19	19102014	094322	40241
20148004423	584030.8	8551254.1	0.025	0.27	19102014	095934	40241
20148004424	583713.9	8556816.2	-0.056	0.23	19102014	100404	40241
20148004425	584110.6	8559557.0	0.064	0.29	19102014	101546	40241
20148004426	583610.0	8563511.3	-0.015	0.00	19102014	101926	40241
20148004442	528215.9	8571371.9	0.117	0.05	19102014	112104	40241
20148004669	521740.0	8571208.2	-0.040	-0.12	19102014	131832	40241
20148004442	528215.4	8571373.3	0.135	0.17	19102014	132352	40241
20148011048	444043.3	8350010.1	-0.096	0.33	19102014	100753	40382
20148011049	444043.3	8352004.8	0.001	-0.27	19102014	101912	40382
20148011050	442057.5	8352007.6	0.033	-0.43	19102014	102257	40382
20148011069	420030.2	8351968.1	0.113	0.09	19102014	112124	40382
20148011066	418035.1	8352049.7	0.040	0.11	19102014	112434	40382
20148011067	418028.0	8353960.8	0.117	-0.22	19102014	112840	40382
20148011068	420038.6	8354166.0	0.007	0.20	19102014	113203	40382
20148011088	435904.6	8353992.5	-0.006	0.65	19102014	121015	40382
20148011085	438048.7	8354000.8	0.050	0.87	19102014	121404	40382
20148011086	438037.8	8356051.3	-0.015	-0.35	19102014	141240	40382
20148011087	435992.8	8355988.6	-0.035	-0.29	19102014	141622	40382
20148011131	420129.0	8359924.0	-0.060	0.10	19102014	164619	40382
20148011128	417844.3	8360025.8	0.050	-0.28	19102014	165219	40382
20148011129	417957.1	8362038.6	-0.022	-0.21	19102014	165538	40382
20148011130	420085.1	8362026.0	0.023	-0.39	19102014	170050	40382
20148004533	580514.4	8532195.9	-0.031	-0.54	20102014	081202	40241
20148004418	580133.2	8536549.7	-0.096	0.56	20102014	081830	40241
20148004557	559730.0	8560331.9	-0.019	-0.82	20102014	090234	40241
20148004558	556642.8	8559974.1	0.002	-0.66	20102014	090652	40241
20148004727	422912.6	8499676.7	-0.016	0.07	20102014	170048	40241
20148004735	424036.7	8503944.8	0.047	0.48	20102014	170444	40241
20148004734	428078.9	8504259.2	-0.023	0.10	20102014	170856	40241
20148004733	432850.9	8504239.8	-0.033	-0.13	20102014	181926	40241
20148004730	431693.7	8499672.8	-0.006	0.35	20102014	182326	40241
20148004729	427661.0	8499928.2	0.008	0.11	20102014	182734	40241
20148011167	439886.0	8364413.5	0.036	-0.19	20102014	064531	40382

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20148011164	434099.3	8363871.7	0.000	-0.81	20102014	065017	40382
20148011161	432014.1	8364055.5	-0.023	0.03	20102014	065554	40382
20148011162	431823.8	8366039.8	0.029	0.16	20102014	080119	40382
20148011163	434187.4	8365953.3	0.120	0.48	20102014	080433	40382
20148011241	439773.3	8376158.6	0.039	0.18	20102014	171735	40382
20148004680	531010.5	8511196.4	0.074	-0.10	21102014	072718	40241
20148004417	574703.8	8536035.4	0.049	-0.19	21102014	084300	40241
20148004442	528215.8	8571372.1	-0.038	-0.15	21102014	122740	40241
20148004667	526599.4	8564089.8	-0.078	-0.64	21102014	130330	40241
20148004415	566988.6	8535131.5	0.072	-0.43	21102014	141918	40241
20148004416	570467.6	8535811.9	0.012	-0.57	21102014	142822	40241
20148014738	514987.2	8512389.8	-0.009	0.16	21102014	160424	40241
20148014730	481885.5	8512437.1	-0.012	-0.16	21102014	164908	40241
20148004615	456609.8	8500342.6	0.049	0.28	21102014	172638	40241
20148004731	436479.1	8500282.4	-0.044	0.26	21102014	182100	40241
20148004730	431693.8	8499673.2	0.043	-0.11	21102014	182458	40241
20148011241	439773.4	8376158.0	0.045	0.32	21102014	120046	40382
20148011299	436059.7	8379330.2	-0.024	-0.01	21102014	120456	40382
20148011294	436004.1	8399982.7	-0.056	-0.07	21102014	133828	40382
20148011295	436126.4	8395964.2	-0.085	-0.24	21102014	143722	40382
20148011296	435898.3	8391751.1	-0.082	0.05	21102014	144104	40382
