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A geomorphological investigation of the Klip River Wetland, south of Johannesburg

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Appendix 1

Digital Aerial Photography and LIDAR Survey Report

PROJECT SURVEY REPORT

Survey Project: **Joburg2006**

Client: **City of Johannesburg**

Project Brief:

The topographical survey was undertaken by Airborne Laser Solutions (ALS) to produce digital orthophotos with a 20cm pixel size, and 25cm contour interval for the City of Johannesburg area of responsibility.

This survey was carried out using an aircraft mounted LIDAR system that "scanned" the ground below with a 33kHz laser resulting in a dense DTM of the ground surface and objects above the ground. Digital colour images were also taken from the aircraft and rectified to produce colour orthophotos of the area. The flying height of the aircraft was 1100m above the ground level with a swathe width of approximately 700m wide.

Index:

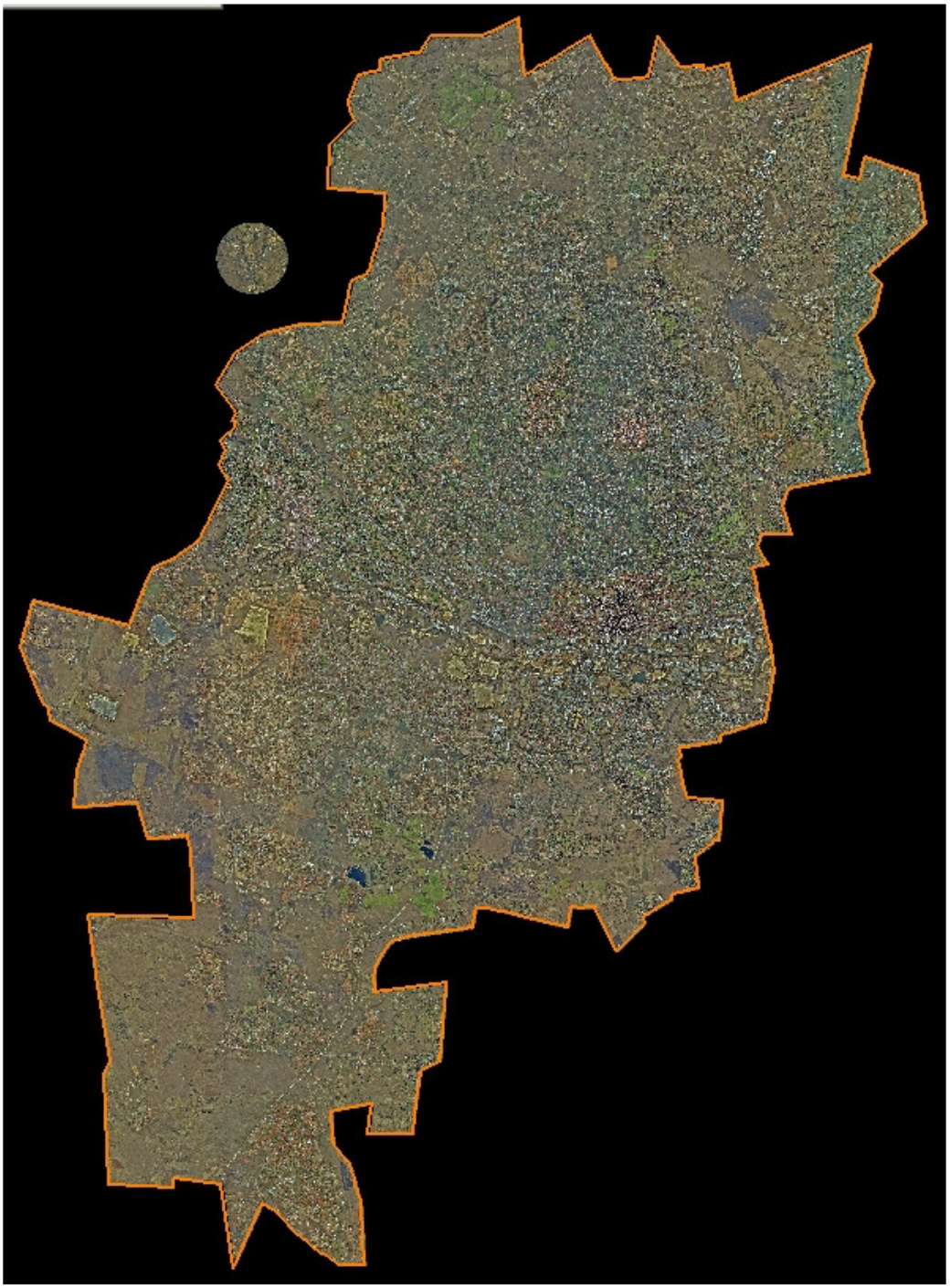
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Equipment Used:

