



Spatial Services

Sydney Opera House GNSS Static GDA2020

Adjustment By:	John Surveyor
Organisation:	DCS Spatial Services
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1. Purpose / Background

The purpose of this survey is to provide GDA2020 survey control for future planned traverses at Sydney Opera House and Mts Macquarie's Chair in Sydney CBD.

The GNSS static survey has been designed and carried out to Class B standards as per the requirements set out in Surveyor-General's Direction No. 12 (SGD12) and associated documentation. The network has been designed at a 500m station density and connects into the Greater Sydney Subspine Network for primary control. The survey covers an approximate area of 7km by 4km and connects into a total of 12 SCIMS survey marks.

A supplementary Class B traverse has also been carried out to provide infill at both sites at a tighter station density. The traverse and corresponding adjustment will be detailed in a separate report, which will be submitted later pending approval of this survey.

It should be noted, during the course of this adjustment, movement was detected at SS168147. As such, additional GNSS static baselines were observed to enable its readjustment.

This report covers the 3D GDA2020 adjustment of Sydney Opera House Static survey. It is intended to update SCIMS with GDA2020 horizontal coordinates, ellipsoid heights, Class, Positional Uncertainty, and other relevant metadata as recommended at the conclusion of this report.

2. Fieldwork / Observations

GNSS static fieldwork was carried out over a period of 2 days by DCS Spatial Services staff. Initial fieldwork was carried out on the 4th of June 2020. Fieldwork specifications follow Class B standards, refer to the attached filed notes and Survey Checklist for further detail. Additional observations were carried out to Class A specifications for the readjustment of SS168147 on the 1st July 2020.

3. Equipment

Table 1: GNSS equipment details.

Designation	Receiver	Antenna	IGS14 Antenna Model Applied		Serial Number
CORS	Trimble NetR9	TRM57971.00 NONE	TRM57971.00	NONE	FTDN (TS12172)
ROVER	Leica GS15	Leica GS15	LEIGS15.R2	NONE	3233384
ROVER	Leica GS15	Leica GS15	LEIGS15.R2	NONE	3233390
ROVER	Leica GS15	Leica GS15	LEIGS15.R2	NONE	3234167
ROVER	Leica GS15	Leica GS15	LEIGS15.R2	NONE	3234406
ROVER	Leica GS15	Leica GS15	LEIGS15.R2	NONE	3234441

TS12172 Fort Denison CORS was observed with data downloaded from the CORSnet-NSW reference data shop on June 6th 2020 and July 3rd 2020.

4. Network Design and Control Strategy

The survey is designed as a triangular network geometry centred around marks MM10469-1, PM103, PM109, SS103889 and SS206367 (refer to **Figure 1** below). Baseline lengths averaged between 0.25 – 3.1km. On shorter lines (<500m), traversing infill has been conducted to meet Class B requirements – this will be covered in a supplementary adjustment and report.

The survey connects into the overarching Class A, Greater Sydney Subspine Network (GSSN) for primary control. All survey control is of an equal or better Class and contains Positional Uncertainty, satisfying the control requirements for SGD12.

As part of the replacement survey for SS168147, additional observations were measured to Class A specifications. This included triple occupying 20% of all survey marks and measuring double independent baselines to all survey marks connecting to SS168147.