20148011297	436163.6	8387182.3	-0.058	0.02	21102014	153018	40382
20148011298	436060.0	8383931.8	0.057	0.17	21102014	153330	40382
20148011299	436059.5	8379330.3	-0.036	-0.15	21102014	164446	40382
20148011241	439773.1	8376158.4	-0.060	-0.44	21102014	164920	40382
20148004839	502646.5	8515768.3	-0.035	0.11	22102014	070418	40241
20148004838	506232.5	8516661.6	0.013	0.07	22102014	070826	40241
20148004831	528813.5	8520096.9	-0.049	-0.07	22102014	074122	40241
20148004415	566988.9	8535131.3	-0.061	-0.21	22102014	101816	40241
20148004831	528813.5	8520096.5	-0.011	0.34	22102014	103936	40241
20148004844	484507.9	8515942.4	-0.008	0.77	22102014	114729	40241
20148014730	481885.5	8512437.1	-0.002	0.46	22102014	115200	40241
20148004845	479258.8	8511997.4	0.012	0.74	22102014	115624	40241
20148004865	471921.6	8515816.1	0.039	0.42	22102014	120930	40241
20148004863	441782.6	8503139.2	0.019	0.70	22102014	123930	40241
20148004862	445371.2	8499793.7	0.113	0.11	22102014	131642	40241
20148004925	468353.0	8516422.2	0.043	-0.85	22102014	141322	40241
20148004864	470454.8	8513035.5	-0.016	-0.02	22102014	141722	40241
20148004865	471914.9	8515822.9	-0.080	-0.34	22102014	142322	40241
20148004924	473398.5	8519433.8	-0.043	-0.50	22102014	142820	40241
20148004910	523923.4	8523692.4	-0.082	-0.40	22102014	153910	40241
20148004909	528290.9	8522311.9	-0.040	-0.33	22102014	154348	40241
20148004948	494939.7	8528221.8	0.041	0.04	22102014	163742	40241
20148004947	491293.1	8528981.8	0.199	0.19	22102014	164152	40241
20148004405	493228.2	8536533.0	-0.030	0.16	22102014	165036	40241
20148004935	454338.0	8512012.0	-0.020	-0.05	22102014	173744	40241
20148004934	452579.7	8513257.3	-0.037	-0.48	22102014	174120	40241

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s²	DATE_DDMMYY	TIME_HHMMSS	METERSN
20148011300	452061.1	8367993.7	-0.055	-0.03	22102014	070958	40382
20148011301	451941.4	8363766.9	0.032	-0.03	22102014	071502	40382
20148011302	451865.1	8359894.0	-0.076	0.21	22102014	072110	40382
20148004935	454338.3	8512012.6	-0.055	-0.40	23102014	060552	40241
20148004967	488863.0	8535758.0	-0.007	0.05	23102014	064350	40241
20148004405	493228.2	8536532.8	-0.004	0.04	23102014	064814	40241
20148004988	510908.7	8548156.7	0.056	-0.13	23102014	090718	40241
20148004987	507582.2	8547706.3	0.036	-0.32	23102014	091124	40241
20148004982	492332.8	8544997.0	0.072	0.08	23102014	092838	40241
20148004442	528216.1	8571372.1	-0.093	0.23	23102014	103814	40241
20148005019	507263.9	8563211.2	-0.020	-0.95	23102014	135622	40241
20148004732	435778.1	8505141.9	-0.038	0.04	23102014	162140	40241
20148004730	431693.6	8499673.7	-0.065	0.01	23102014	162644	40241
20148011300	452061.2	8367995.5	0.082	0.12	23102014	062726	40382
20148011301	451941.3	8363767.5	-0.019	0.05	23102014	063205	40382
20148011302	451865.1	8359894.3	0.059	-0.46	23102014	063637	40382
20148011300	452060.9	8367994.4	0.015	0.05	23102014	125720	40382
20148011501	472129.3	8360506.9	-0.040	-0.27	23102014	132347	40382
20148011497	479647.4	8360215.5	0.058	-0.47	23102014	133428	40382
20148011496	483479.9	8360403.1	0.105	-0.92	23102014	133927	40382
20148011491	495455.1	8359933.9	0.028	-0.21	23102014	135542	40382
20148011490	500063.9	8359831.0	0.093	-0.12	23102014	140052	40382
20148004935	454338.3	8512012.0	0.033	0.03	24102014	061446	40241
20148004978	478443.4	8534454.2	0.001	-0.17	24102014	063047	40241
20148005045	496239.5	8560235.3	0.016	0.10	24102014	064406	40241
20148005031	551103.1	8580512.0	-0.011	0.03	24102014	070932	40241
20148005029	551597.6	8589473.0	-0.107	0.06	24102014	122606	40241
