Land & Property Information

Adjustment Source ID: 234578

Carcoar DCDB Upgrade

Adjustment by: xxxxxxx, supervised by xxxxxxx

Date: 09/03/2011

File Reference:

Purpose / Background / Overview

The purpose of this adjustment is to provide survey control for the Cadastral Upgrade Unit of LPI in aid of their DCDB upgrade program in the township of Carcoar. In order to accurately upgrade the DCDB connections between survey accurate reference marks and the cadastre are needed.

Due to an abundance of mature road side trees, many permanent survey marks were unable to be used in a static GNSS survey and so reference marks directly connected to the cadastre were used instead.

Figure 1, below, depicts a survey plan analysis within the township of Carcoar. Survey marks which are connected to Deposited Plans are denoted by circles surrounding the mark symbol, with larger circles used to display marks connected to more than one DP. The figure also shows the historical composition of the registered survey plans within town. Information such as the age composition of plans available within the area of interest provide an abundance of information such as the type and location of cadastral reference marks, which can then be used in the planning of future surveys for DCDB upgrade purposes.

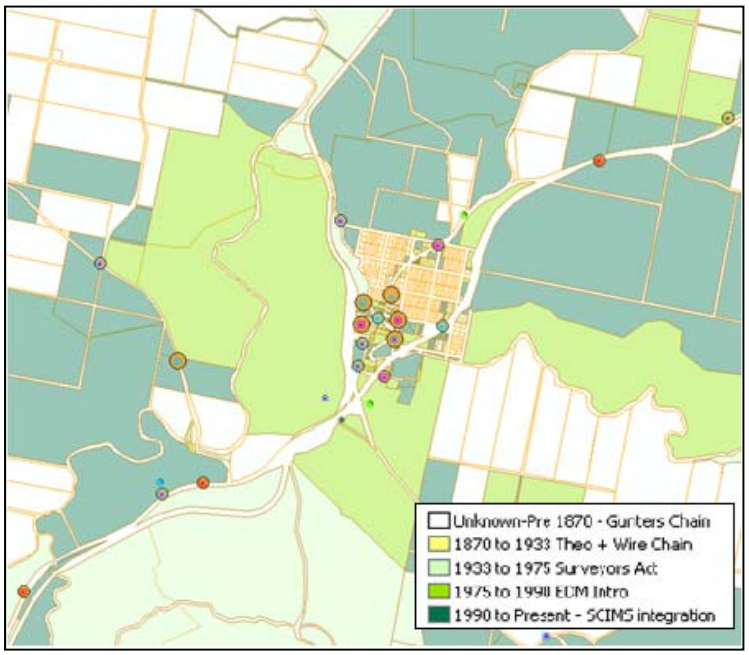

Figure 1: **Carcoar - Plan Analysis**

Fieldwork / Observations

Reconnaissance and survey fieldwork for this adjustment was performed between 21st – 23rd February 2011 by Mr xxxxxxx, Mr xxxxxxx and Mr xxxxxxx.

Figure 2: **Typical Heavy Foliage Site**

During initial reconnaissance, many permanent marks were found to be in heavy foliage and deemed unsuitable for a GNSS survey. Figure 2, taken at SS136178, depicts obstructions typically found around marks in Carcoar. In order to complete this survey, cadastral reference marks were searched for and if found conclusions were made as to the marks' suitability for GNSS survey techniques. Once the extent of the cadastral reference marks found was known, a survey methodology was designed so as best to provide control to the required accuracy. Cadastral Reference Mark numbers were also allocated for the project.

It was decided that Static GNSS would be the most suitable survey methodology. The survey was planned and observed using current static GNSS control best practices (e.g. ARP heights, double occupations, session lengths) and was designed as to provide coordinates to the specified accuracy requirements for each of the permanent marks and cadastral reference marks. The static GNSS observations were carried out using two Trimble 5700 GNSS receivers and one Trimble R7 GNSS receiver equipped with Zephyr Geodetic antennas.

In order to strengthen the orthometric heights within the network, an extra twelve GNSS baselines were sourced from adjustment 231048. Direction and distance observations between marks were sourced from Deposited Plans: DP1000547, DP1106797, DP853751, DP1043599 and DP1084365.

GNSS baselines within the adjustment range in length between 0.02 km and 11.1 km.