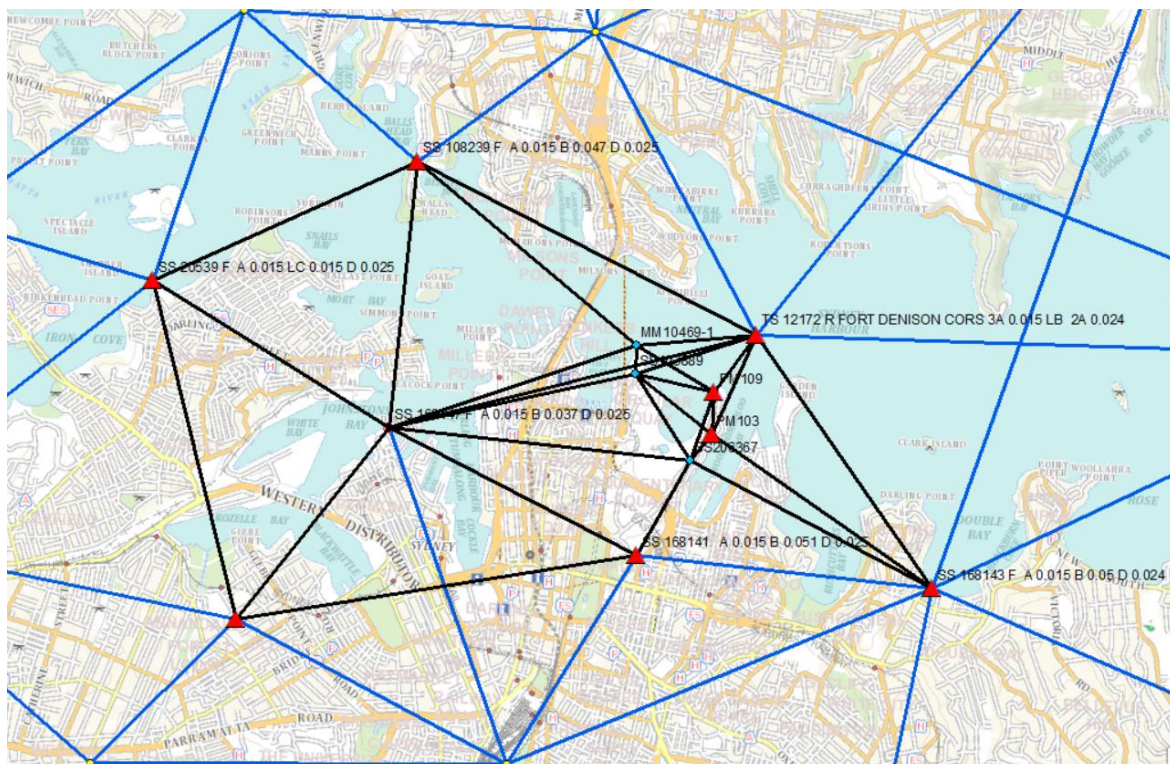


Figure 1: The GNSS static network (shown in black) with the Greater Sydney Subspine Network overlayed (shown in blue). Survey control marks (GDA2020 Hz + EHGT constraints) are shown via the red triangles, while survey marks to be adjusted are shown via the blue circles.

5. Processing and Reduction Strategy.

Software: Leica Geomatics Office (LGO)

Version: v8.4.0.0

Leica Geomatics Office (LGO) v. 8.4 was used to process baselines for this adjustment. All baselines were processed using IGS Precise Ephemeris. The processing was seeded from TS12172 using SCIMS coordinates (see **Table 2**). Baselines were manually processed on the GDA2020 ellipsoid (using AusGeoid2020) with IGS orbits and antennas. All processed baselines achieved ambiguity resolution and were 'cleaned' to remove any cycle slips and high residual satellite data. No trivial baselines were processed.

There were no issues in the GNSS static network processing attributable to the extended observation sessions, clear sky view, dual-frequency GNSS equipment and general Class B specifications adopted.

Table 2: Details of datum station for GNSS processing

Datum Station	GDA2020 Class / PU	Source
TS12172 Fort Denison CORS	3A 0.015 D 0.024	SCIMS

Table 3: Typical GNSS processing settings

Epoch Interval	10"
Elev. Mask (Processing)	15°
Session Length	2d + 10 mins (d = distance in km)
Iono Free threshold	15 km
Ionospheric Model	Automatic
Tropospheric Model	Hopfield
Orbit Type	Precise
Orbit Source	IGS
Antenna Model	Absolute IGS14
Constellation	Multi-constellation

In preparation for the least squares adjustment, baselines were exported from LGO in a custom ASCII format and were imported into Microsearch Geolab 2001 (v 2001.9.20.0) via the 'StrangeLove2020' (v 08/01/2020) reformatting utility in order to convert the X, Y, Z data in North, East and Up components.

The survey network was seeded with GDA2020 coordinates, ellipsoid heights, and uncertainty sourced from SCIMS.

6. Adjustment Strategy and Options Used

Software: Microsearch Geolab 2001

Version: 2001.9.20.0

Table 4: GNSS baseline weightings applied to overall adjustment.