Aircraft: Gulfstream Commander twin-engine aircraft.
Laser Scanner: Optech ALTM 3033 (33 000 laser ranges per second)
Camera: Rollei AIC with a 16 mega-pixel Phase One digital CCD.
GPS: TopCon dual frequency receivers.

Project Extent:

The following area was flown during April and May 2006:



Primary Control Beacons

The following primary control beacons were used for horizontal and vertical GPS control:

Name	Latitude South	Longitude East	Published Orthometric Height
Trig568 (Drome)	26° 14' 37.0848"	28° 09' 38.6923"	1680.4
Trig103 (Pre 95)	25° 56' 03.5130"	27° 55' 27.2144"	1376.5
Trig371 (Ver 110)	26° 17' 45.1364"	27° 49' 53.4257"	1579.2
Trig91 (Waterval)	26° 08' 44.7455"	27° 57' 58.5822"	1808.4
Pretoria Trignet	25° 43' 55.3085"	28° 16' 57.4761"	----

NOTE: ALL HEIGHTS ARE ORTHOMETRIC HEIGHTS BASED ON THE ABOVE PRIMARY CONTROL BEACONS.

Calculated Control Beacons

The following control points were calculated from the above primary control and then used as GPS ground reference stations:

Name	Latitude South	Longitude East	Ellipsoidal Height
ALS_Roof	25° 59' 14.63090"	28° 08' 21.48642"	1654.05
Block	25° 59' 31.7808"	28° 08' 27.11999"	1648.43
Cross	25° 59' 30.89862"	28° 08' 29.57632"	1649.94

Note: For a summary on the traverse and least squares network solution see Appendix 1 and Appendix 2.

Transformations:

- The published orthometric heights were converted to ellipsoidal heights, purely for the purpose of processing the survey, using the South African Quasi-Geoid model in Xform.
- The survey was calculated in WGS84 Lo29° with ellipsoidal height values.
- The ellipsoidal height values were then converted to orthometric height values using the South African Quasi-Geoid model in Xform.

Topographical Model:

Classification Process:

- Laser strikes were categorized into "ground" and "non-ground" using algorithms tailored to suit the project as a whole.
- Areas of steep terrain and heavy vegetation were identified and a refined classification adopted to remove noise in the bare earth model due to strikes on undergrowth vegetation.

- Every image tile of data was visually inspected for major classification errors, and manually edited where the automatic classification had left areas without ground strikes.
- Due to thick vegetation in certain areas the “ground” points are not very dense resulting in a higher degree of interpolation to determine the ground model.
- Ortho-rectified imagery was used to manually inspect and edit this classification process

Checkpoints and

Height Accuracy:

Checkpoints were fixed and calculated within each block based on the local Trig network.
Note: All heights are orthometric heights at ground level.