20148005030	552142.2	8584334.2	-0.048	0.31	24102014	123032	40241
20148005031	551103.1	8580512.0	-0.003	0.20	24102014	124018	40241
20148004442	528215.9	8571372.2	-0.019	-0.31	24102014	170242	40241
20148005012	491468.1	8551477.9	-0.048	0.01	24102014	172218	40241
20148011003	484589.5	8372002.3	-0.118	-0.31	24102014	064656	40382
20148011004	531956.7	8383940.0	0.012	-0.10	24102014	082239	40382
20148011003	484589.4	8372002.2	0.000	0.18	24102014	105201	40382
20148011000	460322.1	8372037.2	-0.064	-0.27	24102014	115417	40382
20148011637	483524.1	8387447.5	-0.088	0.06	24102014	133528	40382
20148011636	487946.2	8387726.8	-0.104	-0.16	24102014	134127	40382
20148011005	532021.5	8392029.9	0.162	-0.70	24102014	160115	40382
20148004935	454338.0	8512012.3	0.044	-0.11	25102014	061752	40241
20148004978	478443.0	8534453.3	-0.016	-0.03	25102014	063120	40241
20148005045	496239.5	8560235.5	-0.026	0.13	25102014	064454	40241
20148005170	521118.8	8612607.4	-0.122	0.35	25102014	074510	40241
20148005157	519927.1	8639949.5	-0.134	-0.22	25102014	082242	40241
20148005156	528515.9	8639968.0	-0.079	-0.18	25102014	084324	40241
20148005155	530399.2	8640733.6	-0.049	0.23	25102014	084636	40241
20148005031	551103.4	8580511.4	0.019	-0.15	25102014	113552	40241
20148004442	528215.5	8571373.4	0.003	0.02	25102014	123128	40241

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_µm/s²	DATE_DDMMYY	TIME_HHMMSS	METERSN
20148005175	528612.3	8601046.9	0.038	0.07	25102014	130612	40241
20148005174	528256.2	8604098.4	-0.021	-0.21	25102014	132552	40241
20148004442	528215.7	8571372.0	-0.030	-0.23	25102014	140834	40241
20148005267	519327.1	8579805.7	0.014	0.28	25102014	150500	40241
20148005045	496239.6	8560235.8	-0.004	-0.20	25102014	152124	40241
20148005012	491468.8	8551479.7	0.153	-0.29	25102014	154906	40241
20148004732	435778.4	8505141.1	-0.024	0.27	25102014	175506	40241
20148004733	432852.4	8504244.6	-0.028	0.43	25102014	175834	40241
20148004730	431694.4	8499673.9	-0.046	0.16	25102014	180258	40241
20148004729	427660.9	8499928.0	-0.045	0.19	25102014	180644	40241
20148004727	422912.1	8499676.6	-0.051	0.18	25102014	181102	40241
20148011009	563429.5	8446883.9	0.034	-0.44	25102014	164641	40382
20148011636	487946.4	8387726.8	0.173	-0.07	25102014	173500	40382
20148011637	483524.4	8387447.8	0.116	-0.83	25102014	174009	40382
20148004978	478442.9	8534453.7	0.054	-0.14	26102014	080220	40241
20148004979	485005.7	8536263.8	0.008	-0.16	26102014	080724	40241
20148004967	488862.9	8535758.2	0.005	-0.12	26102014	081122	40241
20148004405	493227.8	8536532.8	0.013	0.18	26102014	081536	40241
20148011742	587059.9	8461957.6	0.095	-0.68	26102014	130056	40382
20148011636	487946.5	8387727.3	-0.052	-0.25	26102014	171317	40382
20148011638	483557.7	8384588.6	-0.090	-0.51	26102014	171727	40382
20148011001	468164.7	8371963.0	0.008	-0.98	26102014	172646	40382
20148011009	563429.3	8446883.8	-0.033	0.32	27102014	114020	40382
20148011011	547733.5	8431586.1	0.030	0.69	27102014	162956	40382
20148011012	539750.3	8424207.1	0.092	0.00	27102014	170741	40382
20148011012	539750.4	8424207.0	0.168	0.07	28102014	122958	40382
20148011009	563429.3	8446883.9	-0.036	0.23	28102014	141833	40382
20148011007	532109.5	8407842.3	0.196	-0.33	28102014	162901	40382
20148009012	625894.9	8620163.3	0.011	0.12	29102014	122234	40241
20148009011	631028.3	8620098.7	0.031	0.21	29102014	122648	40241
20148009010	633907.9	8620323.0	0.127	0.00	29102014	122948	40241
20148009009	639871.1	8625140.4	0.070	-0.65	29102014	123846	40241
20148009005	650553.5	8640997.5	-0.007	0.22	29102014	145230	40241
20148011636	487946.5	8387727.6	0.007	0.12	29102014	124555	40382