Component	Constant (m)	PPM	Centering To (m)	Centering From (m)
Horizontal	0.005	0.7	0.0015	0.0015
Vertical	0.015	2.0	0.002	0.002

A 3D minimally constrained and fully constrained least squares adjustment has been run to determine Class, provisional coordinates, and Positional Uncertainty respectively.

Applied observation weightings are listed in **Table 4**. Baselines are fully correlated with the correlations between North/East/Up components enabled (i.e. 3D correlated).

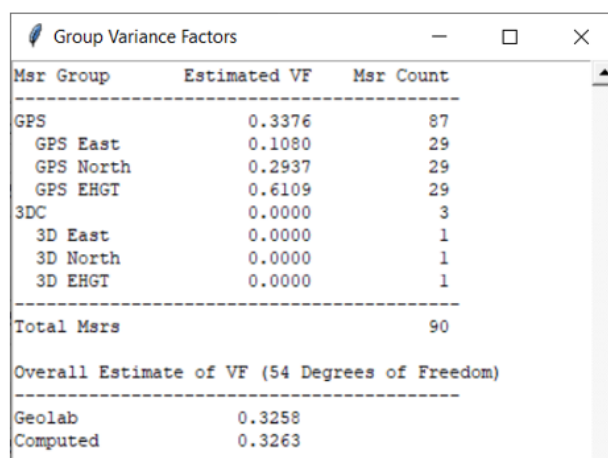
Adjustment constraints have been sourced from SCIMS and use the survey mark's corresponding GDA2020 horizontal and vertical positional uncertainty (HPU, VPU).

7. Minimally Constrained Adjustment

The intent of this survey is to award a **GDA2020 horizontal Class B** and **GDA2020 vertical (EHGT) Class D**.

A minimally constrained adjustment was run to validate the quality of the control survey and make a statistical determination of Class. **TS12172 Fort Denison CORS (3A 0.015 D 0.024)** was constrained in GDA2020 horizontal coordinates and ellipsoid height (3D) as sourced from SCIMS.

The initial variance factor (VF) from the adjustment was below one, at 0.326, which fails the Chi-Square test. The horizontal group VFs for the GNSS baselines (GPS East and North) were quite small but generally balanced, while the vertical group VF (GPS EHGT) was higher given the looser input standard deviations applied and inherent noise in GNSS baselines (see **Figure 2**).



Msr Group	Estimated VF	Msr Count
GPS	0.3376	87
GPS East	0.1080	29
GPS North	0.2937	29
GPS EHGT	0.6109	29
3DC	0.0000	3
3D East	0.0000	1
3D North	0.0000	1
3D EHGT	0.0000	1
Total Msrs		90
Overall Estimate of VF (54 Degrees of Freedom)		
Geolab	0.3258	
Computed	0.3263	

Figure 2: Minimally constrained variance factor results.

Examining the fit of the adjustment indicated a normalised distribution of residuals with all values well below the critical value of 3.4525.

The largest standardised residual occurred in the EHGT component of baseline #8 between PM109 and PM103 (0.02m residual, 0.35km baseline length, 1.933 standardised residual, 60.88ppm). The largest residual in terms of size and ppm also occurred in the EHGT component of baseline #8. This can be attributed to the inherent noise in a GNSS baseline and the relatively short length and is of no concern in this adjustment. Refer to the attached least square adjustment output files for further detail.

Overall, the variance factors and residuals indicate the network fits well together validating the quality of the observations and the adopted survey methodology. No changes have been made to the applied

observation weightings to ensure realistic least square adjustment statistics commensurate with the achievable measurement precision of the survey.

The difference between adjusted coordinates to SCIMS was computed to observe for any potential mark movement and to gain an idea of how datum behaves in the adjustment (see **Table 5**).

Table 5. Minimally constrained adjustment coordinate differences compared to SCIMS.