Point Name	Easting	Northing	Known Z	Laser Z	Dz
R7	-106051.58	-2899261.61	1688.16	1688.31	0.15
Block	-86022.17	-2876248.80	1622.55	1622.69	0.14
Cross	-85954.03	-2876221.20	1624.07	1624.25	0.18
FNB	-101834.86	-2901998.57	1658.97	1659.17	0.20
N1W	-104565.03	-2901402.97	1673.42	1673.57	0.15
ST0	-107050.27	-2894682.90	1693.24	1693.28	0.04
T103-1	-108093.94	-2869998.13	1352.85	1352.93	0.08
T103-2	-107791.46	-2868463.63	1350.63	1350.63	0.00
T103-3	-107001.85	-2867980.52	1314.25	1314.20	-0.05
T103-4	-105154.79	-2866253.24	1291.33	1291.30	-0.03
T103X	-107721.38	-2870070.00	1372.94	1373.09	0.15
T91X	-103255.55	-2893343.99	1802.90	1802.97	0.07
Trig101	-103211.51	-2870258.09	1401.10	1400.95	-0.15
Trig102	-111333.71	-2873745.33	1397.29	1397.15	-0.14
Trig103	-107767.78	-2869999.34	1375.30	1375.21	-0.09
Trig136	-92376.73	-2907132.54	1811.40	1811.27	-0.13
Trig183	-85709.69	-2870299.73	1574.00	1574.03	0.03
Trig186	-92347.23	-2873335.97	1542.40	1542.27	-0.13
Trig187	-82961.93	-2874195.42	1601.90	1601.94	0.04
Trig227	-124328.54	-2917203.56	1717.60	1717.54	-0.06
Trig314	-97904.27	-2913443.69	1525.69	1525.79	0.10
Trig347	-108347.24	-2918118.62	1734.30	1734.40	0.10
Trig352	-101633.20	-2910053.68	1785.59	1785.79	0.20
Trig354	-119489.63	-2917992.37	1751.04	1751.19	0.15
Trig355	-112876.52	-2919536.85	1751.58	1751.78	0.20
Trig358	-102578.16	-2911760.50	1572.64	1572.54	-0.10
Trig360	-107967.11	-2911140.65	1595.90	1595.87	-0.03
Trig361	-106054.54	-2907790.80	1716.63	1716.74	0.11
Trig369	-122177.74	-2920114.88	1764.10	1764.22	0.12
Trig370	-117533.46	-2920952.87	1664.60	1664.66	0.06
Trig371	-116697.18	-2910141.43	1574.31	1574.30	-0.01
Trig372	-119571.69	-2914844.45	1619.20	1619.26	0.06
Trig373	-116787.25	-2914898.79	1589.50	1589.35	-0.15
Trig413	-107981.25	-2906416.60	1685.40	1685.46	0.06

Trig416	-115092.77	-2891479.39	1775.27	1775.27	0.00
Trig421	-128035.01	-2900525.53	1702.37	1702.39	0.02
Trig427	-114160.00	-2888619.43	1746.95	1746.93	-0.02
Trig43	-106286.04	-2896080.10	1764.96	1764.98	0.02
Trig455	-117383.64	-2931378.87	1565.00	1565.17	0.17
Trig460	-123590.21	-2924747.08	1664.30	1664.46	0.16
Trig48	-92490.57	-2868359.65	1558.36	1558.34	-0.02
Trig538	-107720.84	-2889321.27	1659.80	1660.01	0.21
Trig541	-112281.28	-2885363.44	1540.01	1539.89	-0.12
Trig575	-106897.61	-2909216.58	1651.99	1651.98	-0.01
Trig578	-107322.33	-2885761.90	1634.05	1634.05	0.00
Trig584	-120188.09	-2897003.72	1724.50	1724.31	-0.19
Trig62	-117556.77	-2885979.08	1736.25	1736.29	0.04
Trig65	-107211.13	-2877087.49	1474.60	1474.65	0.05
Trig690	-114396.20	-2907871.57	1632.80	1632.83	0.03
Trig86	-113173.18	-2918301.32	1762.44	1762.60	0.16
Trig9	-83626.50	-2868482.32	1597.53	1597.50	-0.03
Trig91	-103369.80	-2893394.43	1807.20	1807.14	-0.06
W8	-117431.00	-2910295.19	1572.57	1572.78	0.21