20148009010	633907.9	8620323.1	0.010	0.21	30102014	062918	40241
20148009116	588969.6	8650409.7	-0.043	0.11	30102014	091928	40241
20148009028	576482.2	8637441.4	0.037	0.14	30102014	092946	40241
20148009129	567956.5	8652017.5	0.034	-0.40	30102014	101946	40241
20148009128	571802.7	8648166.5	0.007	-0.32	30102014	102740	40241
20148009127	576102.6	8643937.3	-0.036	-0.19	30102014	103516	40241
20148009102	598976.9	8615976.7	0.065	0.39	30102014	112640	40241
20148009101	602179.7	8616331.2	0.069	0.53	30102014	113006	40241
20148009044	617442.2	8616104.8	-0.087	-0.02	30102014	114110	40241
20148009100	631965.9	8615941.6	0.007	0.19	30102014	115336	40241
20148009011	631028.4	8620098.4	0.010	0.23	30102014	115752	40241
20148009010	633911.9	8620323.8	-0.045	-0.33	30102014	120146	40241
20148009055	667683.6	8621679.9	-0.206	0.59	30102014	124828	40241

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_μm/s²	DATE_DDMMYY	TIME_HHMMSS	METERSN
20148009058	662340.2	8628154.2	-0.155	0.67	30102014	132932	40241
20148009005	650553.3	8640996.7	-0.018	0.36	30102014	140056	40241
20148009065	647962.0	8644037.3	-0.012	0.27	30102014	140512	40241
20148011000	460323.2	8372039.2	-0.013	0.86	30102014	062621	40382
20148011001	468166.9	8371971.2	0.032	0.70	30102014	063404	40382
20148011002	476259.0	8371993.6	0.031	-0.46	30102014	064415	40382
20148011003	484588.8	8372002.1	0.041	-0.38	30102014	065132	40382
20148012105	496471.1	8473643.6	0.084	-0.13	30102014	121042	40382
20148011638	483557.7	8384589.2	0.058	-0.44	30102014	145908	40382
20148011637	483524.0	8387447.8	0.044	-0.13	30102014	150344	40382
20148012034	480310.8	8459724.1	0.057	0.04	30102014	161105	40382
20148012105	496465.5	8473639.6	-0.051	0.71	30102014	164406	40382
20148009151	635843.2	8615751.7	-0.042	0.10	31102014	062528	40241
20148009100	631963.5	8615944.6	-0.041	0.00	31102014	063050	40241
20148009127	576105.5	8643934.0	0.047	0.63	31102014	065708	40241
20148009128	571800.3	8648158.8	-0.026	0.66	31102014	070226	40241
20148009129	567957.4	8652016.9	0.001	0.87	31102014	070844	40241
20148009132	563596.2	8660378.3	0.032	0.55	31102014	083406	40241
20148009129	567957.4	8652017.6	-0.002	0.01	31102014	093612	40241
20148005024	551043.2	8606061.6	0.044	0.42	31102014	110910	40241
20148009253	579737.6	8607508.2	0.007	0.17	31102014	141554	40241
20148005024	551043.3	8606061.7	0.101	-0.18	31102014	145512	40241
20148009255	582591.5	8611706.2	0.026	-0.05	31102014	171008	40241
20148009253	579737.3	8607508.2	0.139	-0.06	31102014	171412	40241
20148011001	468165.7	8371965.4	-0.148	0.74	31102014	060142	40382
20148011002	476258.0	8371994.3	-0.066	0.28	31102014	060705	40382
20148011638	483557.6	8384588.8	0.027	0.38	31102014	061529	40382
20148011637	483523.8	8387447.4	0.045	0.89	31102014	061903	40382
20148012084	491996.9	8403517.3	0.096	0.20	31102014	062822	40382
20148012085	511709.5	8415683.1	0.023	-0.73	31102014	150358	40382
20148012166	488196.1	8410902.5	0.010	0.25	31102014	163605	40382
20148009255	582591.9	8611706.7	-0.025	-0.18	01112014	071850	40241
20148009288	572034.9	8636068.9	-0.084	-0.02	01112014	085754	40241
20148009028	576482.2	8637441.3	0.021	0.20	01112014	090230	40241
20148009253	579737.6	8607508.3	-0.120	-0.03	01112014	091858	40241
20148009255	582591.4	8611706.6	-0.020	-0.03	01112014	092358	40241
20148009310	609995.4	8607916.1	-0.001	-0.47	01112014	115822	40241
20148009309	631900.3	8608018.1	0.032	-0.58	01112014	121018	40241
20148009266	652627.6	8605899.6	0.071	-0.61	01112014	132148	40241
20148009310	609995.4	8607915.8	0.012	0.40	01112014	174318	40241
20148009309	631900.7	8608018.4	-0.028	0.49	01112014	180212	40241