Survey Mark	Class & PU	GDA2020 SID	GDA2020 EHGT SID	Δ Easting	Δ Northing	Distance	Δ EHGT
PM14837	A 0.015 D 0.025	300200	300200	0.008	-0.001	0.008	-0.008
SS103889	B	300001		-0.001	-0.018	0.018	No EHGT
SS108239	A 0.016 D 0.027	300200	300200	0.003	0.001	0.003	-0.007
PM103	D 0.016 D 0.025	300200	300200	0.005	0.000	0.005	-0.006
PM109	C 0.016 D 0.024	300200	300200	0.004	-0.004	0.006	-0.010
SS168147	A 0.016 D 0.026	300200	300200	0.017	-0.023	0.029	0.018
SS168143	A 0.015 D 0.025	300200	300200	0.005	0.000	0.005	0.006
SS168141	A 0.015 D 0.025	300200	300200	0.000	-0.006	0.006	-0.013
SS20539	A 0.015 D 0.026	300200	300200	0.006	-0.006	0.008	-0.009
SS206367	U	300006		-0.752	-0.224	0.785	No EHGT
TS12172	A 0.015 D 0.024	300200	300200	0.000	0.000	0.000	0.000
MM10469-1	U	300219		0.055	0.624	0.626	No EHGT

The largest shift in established survey control occurred in SS168147 (17mm dEasting, 22mm dNorthing, 32mm dEHGT), which showed a 25mm horizontal shift well outside its current HPU of 16mm. This of concern given that SS168147 is a Class A survey mark that was planned to be used as control for this adjustment. As discussed previously, additional baselines were observed to SS168147 to Class A specifications to compensate and enable its readjustment (see **Section 8** for further details).

A statistical assessment of horizontal and vertical Class has been made. Using the calculated relative error ellipses (REE) and distance between two survey marks, a corresponding **c** value as been calculated by rearranging the Class formula ($r=c(d+0.2)$). The calculated **c** value was then checked to see what Class it meets. All REE have been converted from 2-sigma (95% CI) to 1-sigma (68% CI) as per SGD12 requirements. Class has been assessed between every survey mark in the network.

Table 6. GDA2020 horizontal and vertical Class assessment.

From	To	Major-Semi Axis		Vertical		Distance		Horizontal Class		Vertical Class	
		(95% CI)	(68% CI)	(95% CI)	(68% CI)	(m)	(km)	c	Class	c	Class
MM10469-1	SS20539	0.012	0.005	0.024	0.012	4006.832	4.007	2.3	2A	6.2	A
MM10469-1	PM14837	0.012	0.005	0.025	0.013	3988.228	3.988	2.4	2A	6.5	A
MM10469-1	SS168143	0.011	0.005	0.024	0.012	3149.53	3.150	2.5	2A	6.8	A
MM10469-1	SS108239	0.009	0.004	0.019	0.010	2347.869	2.348	2.3	2A	6.4	A
MM10469-1	SS168147	0.008	0.003	0.017	0.009	2144.218	2.144	2.1	2A	6.0	A
MM10469-1	PM103	0.009	0.004	0.020	0.010	961.781	0.962	3.8	A	10.2	B
MM10469-1	PM109	0.008	0.003	0.018	0.009	750.067	0.750	3.8	A	10.5	B
MM10469-1	SS103889	0.008	0.003	0.017	0.009	236.26	0.236	6.6	A	17.9	C
MM10469-1	SS168141	0.011	0.005	0.025	0.013	1730.727	1.731	3.5	A	9.6	B
MM10469-1	SS206367	0.009	0.004	0.019	0.010	1047.468	1.047	3.6	A	9.5	B
MM10469-1	TS12172	0.008	0.003	0.017	0.009	986.698	0.987	3.1	A	8.7	B
PM103	SS20539	0.012	0.005	0.026	0.013	4760.487	4.760	2.3	2A	6.0	A
PM103	PM14837	0.012	0.005	0.026	0.013	4192.332	4.192	2.4	2A	6.5	A