Processing and Adjustment Strategy

The raw GNSS observations were post-processed using the Trimble Business Centre (TBC) software (ver. 2.30, GNSS 1.4.2.1), the main options being set to use broadcast orbits, absolute IGS antenna modelling and a 10° elevation mask. The TBC project was named *'CarcoarDCBD'.*

Processing for the *'CarcoarDCBD'* project was seeded with local GDA94 coordinates and AHD71 orthometric height from **PM4190** (Horiz. A1, Vert. LCL3), which was sourced from SCIMS.

Independent baselines were processed individually as to allow the refining of the data to achieve statistically acceptable baseline results. Although some sites were not ideal and a few of the baselines were "noisy", reasonably good multi-frequency fixed solutions (high Ratios, low Reference Variances and low RMS) were obtained for all baselines within the project.

There were three horizontal point tolerances flagged within the TBC project, which is the effect of noisy baselines between PM88442, CR1687 and PM151161.

All baselines were exported in Trimble Exchange Format (*.asc). A copy of all log sheets, raw GNSS data and a copy of the TBC project were archived according to current departmental practices.

The exported observations were imported into Microsearch Geolab 2001 (ver. 2001.9.20.0) via the “StrangeLove” (v1.0, 29/05/2009) reformatting utility written by Mr xxxxxxx, which converted the observations from the XYZ format to the North, East, and Up format.

The following default GNSS observational weightings were initially applied for this adjustment, with the correlations between North/East components enabled:

- **Horizontal** 0.007 m & 0.7 ppm, 0.0015 m centring.
- **Vertical** 0.010 m & 2.0 ppm, 0.002 m centring.

A total of four orthometric height constraints were applied relative to the marks’ vertical Class according to the following rule:

- **Class LC:** 0.001 m
- **Class B:** 0.010 m

The observational weightings applied to the direction and distance observations sourced from DP1000547, DP1106797, DP853751, DP1043599 and DP1084365 were weighted as follows:

- **Directions:** 8” 0.002 m centring.
- **Distances:** 0.010 m & 15.0 ppm, 0.002 m centring.

The options used in the adjustment are reproduced below:

SUMMARY OF SELECTED OPTIONS

OPTION	SELECTION
Computation Mode	Adjustment
Maximum Iterations	5
Convergence Criterion	0.00100
Angular Misclosure Limit Factor	2.00
Linear Misclosure Limit Factor	2.00
Residual Rejection Criterion	Tau Max
Confidence Region Types	1D 2D Station Relative
Relative Confidence Regions	Connected Only
Variance Factor (VF) Known	Yes
Scale Covariance Matrix With VF	Yes
Scale Residual Variances With VF	No
Force Convergence in Max Iters	No
Distances Contribute To Heights	No
Compute Full Inverse	Yes
Optimize Band Width	Yes
Generate Initial Coordinates	Yes
Re-Transform Obs After 1st Pass	Yes
Geoid Interpolation Method	Bi-Quadratic

No scale and orientation parameters are solved for in the adjustment.

Results

Minimally Constrained Adjustment - Results

A minimally constrained adjustment of the GNSS observations was carried out by holding PM4190 fixed both horizontally and vertically. The observational weightings applied to the GNSS observations in the minimally constrained adjustment are the same as those stated above in the *Processing and Adjustment Strategy* section.

The minimally constrained adjustment returned a variance factor of 0.70 which is expected based upon the survey methodology used and the quality of the observations measured. The largest standardised residual is 3.2, which was a result of a 0.019 m residual in the Easting component of the 4.3 km baseline between PM4190 and SS2484, which represents a 4.3 ppm error in the baseline.

A determination of Class was made using the “Transaction Check” (v2.07 BETA, 9/03/2010) utility, written by Mr. xxxxxxx. All marks achieved a Class C horizontal classification and Class D vertical classification.

However, the vertical classification of all marks aside from SS107481 and SS107478 were downgraded to Class E, due to poor height constraint within the adjustment and to match the achievable Order for these marks.

Adjustment Constraints

The constrained adjustment used the same observational weightings as those in the minimally constrained adjustment.