20148009266	652626.9	8605899.9	0.038	0.20	01112014	181228	40241
20148004615	456609.3	8500342.5	0.086	-0.86	01112014	092714	40382
20148011638	483557.8	8384588.7	0.040	0.42	01112014	135158	40382
20148011635	488180.5	8383771.7	0.131	-0.22	01112014	135651	40382
20148011618	516112.5	8383763.3	0.139	-0.67	01112014	142737	40382
20148011615	520128.6	8383991.5	-0.011	0.43	01112014	143233	40382

STATION	MGAEAST	MGANORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_μm/s²	DATE_DDMMYY	TIME_HHMMSS	METERSN
20148011004	531956.6	8383940.1	0.048	-0.24	01112014	144614	40382
20148012071	464610.6	8415921.5	0.089	0.12	01112014	162020	40382
20148009266	652627.3	8605900.0	-0.014	0.02	02112014	062830	40241
20148009412	642531.2	8562297.6	0.035	-0.34	02112014	092146	40241
20148009266	652627.1	8605900.1	0.126	-0.37	02112014	131350	40241
20148009482	650753.3	8598304.6	-0.164	0.78	02112014	162300	40241
20148009266	652627.6	8605899.4	-0.136	-0.20	02112014	162832	40241
20148012322	452146.6	8394445.9	-0.027	0.57	02112014	062524	40382
20148012071	464610.3	8415920.9	-0.179	-0.13	02112014	064713	40382
20148004085	439565.9	8456149.5	-0.070	-0.45	02112014	093219	40382
20148004084	435851.8	8456405.3	-0.008	-0.17	02112014	093944	40382
20148011299	436059.3	8379330.3	0.034	0.20	02112014	125339	40382
20148011298	436059.6	8383931.7	-0.027	0.14	02112014	125845	40382
20148011297	436163.6	8387182.3	0.023	-0.06	02112014	130350	40382
20148011296	435898.4	8391750.8	0.109	-0.10	02112014	131006	40382
20148011295	436126.1	8395964.1	0.170	0.13	02112014	131524	40382
20148011294	436003.9	8399982.6	0.041	-0.01	02112014	132054	40382
20148011294	436003.6	8399982.0	0.056	0.07	02112014	171839	40382
20148011295	436126.4	8395964.1	0.021	0.08	02112014	172253	40382
20148011296	435898.2	8391751.3	0.019	-0.27	02112014	172843	40382
20148011297	436163.7	8387182.1	0.117	-0.21	02112014	173351	40382
20148011298	436059.8	8383932.0	0.068	0.10	02112014	173831	40382
20148009266	652627.4	8605899.8	-0.031	-0.28	03112014	061116	40241
20148009520	647003.5	8587519.9	-0.083	-0.29	03112014	093452	40241
20148009266	652627.4	8605899.8	-0.166	-0.14	03112014	101116	40241
20148009368	643452.2	8575579.7	-0.045	-0.19	03112014	123820	40241
20148009520	647003.2	8587520.1	0.055	0.18	03112014	130902	40241
20148009552	657434.2	8587889.2	0.063	0.07	03112014	152632	40241
20148009368	643452.0	8575580.0	-0.028	0.06	03112014	171536	40241
20148009266	652627.3	8605899.9	-0.020	0.05	03112014	173358	40241
20148011299	436059.4	8379330.5	0.021	0.08	03112014	055956	40382
20148011298	436059.9	8383932.0	-0.069	0.22	03112014	060434	40382
20148011297	436163.6	8387182.2	-0.031	0.27	03112014	060908	40382
20148011296	435898.2	8391751.2	-0.029	0.16	03112014	061414	40382
20148011295	436126.5	8395964.6	-0.085	0.13	03112014	061901	40382
20148011294	436004.1	8399982.7	-0.020	0.08	03112014	062438	40382
20148012034	480310.7	8459724.1	0.046	0.19	03112014	165521	40382
20148009619	685070.1	8611402.8	0.024	0.00	04112014	090244	40241
20148009005	650553.4	8640997.1	-0.001	0.01	04112014	105706	40241
20148012322	452146.3	8394446.1	0.007	-0.28	04112014	060315	40382

APPENDIX G
Repeat Listing: Multiple Control Station Observations

STATION	MGA94EAST	MGA94NORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_μm/s²	DATE_DDMMYY	TIME_HHMMSS	METERSN	GRVBASE	GPSBASE
20148001017	386041.832	8472443.573			16092014	172336	40382	201407800001	201407800001
20148001017	386041.971	8472443.795	0.003		17092014	164616	40382	201407800001	201407800101
20148001055	388029.927	8431982.963			17092014	092900	40382	201407800001	201407800101
