EVALUATION OF TRIMBLE POCKET PATHFINDER

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Overview

As part of the process of validating measurement equipment for use on a Transit New Zealand project, the accuracy of a Trimble Pocket Pathfinder receiver was tested. This memo outlines the results of these tests.

Benchmark Site

The benchmark site used was the LINZ Geodetic Database NZGD1949 Benchmark site in Auckland. This first order site, located on the Mount Eden summit, is defined as follows:

Geodetic code	1328
Northing	6478898.36
Easting	2667687.29
Orthometric Height	195.974
Order	1
Height order	3V
Land District	North Auckland
Name	16 MOUNT EDEN

As a first order site it is used to define the NZGD49 datum and the co-ordinates are derived from the original adjustment in 1949. The observations used meet the first order standards and can be therefore taken as the most accurate available.

Methodology

The GPS Antennae was placed on top of the mark and four recordings were made on two separate days for varying amounts of time.

The following readings were made:

1. 2/11/01 62 positions over 5mins
2. 2/11/01 30 positions over 2mins 30 secs
3. 11/11/01 232 positions over 19 mins
4. 11/11/01 221 positions over 18 mins

The data were recorded at 5 second GPS time intervals so that it corresponds exactly with the base station data which is also recorded at 5 second intervals.

The data were them differentially corrected using Trimble PathFinder Office software and base station data downloaded from the GPS Control Auckland Base station.

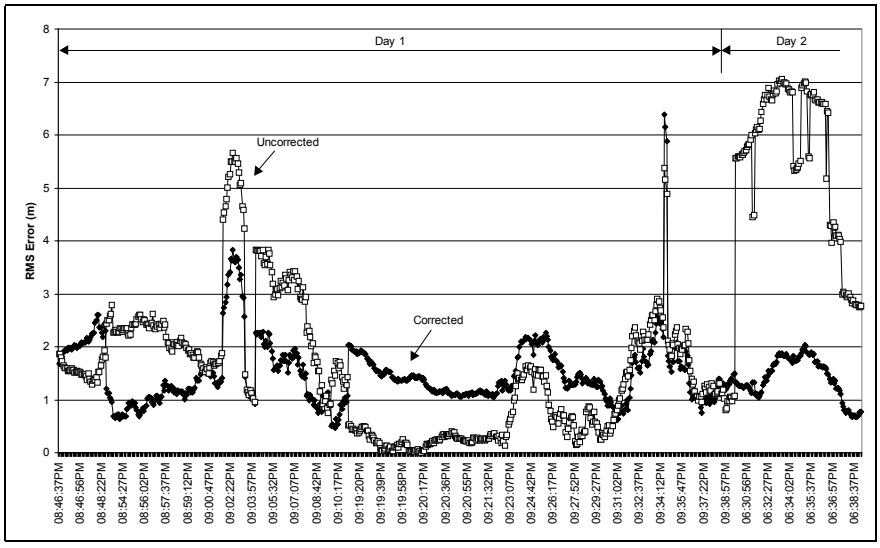
Results

The differentially corrected data consisted of a pair of NZMG co-ordinates at 1 second intervals. The RMS error was calculated as:

$$\text{ERROR} = \sqrt{(\text{BSN} - \text{N})^2 + (\text{BSE} - \text{E})^2}$$

where ERROR = RMS error in m
BSN = Benchmark Site Northing
BSE = Benchmark Site Easting
N = GPS Receiver Northing
E = GPS Receiver Easting

Four sets of readings were taken of different lengths over a two day period. The figure below shows the RMS error for the differentially corrected and uncorrected data over the two days by time of day. This shows how there were periods when the uncorrected error was as much as 7 m. Surprisingly, there were periods when the uncorrected error was less than the corrected error. This suggests that there could have been problems with multipath[1] errors on the site.



[1] Multipath errors arise when there are reflections of the signals which 'confuse' the receivers. Being a trig point, these were a real possibility at the site.

The table below gives the average errors for the differentially corrected and uncorrected data. This table includes the RMS errors in the Northing and Eastings which was calculated using a similar manner to the overall RMS error.

Length of Sample (seconds)	Average Error in m					
	Differentially Corrected			Uncorrected		
	Northing	Easting	RMS	Northing	Easting	RMS
375	0.62	1.11	1.49	1.23	1.07	1.68
223	1.11	0.80	1.53	0.90	0.74	1.23
78	0.74	1.36	1.58	6.12	1.38	6.32
34	0.43	0.92	1.05	3.51	1.30	3.79

The above results indicate the need to calculate the position by sampling over an extended period of time. The table below shows the average northing and easting from each of the samples as well as the difference between this position and the benchmark position. When differentially corrected the errors are on the order of 1 m or less and even when uncorrected samples over extended periods have errors of the same magnitude. This confirms the suitability of the receiver for meeting the accuracy requirements.

Reading	Length of Sample (seconds)	Average Northing (m)	Average Easting (m)	Northing Error (m)	Easting Error (m)
Differentially Corrected	375	6478897.93	2667688.24	0.43	0.95
	223	6478897.30	2667687.98	1.06	0.69
	78	6478897.72	2667688.65	0.64	1.36
	34	6478898.08	2667688.21	0.28	0.92
Uncorrected	375	6478897.20	2667686.26	1.16	1.03
	223	6478897.59	2667686.56	0.77	0.73
	78	6478892.24	2667688.67	6.12	1.38
	34	6478894.85	2667688.59	3.51	1.30