Average dz	**0.033**
Minimum dz	**-0.19**
Maximum dz	**0.21**
Average magnitude	**0.093**
Root mean square	**0.113**
Std deviation	**0.109**

Orthophoto Accuracy:

The horizontal accuracy of the orthophoto tiles is within 1 pixel of resolution.

Laser-point Accuracy:

The horizontal accuracy of the laser points is within 0.25m.

Thinning of laser-point data:
Because of the shear volume of Lidar points some data thinning algorithms are applied to the data without having any affect on the data model and accuracy.

1. **ASCII Data:**
    a. **Ground Points:**
        i. Maximum point separation in XY is 10m
        ii. Model elevation tolerances:
            - Above model = 0.20m
            - Below model = 0.20m
    b. **Non-Ground Points:**
        i. Maximum point separation in XY is 10m
        ii. Model elevation tolerances:
            - Above model = 0.10m
            - Below model = 0.10m

2. **LAS Binary Data:**
    a. **Ground Points:**
        i. **NO** thinning of data.
    b. **Non-Ground Points:**
        i. **NO** thinning of data.

APPENDICES

Appendix 1:

*** TRAVERSE SOLUTION: ***

DATE(m/d/y): 5/09/06 TIME: 8:12:29

DATUM: WGS84
****
COMPUTED COORDINATES:
****

Station	Latitude	Longitude	EllHgt(m)	RefSta	Result
Cross	-25 59 30.89887	28 08 29.57698	1649.963	trig103	Good
PRETORIA	-25 43 55.30850	28 16 57.47610	1387.559	trig103	Published (Horiz.)
Trig568	-26 14 37.08480	28 09 38.69230	1707.436	trig103	Published (Horiz.)
Trig103	-25 56 03.51300	27 55 27.21440	1402.083	(-)	Published (3-D)
Trig371	-26 17 45.13640	27 49 53.42570	1606.455	(-)	Published (3-D)
Trig91	-26 08 44.74550	27 57 58.58220	1834.932	(-)	Published (3-D)

****
LOOP, CHECK & DUPLICATE TIES:
****

NAME/SESSION	TYPE	RESULT	DN (m)	DE (m)	DH (m)
POINT cross	Check	Good	-0.0077	0.0184	0.0197
Trig91 to cross	Loop	Good	-0.0133	0.0146	0.0321
POINT PRETORIA	GcpHz	Good	0.0081	0.0388	
Trig91 to PRETORIA	Loop	Good	-0.0165	-0.0305	0.0647
Cross to PRETORIA	Loop	Good	0.0046	-0.0220	-0.0068
POINT trig568	GcpHz	Good	-0.0063	0.0433	
Trig371 to trig568	Loop	Good	-0.0279	-0.0916	-0.0211
Trig91 to trig568	Loop	Good	0.0014	-0.0177	0.0325
Cross to trig568	Loop	Good	0.0083	-0.0335	0.0087
PRETORIA to trig568	Loop	Good	0.0206	0.0000	-0.0179
RMS			**0.0138**	**0.0390**	**0.0307**

*** NETWORK - WEIGHTED GPS NETWORK ADJUSTMENT ***
****

DATE(m/d/y): Tue. 5/09/06 TIME: 8:11:29

DATUM: 'WGS84'
SCALE_FACTOR: 3500.0000
CONFIDENCE LEVEL: 39.40 % (Scale factor is 1.0009)