The following eight marks were held fixed horizontally in the constrained adjustment (see Table 1):

Table 1: Horizontal Constraints – Carcoar

Mark	Easting	Northing	C	O	Source
PM4190	697021.86	6277451.87	A	1	231048
PM78191	694939.97	6289347.547	A	1	231048
SS2481	695507.446	6276530.98	A	1	231048
SS2484	700382.235	6280179.853	A	1	231048
PM80442	698366.649	6278791.823	B	2	231048
SS102039	698678.056	6278831.87	B	2	231048
SS55150	698557.693	6278346.774	B	2	231048
SS66695	699018.267	6279462.791	B	2	231048

These horizontal constraints were supplemented with four orthometric heights observations (see Table 2). Each of these vertical control marks were constrained in the adjustment according to the weighting strategy mentioned earlier.

Table 2: Vertical Constraints – Carcoar

Mark	Height	C	O	Source
PM4190	715.326	LC	L3	204224
SS2481	681.774	LC	L3	204224
SS2484	818.176	LC	L3	204224
PM78191	945.419	B	2	233225

■ Fill this box when constrained stations have been checked against the latest SCIMS search of the area that includes ecce/witness marks – all sorted by Class & Order.

Constrained Adjustment - Results

The statistical results for the final constrained adjustment are displayed below. Statistically the Chi-Square test on the variance factor PASSED with a variance factor of 1.0.

S T A T I S T I C S S U M M A R Y	
Residual Critical Value Type	Tau Max
Residual Critical Value	3.6348
Number of Flagged Residuals	1
Convergence Criterion	0.0010
Final Iteration Counter Value	2
Confidence Level Used	95.0000
Estimated Variance Factor	1.0435
Number of Degrees of Freedom	92

Chi-Square Test on the Variance Factor:

7.9716e-01 < 1.0000 < 1.4253e+00 ?

THE TEST PASSES

There is one flagged residual within the constrained adjustment, which is the result of a 0.031 m discrepancy between observed and fixed heights.

From further analysing the adjustment, in particular the point and relative error ellipses, it can be concluded that the delivered accuracy of the cadastral reference marks established is well within the required accuracy for control for DCDB upgrade.

A determination of Order was evaluated from a mathematical and measurement/reduction view point using the Transaction Check utility. All cadastral marks and a majority of permanent marks achieved an Order 3 horizontal and Order 5 vertical. SS40706, PM80443 and PM148877 achieved an Order 2 horizontal and Order 5 vertical. SS107478 and SS107481 achieved vertical Order 4.

However, each of the cadastral reference marks (CR's), as well as SS40706, PM148877 and SS107478 were downgraded to Order 4 horizontally, based upon the fact that they have been extrapolated from the fixed control. The poor physical monumentation of the cadastral reference marks and the short baselines between them also contributed to the downgrading of these marks. All other marks within this adjustment were deemed to be Order 3 horizontal; the vertical Orders were left as determined by Transaction Check.

CR1688 was allocated to a concrete block (Figure 3) which was believed to be referenced in DP833757 but has since been proven to be a random concrete block which is possibly the remains of a concrete fence post. For this reason CR1688 has been excluded from the update file and CR number 1688 will be reissued to the CR database. SS19735-1 has also been removed from the update file as it was only in the

adjustment for the purpose of transferring height through the network and was brought in from adjustment 231048 by Mr xxxxxxx.

Figure 3: **Incorrect CR Mark**

Network Design and Geometry

This network extends approximately 12 km by 5 km and covers the township of Carcoar (see Figure 4, below).

The network consists of 40 static GNSS baselines (depicted by green lines) ranging in length between 0.02 km and 11.1 km, twelve of which were sourced from 231048 along with six direction (depicted by red dashed lines) and nine distance observations (depicted by blue dashed lines). Within the network there are four horizontally and vertically constrained stations (depicted by black triangles) and four horizontally controlled stations (depicted by red squares).

The geometry of the network is deemed “fit for purpose” as a control network with the goal of coordinating cadastral reference marks for eventual DCDB upgrade.