PM103	SS108239	0.010	0.004	0.022	0.011	3298.854	3.299	2.3	2A	6.2	A
PM103	SS168147	0.009	0.004	0.019	0.010	2651.794	2.652	2.2	2A	5.9	A
PM103	SS168143	0.009	0.004	0.020	0.010	2211.401	2.211	2.4	2A	6.7	A
PM103	SS168141	0.012	0.005	0.024	0.012	1167.461	1.167	4.3	A	11.5	B
PM103	SS103889	0.008	0.003	0.016	0.008	800.344	0.800	3.6	A	9.4	B
PM103	PM109	0.008	0.003	0.017	0.009	352.794	0.353	5.4	A	14.3	B
PM103	SS206367	0.008	0.003	0.016	0.008	279.16	0.279	5.9	A	15.5	C
PM103	TS12172	0.007	0.003	0.016	0.008	898.825	0.899	3.2	A	8.8	B
PM109	SS20539	0.012	0.005	0.026	0.013	4704.764	4.705	2.3	2A	6.0	A
PM109	PM14837	0.012	0.005	0.026	0.013	4355.225	4.355	2.3	2A	6.3	A
PM109	SS108239	0.010	0.004	0.022	0.011	3090.858	3.091	2.3	2A	6.3	A
PM109	SS168147	0.008	0.003	0.019	0.010	2693.144	2.693	2.1	2A	5.8	A
PM109	SS168143	0.010	0.004	0.022	0.011	2410.362	2.410	2.7	2A	7.3	A
PM109	SS103889	0.007	0.003	0.016	0.008	666.824	0.667	3.7	A	10.2	B
PM109	SS206367	0.008	0.003	0.017	0.009	601.795	0.602	4.3	A	11.1	B
PM109	TS12172	0.008	0.003	0.016	0.008	579.361	0.579	4.1	A	11.0	B
PM109	SS168141	0.012	0.005	0.025	0.013	1489.269	1.489	3.9	A	10.2	B
PM14837	SS168143	0.013	0.006	0.029	0.015	5728.916	5.729	2.3	2A	6.1	A
PM14837	TS12172	0.012	0.005	0.025	0.013	4871.254	4.871	2.1	2A	5.7	A
PM14837	SS108239	0.012	0.005	0.025	0.013	4043.976	4.044	2.4	2A	6.3	A
PM14837	SS206367	0.012	0.005	0.024	0.012	3950.273	3.950	2.4	2A	6.1	A
PM14837	SS103889	0.012	0.005	0.025	0.013	3854.323	3.854	2.4	2A	6.5	A
PM14837	SS168141	0.010	0.004	0.022	0.011	3337.005	3.337	2.2	2A	6.1	A
PM14837	SS20539	0.011	0.005	0.023	0.012	2860.903	2.861	2.7	2A	6.9	A
PM14837	SS168147	0.009	0.004	0.020	0.010	2013.536	2.014	2.7	2A	7.2	A
SS103889	SS20539	0.012	0.005	0.025	0.013	4038.312	4.038	2.3	2A	6.3	A
SS103889	SS168143	0.010	0.004	0.022	0.011	3010.287	3.010	2.4	2A	6.4	A
SS103889	SS108239	0.010	0.004	0.021	0.011	2501.274	2.501	2.5	2A	6.7	A
SS103889	SS168147	0.008	0.003	0.017	0.009	2075.157	2.075	2.2	2A	5.9	A
SS103889	TS12172	0.007	0.003	0.016	0.008	1040.016	1.040	2.9	2A	7.9	B
SS103889	SS206367	0.008	0.003	0.016	0.008	842.259	0.842	3.6	A	9.0	B
SS103889	SS168141	0.011	0.005	0.024	0.012	1494.666	1.495	3.7	A	9.8	B
SS108239	SS168143	0.012	0.005	0.025	0.013	5497.327	5.497	2.0	2A	5.5	A
SS108239	SS168141	0.012	0.005	0.025	0.013	3706.763	3.707	2.5	2A	6.7	A
SS108239	SS206367	0.010	0.004	0.021	0.011	3324.908	3.325	2.3	2A	6.0	A
SS108239	TS12172	0.009	0.004	0.019	0.010	3126.197	3.126	2.0	2A	5.4	A
SS108239	SS20539	0.011	0.004	0.022	0.011	2382.778	2.383	2.8	2A	7.3	A
SS108239	SS168147	0.008	0.003	0.018	0.009	2199.432	2.199	2.3	2A	6.1	A
SS168141	SS20539	0.012	0.005	0.026	0.013	4572.642	4.573	2.3	2A	6.2	A
SS168141	SS168147	0.009	0.004	0.020	0.010	2293.015	2.293	2.4	2A	6.7	A
SS168141	SS206367	0.011	0.004	0.021	0.011	892.109	0.892	4.6	A	11.5	B
SS168141	SS168143	0.013	0.005	0.027	0.014	2442.448	2.442	3.4	A	9.0	B
SS168141	TS12172	0.011	0.005	0.024	0.012	2061.643	2.062	3.1	A	8.4	B
SS168143	SS20539	0.014	0.006	0.029	0.015	6884.887	6.885	2.1	2A	5.6	A
SS168143	SS168147	0.011	0.004	0.023	0.012	4656.847	4.657	2.0	2A	5.4	A
SS168143	TS12172	0.009	0.004	0.020	0.010	2539.122	2.539	2.3	2A	6.5	A
SS168143	SS206367	0.010	0.004	0.020	0.010	2253.166	2.253	2.7	2A	6.9	A
SS168147	TS12172	0.008	0.003	0.016	0.008	3111.877	3.112	1.8	2A	4.8	A
SS168147	SS206367	0.008	0.003	0.017	0.009	2486.874	2.487	2.1	2A	5.4	A
SS168147	SS20539	0.010	0.004	0.020	0.010	2283.39	2.283	2.6	2A	6.8	A
SS20539	TS12172	0.011	0.005	0.024	0.012	4974.936	4.975	2.1	2A	5.5	A