****
INPUT CONTROL/CHECK POINTS
****

STA_ID	TYPE	-- LATITUDE --	-- LONGITUDE --	ELLHGT -	HZ-SD	V-SD
cross	CHK-3D	-25 59 30.89862	28 08 29.57632	1649.943		

PRETORIA GCP-HZ -25 43 55.30850 28 16 57.47610 0.00500
t568 GCP-HZ -26 14 37.08480 28 09 38.69230 0.00500
trig103 GCP-3D -25 56 03.51300 27 55 27.21440 1402.083 0.00500 0.00500
trig371 GCP-3D -26 17 45.13640 27 49 53.42570 1606.455 0.00500 0.00500
trig91 GCP-3D -26 08 44.74550 27 57 58.58220 1834.932 0.00500 0.00500

****
INPUT VECTORS
****

SESSION NAME VECTOR(m) ------ Covariance (m) [unscaled] ------
DX/DY/DZ standard deviations in brackets

cross to PRETORIA (1) 4174.9411 2.8414e-007 (0.0005)
18291.3174 1.4886e-007 1.4803e-007 (0.0004)
26028.7908 -9.7865e-008 -6.0046e-008 8.8160e-008 (0.0003)

cross to t568 (1) -11688.0225 3.9232e-007 (0.0006)
-4075.7986 2.7391e-007 3.2125e-007 (0.0006)
-25072.1313 -1.3804e-007 -1.2024e-007 1.4286e-007 (0.0004)

PRETORIA to t568 (1) -15862.9382 3.7759e-007 (0.0006)
-22367.1154 1.3628e-007 1.4711e-007 (0.0004)
-51100.9521 -1.2789e-007 -6.8194e-008 1.3250e-007 (0.0004)

trig103 to cross (1) -12501.4852 4.1631e-007 (0.0006)
18007.0520 3.9096e-008 3.3730e-007 (0.0006)
-5847.9392 -9.3110e-008 -4.3039e-008 8.4294e-008 (0.0003)

trig103 to PRETORIA (1) -8326.5527 8.9765e-007 (0.0009)
36298.3838 2.9901e-008 6.9151e-007 (0.0008)
20180.8660 -1.8361e-007 -8.5685e-008 1.6562e-007 (0.0004)

trig103 to t568 (1) -24189.5047 1.8353e-006 (0.0014)
13931.2661 -1.0754e-009 8.5750e-007 (0.0009)
-30920.0726 -3.6592e-007 -1.2087e-007 3.1313e-007 (0.0006)

trig371 to t568 (1) -13099.3560 1.3038e-006 (0.0011)
30291.5021 -2.7494e-008 6.6978e-007 (0.0008)
5146.3547 -2.0794e-007 -9.0600e-008 1.8387e-007 (0.0004)

trig371 to trig103 (1) 11090.1453 1.8717e-006 (0.0014)
16360.2313 2.3157e-008 8.7605e-007 (0.0009)
36066.4324 -3.8211e-007 -1.2684e-007 3.2012e-007 (0.0006)

trig91 to PRETORIA (1) 2389.8033 3.8110e-007 (0.0006)
37218.3896 1.4215e-007 1.5789e-007 (0.0004)
41424.8159 -1.3969e-007 -7.0765e-008 1.5085e-007 (0.0004)

trig91 to cross (1) -1785.0985 2.1008e-007 (0.0005)
18927.0672 1.1735e-007 1.2318e-007 (0.0004)
15396.0011 -7.3972e-008 -4.3473e-008 7.1353e-008 (0.0003)

trig91 to t568 (1) -13473.1162 3.5678e-007 (0.0006)
14851.2698 1.9369e-007 2.0706e-007 (0.0005)
-9676.1395 -1.2364e-007 -9.9580e-008 1.4289e-007 (0.0004)

trig91 to trig103 (1) 10716.3866 2.1909e-007 (0.0005)
920.0267 1.2068e-007 1.2615e-007 (0.0004)
21243.9368 -7.6923e-008 -4.4864e-008 7.4509e-008 (0.0003)

trig91 to trig371 (1) -373.7753 3.9236e-007 (0.0006)
-15440.2070 3.0050e-007 3.0510e-007 (0.0006)
-14822.4978 -1.3508e-007 -8.9206e-008 1.1005e-007 (0.0003)