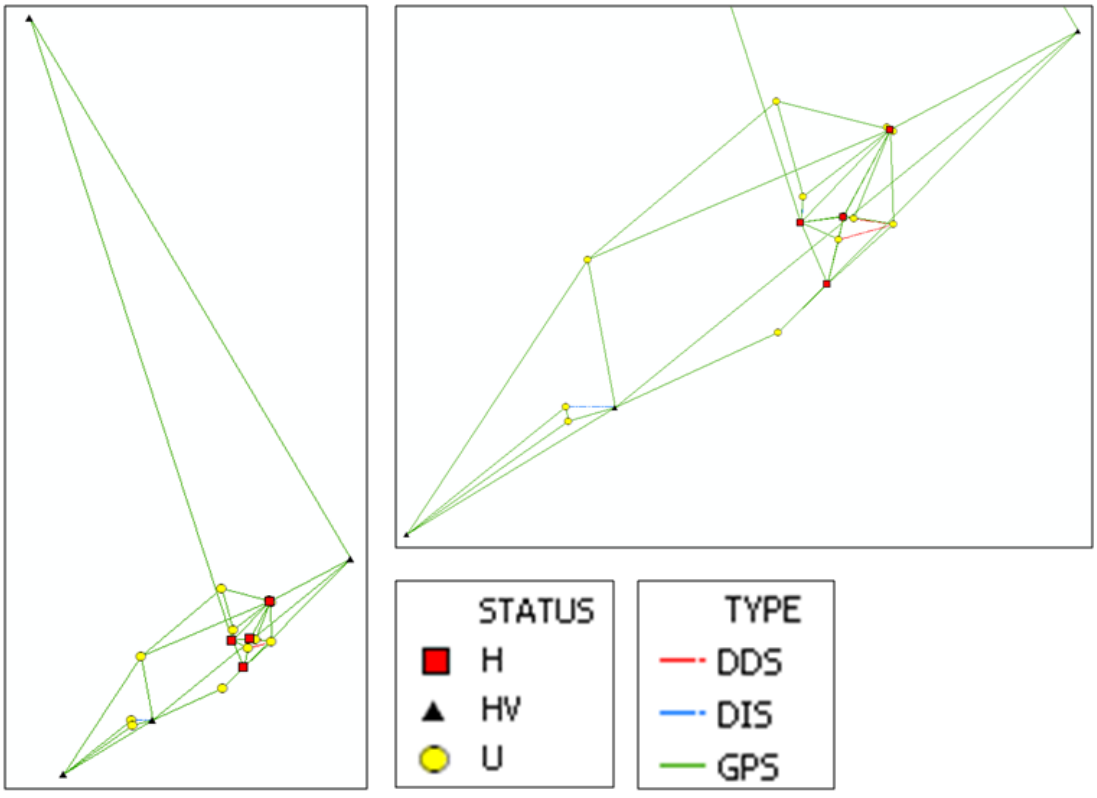

Figure 4: **234578 Carcoar Network**

Data Archive

All necessary files have been stored in the following directory:

G:\...\SIGArchive\Adjustments & Project Data\234500_234999\234578 Carcoar DCDB Upgrade\...

Recommendation

Due to heavy foliage throughout the township of Carcoar many permanent survey marks as well as cadastral marks were unable to be surveyed using static GNSS. The survey network within Carcoar would benefit greatly from more conventional surveying methodology such as traversing.

I hereby recommend that the GDA94 and AHD values for all stations as listed in the file "**234578.csv**" and in Appendix 1, be updated in SCIMS with the horizontal and vertical Class & Order specified.

Signed A. Sample

Signed 09/03/2011

LPI use only

Approved for SCIMS Update

Comments from Senior Surveyor:

Transaction #: 85988

SCIMS Updated: ***20/05/2011***

APPENDIX 1: 234578

Final GDA94/AHD71 Coordinates and CLASS/ORDER

MARK	EASTING	NORTHING	ZONE	HC	HO	HEIGHT	VC	VO
PM151161	699037.651	6278780.174	55	C	3	732.951	E	5
PM80443	698382.693	6278979.209	55	C	3	701.265	E	5
SS107481	696679.074	6277354.017	55	C	3	705.222	D	4
SS89230	698643.962	6278668.729	55	C	3	716.865	E	5
CR1687	698678.031	6278835.835	55	C	4	708.861	E	5
CR1689	699037.473	6279453.783	55	C	4	765.506	E	5
CR1690	698755.064	6278821.732	55	C	4	715.828	E	5
PM148877	698190.177	6279670.742	55	C	4	695.663	E	5
SS107478	696665.015	6277453.884	55	C	4	704.375	D	4
SS40706	696821.932	6278524.355	55	C	4	692.767	E	5

Final AHD71 CLASS/ORDER for Fixed Horizontal

MARK	HFIX	HEIGHT	VC	VO
PM80442	B2	705.186	E	5
SS102039	B2	708.926	E	5
SS55150	B2	723.354	E	5
SS66695	B2	764.895	E	5