SS20539	SS206367	0.012	0.005	0.025	0.013	4651.555	4.652	2.3	2A	5.8	A
SS206367	TS12172	0.008	0.003	0.017	0.009	1169.69	1.170	3.1	A	8.0	B

Based on **Table 6**, the survey predominately meets a horizontal **Class A** and vertical **Class B**. Two lines extending from PM103 and PM109 only pass for Class C vertically due to the short distances. All lines connecting to SS161847 pass for **Class A**.

Based on the statistical results above and factoring in network design, survey practices adopted, equipment / instrumentation used, reduction techniques employed; as well as other considerations such as monument quality, survey intent, and current Spatial Services business rules; the following recommendations are made:

- The control survey is overall awarded **Class B** horizontally and **Class D** vertically (EGHT).
- **SS168147** is awarded **Class A** horizontally and **Class D** vertically (EHGT).

8. Adjustment Constraints

To determine appropriate adjustment constraints, a fixed adjustment was run to observe the fit of available survey control. There are 9 potential survey marks with GDA2020 positional uncertainty connected to in the survey network that can be used as adjustment constraints (see **Section 4**). All potential survey marks have been 'fixed' by applying 0.000m standard deviations.

The initial adjustment returned an overall VF of 3.1369 with 3 flagged residuals indicating a fair amount of disagreement in survey control.

Floating SS168147, the adjustment returns a VF of 0.5102 with 0 flagged residuals. This confirms the suspected movement highlighted in the minimally constrained adjustment. SS168147 will be floated and readjusted via this adjustment.

PM103 and PM109 currently exist in SCIMS at GDA2020 horizontal Class D and C respectively and contain Positional Uncertainty. Both survey marks show good agreement and are therefore proposed to be used as constraints and upgraded in Class only at the conclusion of this adjustment. Sufficient survey control at Class B or better has been connected into the survey to satisfy SGD12 control strategy requirements.

Final GDA2020 adjustment constraints are listed in **Table 5**.

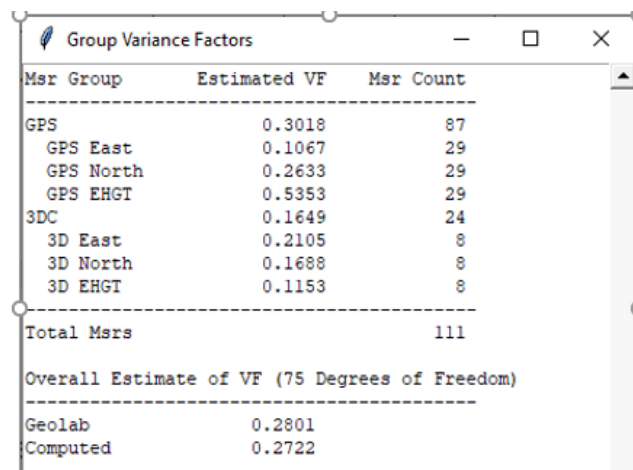
Table 5: GD2020 constraints from SCIMS applied in the fully constrained adjustment.