****
OUTPUT VECTOR RESIDUALS (East, North, Height - Local Level)
****

SESSION NAME	-- RE -- (m)	-- RN -- (m)	-- RH -- (m)	- PPM - (km)	DIST - STD - (m)	
cross to PRETORIA (1)	-0.0009	-0.0003	-0.0195	0.608	32.1	0.0427
cross to t568 (1)	-0.0115	0.0001	0.0079	0.500	28.0	0.0547
PRETORIA to t568 (1)	0.0009	0.0174	-0.0061	0.319	58.0	0.0480
trig103 to cross (1)	-0.0173	0.0043	-0.0179	1.113	22.7	0.0542
trig103 to PRETORIA(1)	-0.0351	-0.0086	-0.0304	1.113	42.4	0.0784
trig103 to t568 (1)	-0.0386	0.0024	-0.0186	1.031	41.7	0.1026
trig371 to t568 (1)	-0.0834	-0.0250	-0.0411	2.883	33.4	0.0869
trig371 to trig103 (1)	-0.0423	-0.0297	-0.0156	1.312	41.1	0.1036
trig91 to PRETORIA (1)	-0.0275	-0.0113	0.0314	0.776	55.7	0.0491
trig91 to cross (1)	-0.0036	-0.0035	0.0113	0.507	24.5	0.0376
trig91 to t568 (1)	-0.0140	0.0029	0.0109	0.806	22.3	0.0497
trig91 to trig103 (1)	0.0035	-0.0069	0.0229	1.014	23.8	0.0383
trig91 to trig371 (1)	0.0402	0.0318	0.0517	3.400	21.4	0.0532
RMS	0.0334	0.0155	0.0255			

$ - This session is flagged as a 3-sigma outlier

****
CHECK POINT RESIDUALS (East, North, Height - Local Level)
****

STA. NAME	-- RE -- (m)	-- RN -- (m)	-- RH -- (m)
cross	-0.0000	-0.0001	0.0003
RMS	0.0000	0.0001	0.0003

****
CONTROL POINT RESIDUALS (ADJUSTMENT MADE)
****

STA. NAME	-- RE -- (m)	-- RN -- (m)	-- RH -- (m)
PRETORIA	0.0027	0.0028	
t568	0.0036	-0.0006	
trig103	-0.0012	0.0033	-0.0015
trig371	-0.0049	-0.0033	0.0001
trig91	-0.0002	-0.0022	0.0014
RMS	0.0030	0.0027	0.0012

****
OUTPUT STATION COORDINATES (LAT/LONG/HT)
****

STA_ID	-- LATITUDE --	-- LONGITUDE --	- ELLHGT -
cross	-25 59 30.89862	28 08 29.57632	1649.9432
PRETORIA	-25 43 55.30841	28 16 57.47620	1387.5273
t568	-26 14 37.08482	28 09 38.69243	1707.4154
trig103	-25 56 03.51289	27 55 27.21436	1402.0815
trig371	-26 17 45.13651	27 49 53.42552	1606.4551
trig91	-26 08 44.74557	27 57 58.58219	1834.9335

****
OUTPUT VARIANCE/COVARIANCE
****

STA_ID SE/SN/SUP --------- CX matrix (m)----------
(39.40 %) (not scaled by confidence level)
(m) (ECEF, XYZ cartesian)

cross 0.0085 3.0219e-004
0.0077 1.5636e-004 1.7279e-004
0.0210 -1.0597e-004 -6.3967e-005 9.7635e-005