20148001055	388030.054	8431982.777	-0.054		17092014	123228	40382	201407800001	201407800101
20148001055	388028.409	8431982.731	-0.094		18092014	134548	40382	201407800001	201407800101
20148001055	388030.832	8431985.266	0.087		28092014	163824	40382	201407800001	201407800105
20148001056	387714.555	8430044.118			17092014	093402	40382	201407800001	201407800101
20148001056	387715.133	8430044.326	-0.065		17092014	122750	40382	201407800001	201407800101
20148001056	387715.529	8430044.024	-0.061		18092014	134942	40382	201407800001	201407800101
20148001056	387715.083	8430043.896	0.072		28092014	163500	40382	201407800001	201407800105
20148001126	384241.906	8450286.492			17092014	153618	40382	201407800001	201407800101
20148001126	384242.006	8450286.742	-0.028		28092014	170155	40382	201407800001	201407800001
20148001127	383818.696	8452307.378			17092014	154144	40382	201407800001	201407800101
20148001127	383819.045	8452307.798	-0.067		28092014	170658	40382	201407800001	201407800001
20148001157	416176.376	8447933.968			18092014	070406	40382	201407800001	201407800101
20148001157	416176.490	8447934.099	0.004		18092014	124558	40382	201407800001	201407800101
20148001157	416177.314	8447937.423	-0.009		15102014	082824	40241	201407800001	201407800001
20148001929	360010.672	8472472.132			26092014	065748	40382	201407800001	201407800100
20148001929	360010.770	8472472.085	-0.112		29092014	070130	40241	201407800001	201407800001
20148003292	353476.354	8451810.987			08102014	095608	40241	201407800001	201407800100
20148003292	353476.092	8451811.324	0.008		11102014	080546	40241	201407800001	201407800101
20148003293	354189.610	8449300.971			08102014	100030	40241	201407800001	201407800100
20148003293	354189.682	8449300.681	-0.033		11102014	080220	40241	201407800001	201407800101
20148003492	364229.652	8460101.131			10102014	063746	40241	201407800001	201407800001
20148003492	364229.171	8460104.144	-0.001		11102014	062602	40241	201407800001	201407800101
20148003891	419832.212	8447721.309			13102014	092554	40241	201407800001	201407800101
20148003891	419832.290	8447720.541	-0.031		13102014	173706	40241	201407800001	201407800101
20148003891	419832.055	8447721.309	-0.042		14102014	071428	40241	201407800001	201407800101
20148003891	419832.085	8447720.893	0.050		14102014	104748	40241	201407800001	201407800101
20148003891	419831.987	8447721.183	-0.005		15102014	082440	40241	201407800001	201407800001

STATION	MGA94EAST	MGA94NORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_μm/s²	DATE_DDMMYY	TIME_HHMMSS	METERSN	GRVBASE	GPSBASE
20148003898	411870.461	8456035.197			13102014	100400	40241	201407800001	201407800101
20148003898	411870.620	8456035.284	0.027		15102014	083420	40241	201407800001	201407800001
20148003899	410280.019	8456018.771			13102014	100750	40241	201407800001	201407800101
20148003899	410279.851	8456018.591	0.021		15102014	083812	40241	201407800001	201407800001
20148004012	421914.257	8447571.039			14102014	101230	40241	201407800001	201407800101
20148004012	421914.132	8447571.415	-0.030		15102014	082056	40241	201407800001	201407800001
20148004080	419917.788	8457893.659			14102014	172724	40241	201407800001	201407800101
20148004080	419917.806	8457893.924	-0.031		15102014	102510	40241	201407800001	201407800001
20148004084	435852.191	8456404.615			14102014	175012	40241	201407800001	201407800101
20148004084	435852.419	8456404.648	0.047	-0.06	15102014	062330	40241	201407800001	201407800001
20148004084	435851.992	8456404.732	-0.008	0.42	15102014	105100	40241	201407800001	201407800001
20148004084	435851.761	8456405.254	-0.008	-0.17	02112014	093944	40382	201407800002	201407800002
