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GPS USE AND ARCHAEOLOGICAL SITE RECORDING

Tony Walton
Department of Conservation
Wellington

The minimum standard for recording the location of an archaeological site in the New Zealand Archaeological Site Recording Scheme is a grid reference (New Zealand Map Grid) at the 100-metre level of accuracy and precision. Many records contain more detailed information on location although not necessarily in a grid reference or co-ordinate form that can be readily manipulated in electronic databases. The Site Recording Scheme currently contains over 54,000 records and data have been captured at about the 100-yard or 100-metre order of accuracy and precision since 1958. It is not a simple task to shift to a higher minimum standard except in a piecemeal fashion.

For many purposes a higher degree of accuracy and precision in recording location is now desirable and Global Positioning System (GPS) has become a common way of providing it, particularly since the removal of selective availability in 2000. A GPS reading is not, however, a grid reference. GPS and grid references are different location formats. The two are often treated as equivalent for practical purposes and acceptable grid references can be derived from GPS readings if allowance is made for salient differences. For most purposes, however, it is better to handle them as separate data sets.

A grid reference specifies the bottom left-hand (or south-west) corner of a square within which the given point in located. A six-figure grid reference represents a 100-metre square, while an eight-figure grid reference represents a 10-metre square, and a ten-figure grid reference represents a 1-metre square. The actual location of the given point lies somewhere within the square at an imprecisely defined and perhaps uncertain point (Fernie & Gilman 2000: B.28). A site may have more than one valid grid reference and how well a 100-metre grid reference represents the location of a site depends to some extent on its size

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and shape. Extensive linear features, such as coach roads, are particularly difficult to represent with a single grid reference.

On 1:50,000 maps the smallest distance that can be conveniently distinguished is 0·5 mm, representing 25 metres on the ground, although this order of accuracy and precision is seldom achieved in practice. Recorders have sometimes quartered the 100-metre square, adding a nominal fourth figure 0 or 5 to indicate in which quarter of the square the site lay. This was sometimes done to differentiate two sites within the same 100-metre grid square. This is not a helpful practice as the figures wrongly suggest a 10-metre level of accuracy and precision.

If a grid reference represents a square within which the point lies, a GPS reading represents a point at the centre of a circle. The larger the circle the greater the probability that it actually contains the point being measured, but with lesser precision about exactly where. A Garmin 38 GPS, an older c. 1996 model, has a manufacturer's RMS (Root Square Mean) of 15 metres. This is a measure of position accuracy and is a standard error. On average, one in three readings will fall outside one standard error, one out of twenty readings will exceed two standard errors, and one out of 100 will exceed three standard errors. A circle with a radius of 45 metres (three standard errors) has a 99% chance of actually containing the measured point. In practice, two standard errors, i.e. a circle with radius of 30 metres, is usually regarded as providing a sufficient (95%) level of confidence. These uncertainties in the data cannot simply be ignored.

Most current hand-held GPS instruments, such as the Garmin 12XL, have a RMS of about 15 metres and accuracy and precision is not markedly better from instrument to instrument, although newer models contain more advanced features (http://celia.mehaffey.com/dale/tech.htm).

Extensive independent testing reported on the internet has shown that the readings are generally better than the 15 metres figure suggests and that the actual standard error is about 10 metres (see, for example, http://www.cnde.iastate.edu/staff/swormley/gps/check_sa.html or http://sparkie.nrri.umn.edu /saoff/intro.html) and new handheld units just now coming on to the market are more accurate. EPE (Estimated Position Error) is also a guide to the likely error. It is an estimate based on all the information the GPS receives, but does not include all error-producing factors.

Using a handheld GPS to define a co-ordinate to the last metre gives an impression of precision and accuracy, but this is spurious. Every reading unavoidably has a standard error of 10-15 metres. The only way to improve accuracy and precision to the 1-metre level or better is to employ survey quality GPS.

Precision and Accuracy

Precision and accuracy are not the same thing. Precision is the tightness or degree to which a measurement is refined while accuracy is the closeness of the measured point to the actual point. A six-figure grid reference may be accurate but is by current standards relatively imprecise, while an eight-figure or ten-figure grid reference may be precise but may also be inaccurate. The commonly used, handheld GPS units have a level of accuracy and precision that lies somewhere between the 100-metre and 10-metre levels of accuracy and precision so simply adding a fourth figure to the eastings and northings obscures the level of accuracy and precision actually represented.

Data capture for Central Index of New Zealand Archaeological Sites (CINZAS)

There is a change from NZGD49 to NZGD2000 to be handled but the problem for the NZAA Site Recording Scheme and for CINZAS, in particular, is that the relatively simple situation involving a single standard of accuracy and precision has become increasingly complicated. There are now numerous ways of generating co-ordinates to different degrees of accuracy and precision, including GPS and Geographic Information Systems (GIS). This affects how data can be used but there is no simple way of upgrading the existing data or allowing for all the new ways of generating co-ordinates.

GPS readings are being provided for more and more records and they are a valuable aid to re-location. They help to pinpoint a location but, as with a grid reference, they do not define the extent of a site. It is important to record the reading obtained, the receiver used, the manufacturer's RMS, any differential corrections applied, and the NZMG grid reference (read from a map and checked against the GPS reading). The EPE may also usefully be recorded. It is also important to note where the reading was taken: at or near the centre of a site, at or alongside some prominent feature, or towards the periphery of a site. If a series of readings is taken across a large site, this needs to be documented. Where possible, both GPS readings and a conventional grid reference should be provided, as in the NZAA upgrade project.

At the moment the 100-metre square grid reference standard remains in place. Any manipulation of existing data must take this standard into account.

Over recent years the NZAA Site Recording Scheme has been positioned as a general-level archaeological inventory. The data has been widely used, often with much complaint that it does not meet all needs in terms of accuracy and precision required or in the level of detail offered. The problem lies not with the Site Recording Scheme, but with the expectation that information should be provided that is directly relevant to its various uses. Developers and administrative agencies requiring more precise and accurate data need to capture that data for themselves. Nonetheless, upgrading location data is essential if the Site Recording Scheme is to remain relevant.

The level of detail held for many records will gradually improve, thereby raising the general standard. Some records will never be upgraded, and the minimum standard will necessarily remain the 100-metre level. GPS and grid references are different location formats so it is important to handle them separately, if possible. The obvious solution is to capture the GPS data, along with an indication of the likely accuracy and precision. Options for capturing additional data in CINZAS are being considered but will require additional resources.

References

Fernie, K., Gilman, P. 2000. *Informing the Future of the Past: Guidelines for SMRs*. English Heritage, Swindon.