PRETORIA 0.0045 3.6169e-004
0.0044 1.8360e-004 1.1882e-004
0.0235 -1.7828e-004 -9.5897e-005 1.1189e-004

t568 0.0045 3.4171e-004
0.0044 1.7718e-004 1.1776e-004
0.0230 -1.7003e-004 -9.4048e-005 1.0890e-004

trig103 0.0046 2.2654e-005
0.0043 1.1175e-006 2.1745e-005
0.0049 -1.5080e-006 -6.1435e-007 1.9215e-005

trig371 0.0046 2.2877e-005
0.0046 1.4484e-006 2.2646e-005
0.0049 -1.2197e-006 1.4279e-008 2.1221e-005

trig91 0.0041 2.0592e-005
0.0041 3.0547e-006 1.8531e-005
0.0049 -2.3186e-006 -7.5737e-007 1.7600e-005

****

VARIANCE FACTOR = 0.9721

Note: Values < 1.0 indicate statistics are pessimistic, while values > 1.0 indicate optimistic statistics. Entering this value as the network adjustment scale factor will bring variance factor to one.

****

Appendix 2:

*** TRAVERSE SOLUTION: ***

DATE(m/d/y): 5/04/06 TIME: 13:46:55

DATUM: WGS84
****
COMPUTED COORDINATES:
****

Station	Latitude	Longitude	EllHgt(m)	RefSta	Result
als_roof	-25 59 14.63088	28 08 21.48640	1654.054	cross	Good
block	-25 59 31.78129	28 08 27.12039	1648.531	als_roof	Good
cross	-25 59 30.89862	28 08 29.57632	1649.943	(-)	Published (3-D)
PRETORIA	-25 43 55.30840	28 16 57.47623	1387.547	cross	Good

****
LOOP, CHECK & DUPLICATE TIES:
****

NAME/SESSION	TYPE	RESULT	DN (m)	DE (m)	DH (m)
POINT block	Check	Good	-0.0152	0.0110	0.1017
POINT PRETORIA	Check	Good	0.0032	0.0036	
als_roof to PRETORIA	Loop	Good	-0.0065	0.0127	0.0385
block to PRETORIA	Loop	Good	-0.0049	0.0021	-0.0021
			---	---	---
RMS			**0.0088**	**0.0087**	**0.0628**
			==========	==========	==========

****
*** NETWORK - WEIGHTED GPS NETWORK ADJUSTMENT ***
****

DATE(m/d/y): Thur. 5/04/06 TIME: 13:38:14
DATUM: 'WGS84'
SCALE_FACTOR: 250.0000
CONFIDENCE LEVEL: 39.40 % (Scale factor is 1.0009)

****
INPUT CONTROL/CHECK POINTS
****

STA_ID	TYPE	-- LATITUDE --	-- LONGITUDE --	ELLHGT	HZ-SD	V-SD
block	CHK-3D	-25 59 31.78080	28 08 27.11999	1648.429		
cross	GCP-3D	-25 59 30.89862	28 08 29.57632	1649.943	0.00500	0.00500
PRETORIA	CHK-HZ	-25 43 55.30850	28 16 57.47610			

****
INPUT VECTORS
****

SESSION NAME	VECTOR(m)	------ Covariance (m) [unscaled] ------
	DX/DY/DZ	**standard deviations in brackets**
als_roof to block (1)	-282.2994	4.1655e-008 (0.0002)
	26.7607	1.3737e-008 1.4963e-008 (0.0001)

-472.1221 -1.3934e-008 -6.8579e-009 1.4414e-008 (0.0001)

als_roof to PRETORIA (1) 3872.0148 6.5873e-007 (0.0008)
18384.5130 5.0796e-007 4.8862e-007 (0.0007)
25580.4949 -2.5611e-007 -1.9755e-007 2.0894e-007 (0.0005)

block to PRETORIA (1) 4154.3407 2.8360e-007 (0.0005)
18357.7787 1.4914e-007 1.4818e-007 (0.0004)
26052.5980 -9.7716e-008 -6.0277e-008 8.8390e-008 (0.0003)

cross to als_roof (1) 302.9043 4.2624e-008 (0.0002)
-93.2220 1.3865e-008 1.5216e-008 (0.0001)
448.3184 -1.4230e-008 -6.9901e-009 1.4829e-008 (0.0001)

cross to PRETORIA (1) 4174.9411 2.8414e-007 (0.0005)
18291.3174 1.4886e-007 1.4803e-007 (0.0004)
26028.7908 -9.7865e-008 -6.0046e-008 8.8160e-008 (0.0003)