Mark	Class / PU	Source	Easting	Northing	Zone	Ellipsoid Height	Constrained
PM103	D 0.016 D 0.025	300200	6251657.747	335500.605	MGA 56	41.56	Yes
PM109	C 0.016 D 0.024	300200	6252010.331	335506.013	MGA 56	31.679	Yes
PM14837	A 0.015 D 0.025	300200	6249918.754	331686.272	MGA 56	50.689	Yes
SS108239	A 0.016 D 0.027	300200	6253757.707	332956.762	MGA 56	43.371	Yes
SS168141	A 0.015 D 0.025	300200	6250630.383	334946.260	MGA 56	37.777	Yes
SS168143	A 0.015 D 0.025	300200	6250501.001	337385.065	MGA 56	24.081	Yes
SS168147	A 0.016 D 0.026	300200	6251561.013	332850.811	MGA 56	25.518	No
SS20539	A 0.015 D 0.026	300200	6252653.131	330845.664	MGA 56	30.85	Yes
TS12172	A 0.015 D 0.024	300200	6252498.528	335817.881	MGA 56	27.83	Yes

9. Fully Constrained Adjustment

For the fully constrained adjustment, the constraints listed in **Table 5** have been applied using the survey mark's corresponding SCIMS GDA2020 Positional Uncertainty expressed as a standard deviation (see **Section 6**). The observations input standard deviations applied in the minimally constrained adjustment remain unchanged.

The fully constrained adjustment returns an overall VF of 0.2801 with 0 flagged residuals. The horizontal GPS group VF (GPS East and GPS North) remain balanced, and the GPS EHGT group VF remains comparatively elevated as seen in the minimally constrained adjustment. The 3D constraint group VF (3D East, North and EHGT) is balanced and small, indicating good agreement between constraints (see **Figure 3**).



Msr Group	Estimated VF	Msr Count
GPS	0.3018	87
GPS East	0.1067	29
GPS North	0.2633	29
GPS EHGT	0.5353	29
3DC	0.1649	24
3D East	0.2105	8
3D North	0.1688	8
3D EHGT	0.1153	8
Total Msrs		111
Overall Estimate of VF (75 Degrees of Freedom)		
Geolab	0.2801	
Computed	0.2722	

Figure 3: Fully constrained adjustment variance factor results.

While the VFs all fail the Chi Square test, no changes to adjustment constraints have been made to ensure they are as realistic as possible and commensurate with the achievable precision of this survey.

Similar to the minimally constrained adjustment, there were no flagged residuals within the critical value of 3.5087. All residuals follow a normalised distribution. This indicates appropriate input standard deviations and a good fit amongst survey control and observations, as further evidenced in the fully fixed adjustment.

Local Auxiliary parameters (i.e. 3 x rotations and 1 x scale factor) have not been determined in this adjustment.

The fully constrained adjusted coordinates were compared to their current SCIMS coordinates as a check for any gross errors (see **Table 7**).

Table 7: Fully constrained adjustment coordinate differences compared to SCIMS.

Survey Mark	Class & PU	GDA SID	GDA EHGT SID	Δ Easting	Δ Northing	Distance	Δ EHGT
PM14837	A 0.015 D 0.025	300200	300200	0.003	0.001	0.003	-0.001
SS103889	B	300001		-0.005	-0.016	0.017	No EHGT
SS108239	A 0.016 D 0.027	300200	300200	-0.001	0.002	0.002	-0.002
PM103	D 0.016 D 0.025	300200	300200	0.001	0.002	0.002	-0.001
PM109	C 0.016 D 0.024	300200	300200	0.000	-0.002	0.002	-0.004
SS168147	A 0.016 D 0.026	300200	300200	0.013	-0.020	0.024	0.024
SS168143	A 0.015 D 0.025	300200	300200	0.002	0.001	0.002	0.007
SS168141	A 0.015 D 0.025	300200	300200	-0.004	-0.003	0.005	-0.003

SS20539	A 0.015 D 0.026	300200	300200	0.001	-0.003	0.003	-0.001
SS206367	U	300006		-0.755	-0.222	0.787	No EHGT
TS12172	A 0.015 D 0.024	300200	300200	-0.003	0.002	0.004	0.004
MM10469-1	U	300219		0.051	0.626	0.628	No EHGT

SS168147 showed the largest horizontal mark shift of any established survey mark further confirming its movement and need for readjustment. All other constraints show minor movement within their current SCIMS GDA2020 positional uncertainty, as expected. SS103889 (B) showed a 16mm horizontal shift highlighting the strength of the underlying GDA2020 transformation parameters applied in SCIMS. No changes have been made based on the coordinate shifts seen in the fully constrained adjustment.