20148004085	439566.140	8456148.523			14102014	175430	40241	201407800001	201407800101
20148004085	439566.025	8456147.683	0.112	0.19	15102014	061948	40241	201407800001	201407800001
20148004085	439566.045	8456148.591	-0.049	0.50	15102014	105504	40241	201407800001	201407800001
20148004085	439565.933	8456149.548	-0.070	-0.45	02112014	093219	40382	201407800002	201407800002
20148004092	432630.901	8485785.786			14102014	182750	40241	201407800001	201407800101
20148004092	432630.502	8485784.302	0.043		16102014	170908	40241	201407800001	201407800001
20148004615	456609.806	8500342.917			18102014	181400	40241	201407800001	201407800001
20148004615	456609.605	8500342.651	-0.078	0.16	19102014	061700	40241	201407800001	201407800001
20148004615	456609.786	8500342.591	0.049	0.28	21102014	172638	40241	201407800001	201407800001
20148004615	456609.266	8500342.521	0.086	-0.86	01112014	092714	40382	201407800002	201407800102
20148007000	328373.204	8459401.972			17092014	154246	40241	201407800001	201407800100
20148007000	328372.966	8459402.267	0.009		18092014	083308	40241	201407800001	201407800100
20148007000	328373.046	8459401.842	-0.003		18092014	164140	40241	201407800001	201407800100
20148007000	328372.993	8459402.170	0.062		21092014	151744	40241	201407800001	201407800100
20148007000	328373.152	8459401.817	-0.183		29092014	074110	40241	201407800001	201407800001
20148007000	328372.783	8459401.867	-0.006		02102014	063426	40241	201407800001	201407800100
20148007000	328372.835	8459401.750	-0.019		02102014	100626	40241	201407800001	201407800100
20148007000	328372.932	8459402.195	0.019		09102014	152914	40241	201407800001	201407800100
20148007000	328372.802	8459401.695	0.043		11102014	081826	40241	201407800001	201407800101
20148007090	335557.733	8459613.289			18092014	164936	40241	201407800001	201407800100

STATION	MGA94EAST	MGA94NORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_μm/s²	DATE_DDMMYY	TIME_HHMMSS	METERSN	GRVBASE	GPSBASE
20148007090	335557.590	8459613.025	0.125		21092014	160800	40241	201407800001	201407800100
20148007090	335558.025	8459613.286	-0.062		29092014	073130	40241	201407800001	201407800001
20148007091	344250.604	8460007.464			18092014	165742	40241	201407800001	201407800100
20148007091	344250.243	8460007.985	-0.015		29092014	163524	40241	201407800001	201407800001
20148007300	395847.758	8483458.294			21092014	125550	40241	201407800001	201407800101
20148007300	395848.127	8483458.219	0.006		21092014	174946	40241	201407800001	201407800101
20148007300	395848.915	8483457.169	-0.014		29092014	062532	40241	201407800001	201407800001
20148007302	388990.259	8483719.551			21092014	131140	40241	201407800001	201407800101
20148007302	388990.422	8483719.513	0.033		21092014	174406	40241	201407800001	201407800101
20148007302	388986.187	8483718.913	-0.083		29092014	063152	40241	201407800001	201407800001
20148007303	385048.761	8483716.608			21092014	131628	40241	201407800001	201407800101
20148007303	385049.570	8483715.756	-0.040		29092014	063640	40241	201407800001	201407800001
20148007642	343740.232	8427733.871			29092014	131730	40241	201407800001	201407800001
20148007642	343739.712	8427734.504	0.000		02102014	131512	40241	201407800001	201407800100
20148009255	582591.314	8611706.913			31102014	120126	40241	201407800004	201407800112
20148009255	582591.490	8611706.247	0.026		31102014	171008	40241	201407800004	201407800112
20148009255	582591.905	8611706.658	-0.025		01112014	071850	40241	201407800004	201407800112
20148009255	582591.415	8611706.587	-0.020		01112014	092358	40241	201407800004	201407800110
20148009309	631900.561	8608018.432			01112014	061808	40241	201407800004	201407800113
20148009309	631900.275	8608018.066	0.032		01112014	121018	40241	201407800004	201407800113
20148009309	631900.652	8608018.384	-0.028		01112014	180212	40241	201407800004	201407800111
20148009310	609995.183	8607916.069			01112014	063554	40241	201407800004	201407800112
20148009310	609995.445	8607916.148	-0.001		01112014	115822	40241	201407800004	201407800113
20148009310	609995.385	8607915.815	0.012		01112014	174318	40241	201407800004	201407800111
20148011005	532020.823	8392029.712			18102014	144314	40382	201407800002	201407800002
20148011005	532021.464	8392029.926	0.162		24102014	160115	40382	201407800002	201407800107
20148011007	532109.025	8407842.740			18102014	145704	40382	201407800002	201407800002
20148011007	532109.467	8407842.329	0.196		28102014	162901	40382	201407800002	201407800107
20148012071	464610.702	8415921.065			29102014	105542	40382	201407800002	201407800102
20148012071	464610.649	8415921.523	0.089		01112014	162020	40382	201407800002	201407800102

STATION	MGA94EAST	MGA94NORTH	REPEAT_ERROR ELEVATION_M	REPEAT_ERROR GRAVITY_μm/s^2	DATE_DDMMYY	TIME_HHMMSS	METERSN	GRVBASE	GPSBASE
20148012071	464610.311	8415920.855	-0.179		02112014	064713	40382	201407800002	201407800002
20148012084	491997.197	8403517.327			29102014	130134	40382	201407800002	201407800002
20148012084	491996.853	8403517.320	0.096		31102014	062822	40382	201407800002	201407800107
20148012085	511709.817	8415683.044			29102014	131413	40382	201407800002	201407800102
20148012085	511709.471	8415683.112	0.023		31102014	150358	40382	201407800002	201407800107

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*8399.709299+4.720023434+(dcent*dcent)*4.40696e-5)
dp=(dcent*71.01800936+5.835124713-(dcent*dcent)*1.80545e-4-dcent*2.1817e-
7*(dcent*dcent)
dh=(dcent*628.3319509+4.88162792+(dcent*dcent)*5.27962e-6)
doln=(4.523588564-dcent*33.757153303+(dcent*dcent)*3.6749e-5)
dps=(dcent*0.030005264l6+4.908229461+(dcent*dcent)*7.902463e-6)
des=(0.01675104-dcent*4.18e-5-(dcent*dcent)*1.26e-7)
dsoln=(sin(doln))
dci=(0.91369-cos(doln)*0.03569)
dsi=(sqrt(1.0-(dci*dci))
dsn=(dsoln*0.08968/dsi)
dcn=(sqrt(1.0-(dsn*dsn))
dtit=(dsoln*0.39798/(dsi*cos(doln)*dcn+1.0dsoln*0.91739*dsn))
det=(atan(dtit)*2.0)
if (det<0.0)then det=det+6.2831852)

dolm1=(ds-doln+det+sin(ds-dp)*0.10979944)
dolm=(dolm1+sin((ds-dp)*2.0)*0.003767474+sin(ds-
dh*2.0+dp)*0.0154002+sin((ds-dh)*2.0)*0.00769395)
dha=((dTime*15.0-180)*0.017453292519 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 P2014078
COMM GA PROJECT NUMBER 201480
COMM CLIENT GA
COMM PROJECT AREA NORTHERN MCARTHUR BASIN GRAVITY SURVEY
COMM START DATE 16092014
COMM END DATE 14112014
COMM PROCESSED BY LR MATHEWS
COMM
COMM VESSEL HELICOPTER ROBINSON R44
COMM OPERATORS GEOSCIENCE AUSTRALIA / GA
COMM OBSERVERS DH,JF,BM,MC,CR
COMM
COMM MIN SPACING 1000m
COMM MAX SPACING 4000m
COMM LAYOUT CELL CENTRE
COMM
COMM GRAVITY STATIONS 6895
COMM
COMM GEODETIC DATUM GDA94
COMM PROJECTION MGA53
COMM HORIZ ACCURACY 0.05 m
COMM
COMM VERTICAL DATUM GRS80
COMM VERTICAL ACCURACY 0.06 m
COMM
COMM GRAVITY DATUM AAGD07
COMM GRAVITY ACCURACY 0.37 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 20148000001, 20148000002, 20148000004, 20148000101-20148100113
COMM GRV BASE 20148000001, 20148000002, 20148000004
COMM CTRL TIE STATION 1980902318, 2012999315, 1964910168
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 TCQFINNER	QUALITY FACTOR OF INNER ZONE TERRAIN CORRECTION	NONE
COMM TCOUTER267	OUTER ZONE TERRAIN CORRECTION 2.67 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