****

OUTPUT VECTOR RESIDUALS (East, North, Height - Local Level)

****

SESSION NAME	**-- RE --**	**-- RN --**	**-- RH --**	**- PPM -**	**DIST -**	**STD -**
	(m)	**(m)**	**(m)**	**(km)**	**(m)**	
als_roof to block (1)	-0.0001	-0.0001	-0.0006	1.096	0.6	0.0042
als_roof to PRETORIA(1)	0.0094	-0.0024	0.0344	1.126	31.7	0.0184
block to PRETORIA (1)	-0.0012	-0.0008	-0.0055	0.178	32.1	0.0114
cross to als_roof (1)	0.0006	-0.0007	0.0003	1.728	0.5	0.0043
cross to PRETORIA (1)	-0.0028	0.0033	-0.0038	0.180	32.1	0.0114
RMS	**0.0044**	**0.0019**	**0.0157**			

$ - This session is flagged as a 3-sigma outlier

****

CHECK POINT RESIDUALS (East, North, Height - Local Level)

****

STA. NAME	**-- RE --**	**-- RN --**	**-- RH --**
	(m)	**(m)**	**(m)**
block	0.0115	-0.0160	0.1014
PRETORIA	0.0008	0.0065	
RMS	0.0081	0.0122	0.1014

****

CONTROL POINT RESIDUALS (ADJUSTMENT MADE)

****

STA. NAME	**-- RE --**	**-- RN --**	**-- RH --**
	(m)	**(m)**	**(m)**
cross	-0.0000	0.0000	-0.0000
RMS	0.0000	0.0000	0.0000

****

OUTPUT STATION COORDINATES (LAT/LONG/HT)

****

```
STA_ID      -- LATITUDE --  -- LONGITUDE -- - ELLHGT -
als_roof   -25 59 14.63090   28 08 21.48642  1654.0541
block      -25 59 31.78132   28 08 27.12040  1648.5303
cross      -25 59 30.89862   28 08 29.57632  1649.9430
PRETORIA   -25 43 55.30829   28 16 57.47613  1387.5427

*********************************************************************
   OUTPUT VARIANCE/COVARIANCE
*********************************************************************

STA_ID      SE/SN/SUP  --------- CX matrix (m )----------
          (39.40 %)  (not scaled by confidence level)
            (m)         (ECEF, XYZ cartesian)
als_roof       0.0052  3.4620e-005
            0.0052  3.3251e-006 2.8596e-005
            0.0061  -3.2480e-006 -1.6376e-006 2.8372e-005

block          0.0054  4.3023e-005
            0.0054  6.3660e-006 3.1833e-005
            0.0070  -6.0783e-006 -3.0864e-006 3.1243e-005

cross          0.0050  2.5000e-005
            0.0050  -5.0318e-021 2.5000e-005
            0.0050  -1.7217e-020 -1.6332e-021 2.5000e-005

PRETORIA       0.0056  5.7612e-005
            0.0056  1.7955e-005 4.2814e-005
            0.0086  -1.1578e-005 -7.3213e-006 3.5653e-005


*********************************************************************
   VARIANCE FACTOR = 0.7904

   Note: Values < 1.0 indicate statistics are pessimistic, while
         values > 1.0 indicate optimistic statistics. Entering this
         value as the network adjustment scale factor will bring
         variance factor to one.
*********************************************************************
```


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