Analysing the calculated GDA2020 positional uncertainties in this adjustment, all survey marks proposed for upgrade achieved a HPU of less than 20mm and VPU of 30mm which is deemed fit-for-purpose.

Final recommendations are made at the conclusion of this report.

10. Recommendation

It is recommended that SCIMS is updated with the survey marks listed in **Table 8** including GDA2020 coordinates, ellipsoid height, Class and Positional Uncertainty.

Overall, it is recommended that the survey be awarded a GDA2020 **horizontal Class B** and **vertical Class D** based on the results of this adjustment.

Specifically, it is recommended that **SS168147** be **readjusted** and awarded a GDA2020 **horizontal Class A** and **vertical Class D**.

Table 8: Final adjusted GDA2020 coordinates, Class and Positional Uncertainty. Note coordinates shown with a corresponding 'F' under 'HFIX' or 'VFIX' are adjustment constraints and are not proposed for update via this survey.

MARK	HFIX	EASTING	NORTHING	ZONE	HC	HPU	VFIX	HEIGHT	VC	VPU
MM10469-1		334841.349	6252357.773	56	B	0.019		26.202	D	0.028
PM103		335500.605	6251657.747	56	B	0.016	F	41.560	D	0.025
PM109		335506.013	6252010.331	56	B	0.016	F	31.679	D	0.024
PM14837	F	331686.272	6249918.754	56	A	0.015	F	50.689	D	0.025
SS103889		334848.612	6252121.748	56	A	0.018		33.330	D	0.029
SS108239	F	332956.762	6253757.707	56	A	0.016	F	43.371	D	0.027
SS168141	F	334946.260	6250630.383	56	A	0.015	F	37.777	D	0.025
SS168143	F	337385.065	6250501.001	56	A	0.015	F	24.081	D	0.025
SS168147		332850.798	6251561.033	56	A	0.017		25.494	D	0.028
SS20539	F	330845.664	6252653.131	56	A	0.015	F	30.850	D	0.026
SS206367		335334.215	6251433.654	56	B	0.018		37.371	D	0.027
TS12172	F	335817.881	6252498.528	56	A	0.015	F	27.830	D	0.024

11. Appendix

Indicate which appendices have been attached to this report and provide relevant file names.

Yes	N/A	Appendices
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- | | | |
|-------------------------------------|--------------------------|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Appendix A:
<i>SGD12 Survey Checklist.pdf</i> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Appendix B:
<i>Photos</i> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Appendix C:
<i>Field notes, log sheets, session diagrams</i> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Appendix D:
<i>Instrument calibration certificate(s)</i> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Appendix E:
<i>Native instrument raw data files</i> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Appendix F:
<i>Spatial Services format specific raw data file(s)</i> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Appendix G:
<i>Processing / reduction files</i> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Appendix H:
<i>Network diagrams, plans</i> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Appendix I:
<i>Least squares adjustment input file(s) – minimally + fully constrained</i> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Appendix J:
<i>Least squares adjustment output file(s) – minimally + fully constrained</i> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Appendix K:
<i>Provisional coordinates, heights, Class and Positional Uncertainty</i> |
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12. Submission Statement

I, **John Surveyor**, of **DCS Spatial Services**, present the survey outlined in this report as meeting the requirements of a horizontal Class **B** and vertical Class **D** control survey as per *Surveyor-General's Direction No. 12*.

I understand that the inclusion of these results in SCIMS and their final Class and uncertainty classification is at the sole discretion of DCS Spatial Services.

A signed checklist, as per the requirements of *Surveyor-General's Direction No. 12* is attached (Appendix A).

Signed: *Include signature here*

Dated: *Include date of signature here*

End of Report

DCS Spatial Services use only

Analysis by DCS Spatial Services:

Adjustment Source ID: **xxxxxx**

Comments by DCS Spatial Services Senior Surveyor or nominated representative:

Approved for SCIMS update:

Transaction Number:

SCIMS Updated: