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BUCHANAN'S TRAMWAY AND GPS: AN EXPERIMENT IN USING HAND-HELD GPS FOR SURVEYING EXTENSIVE ARCHAEOLOGICAL SITES

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Introduction

The purpose of this paper is twofold. Firstly, it is intended to examine the usefulness of hand-held CPS units in archaeological fieldwork now that the deliberate random error has been removed from the system. Secondly, this GPS technology is used to survey an abandoned bush tramway in the Longwood Forest (Figure 1).

The Longwood Range is located in Southland, thirty miles north-west of Invercargill. It stretches for about 15 miles running north-south. The Longwood trig is at a height of 2,494 feet (764 metres), and the hill slopes are generally quite moderate but broken by numerous gullies and stream courses. The vegetation cover is a mixture of virgin beech forest, regenerating cut-over forest, scrub and some plantation forest. The area has a history of extractive industry, and numerous gold mining and logging sites are to be found in the range.

Early this year Rachael Egerton (Department of Conservation, Southland) commissioned a brief survey of Buchanan's Tram, an abandoned bush tram in an area of the Longwood Range that is currently being logged under SILNA logging agreements (Petchey 2000). The reason for the archaeological survey was to determine the nature and extent of bush tram remains in the area, as the SILNA block is surrounded by DoC land, and many sites are continuous between the two areas. The timing of this contract also provided the opportunity to experiment with hand-held GPS without the error of selective availability.

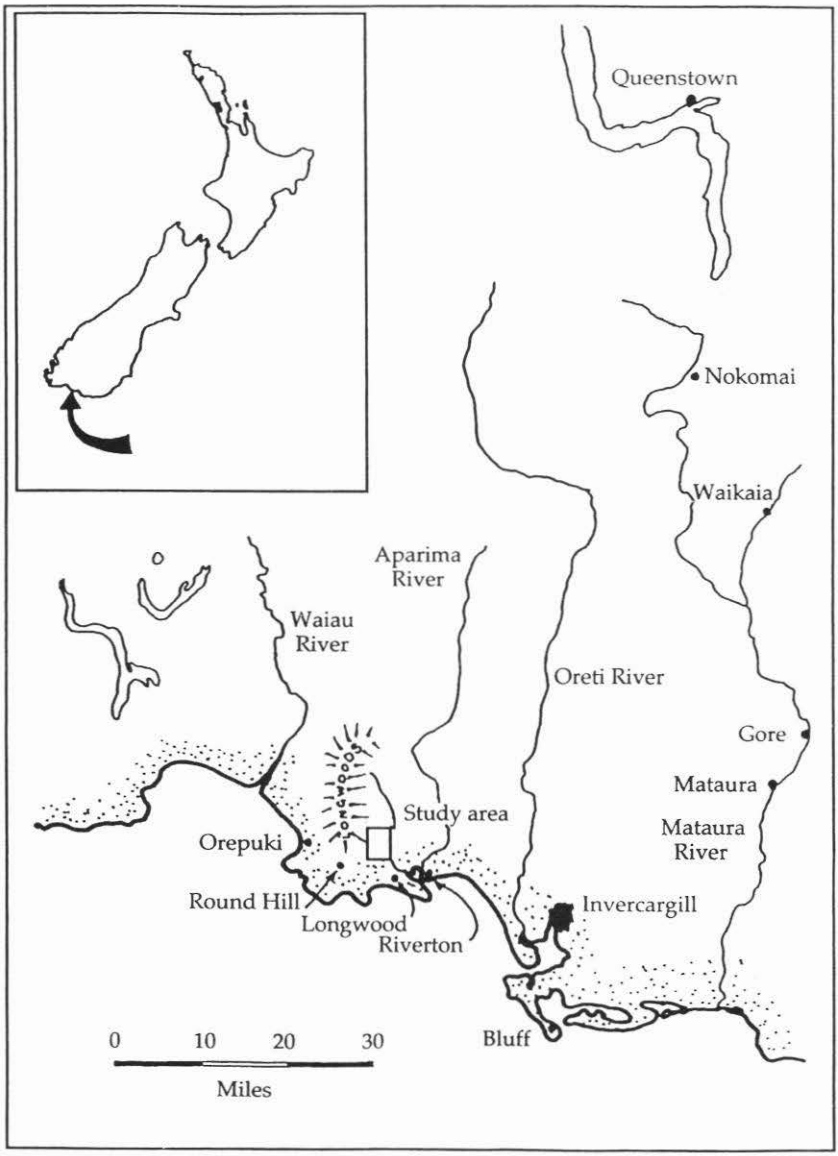

Figure 1. General location map.

GPS Surveying

Global Positioning System (GPS) is an American military satellite-based location system that has been made publically available and has become widely used. However, until May 2000 a rolling random error (termed "selective availability") was fed into the signal, effectively limiting the accuracy of uncorrected GPS units to between 100 metres and 500 metres on the ground. The use of differential GPS equipment can reduce this error considerably, and allow for extremely accurate surveying (see Frederickson *et al.* 1997). However, this equipment is expensive.

Small hand-held GPS units have been on the market for some time. These typically run off four AA batteries, and are about the size of a pocket calculator. Frederickson *et al.* (1997: 128) cautioned against the use of such units by consulting archaeologists because of the large position errors encountered. However, with the removal of selective availability, these units have suddenly become far more accurate. There are still a number of sources of error, such as atmospheric interference with the satellite signal, but the accuracy on the ground is probably somewhere between 10 to 30 metres.

Even before the removal of selective availability, hand held GPS receivers had a productive role in archaeological surveying. In 1998 and 1999 a survey of historic features in the Longwood Range, Southland, was carried out for the Department of Conservation (Petchey 1998, 1999). Features included the 24 mile long Port's water race and the site of Printz's gold mine and battery. The Longwoods are covered with regenerating beech forest, in which it is generally impossible to see more than 30 or 40 yards. Work done in the area in 1983 by Jill Hamel (Hamel 1983) relied on a combination of dead reckoning and aerial photographs for site location, which unavoidably led to some large errors. The 1998 and 1999 surveys considerably improved on the earlier work, with some site grid references being corrected by up to one kilometre.

Historical Background

The first European settlement in the Longwoods area was Captain John Howell's whaling station of the 1840s, which led to the development of the town of Riverton. The early whaling port was no doubt supplied with some locally sawn timber, although this would have been pit-sawn as no sawmill existed at this time. In 1863 Thomas Low constructed the Riverton Sawmills, and over time numerous other sawmills were established around the Longwoods (Hanger nd). At first these exploited the timber on the easily accessible flats, and later moved up the hillsides as the lower areas were cut out.

Logs were transported to the sawmills along bush tramways, which were temporary or semi-permanent railways built to fairly liberal specifications. Horses were used for motive power in the early days, with bullock teams doing the very heavy work in the bush. Later steam lokeys (locomotives) and then internal combustion rail tractors were employed on some lines, each in turn increasing the amount of work that could be done. Milled timber was transported from the sawmills by tramways either to coastal wharves for shipping or to the main line railway. Bush trams were replaced by logging roads and truck transport during the mid twentieth century, with all but one of the surviving tram systems throughout New Zealand closing during the 1960s (Mahoney 1998: 174).

As a result of the intense logging activity in the Longwoods for over a century there is a great deal of archaeological evidence to be found in the hills, although much of this is ephemeral, and is slowly disappearing. Cut stumps are to be found almost everywhere, while tram and hauler lines crisscross the bush. Hanger (nd) commented on the Round Hill area, "as can be imagined, the area was a maze of tram lines."

History of Buchanan's Tram

A sawmill on Centre Road was erected in about 1911 by Henry Moss, who had obtained some bush sections in the Longwood Range (Hamel 1983: 102; Hanger nd). Moss was a Dunedin timber merchant, and originally purchased this mill in 1905 from Alexander Cloughey& Co. who had been operating it at Mitchell's Bay, South Riverton (Hanger nd). Upon Moss' death in the early 1920s the sawmill was sold to Messrs McKay Bros. and Kenneally. During the Depression McKay and Company folded, and the mill was bought by Buchanan Bros., who ran it until about 1957 (Hamel 1983: 102; Hanger nd).

According to Mahoney (1998:184,187) the Buchanan Brothers at Longwood purchased Trails tractor number 134-1929, as well as what was either a Wilson or Melhop tractor (both were manufactured in Invercargill). Thus, from the late 1920s internal combustion rail tractors were being used to work Buchanan's Tram. After its abandonment the line continued to be used as walking access up into the Longwoods, and it is still locally known as "Buchanan's" or "Buck's" tram. Due to current logging activity, it is no longer easily passable.

The Archaeological Survey

Buchanan's Tram was surveyed over three days in May 2000. A Garmin 12 hand-held GPS receiver was used to record positions, with the data being

recorded in a notebook in the field. The metric New Zealand Map Grid is included in the software of the receiver, so locations can be transferred straight on to NZMS 260 maps. Each grid reference is given nominally to the nearest metre, although the actual accuracy of this is discussed above. Back in the office the results were initially plotted out at a scale of 1:25,000. Contour lines and public road formations were taken from NZMS 260 D46 Riverton, and their location is therefore only as accurate as the 1:50,000 base map.

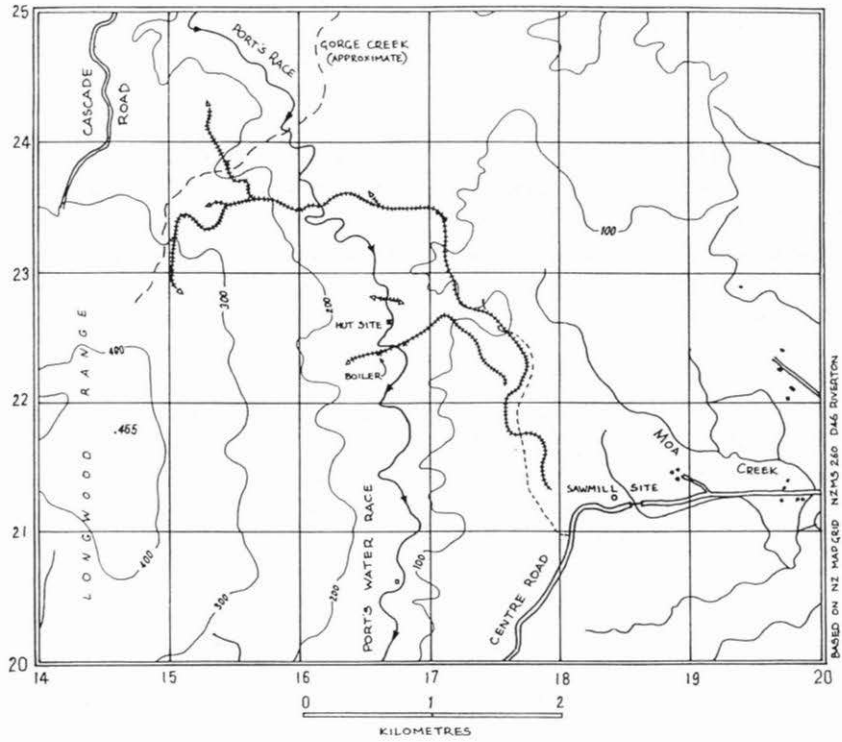

Figure 2. Reconnaissance survey of Buchanan's Tram using hand-held GPS receiver. 100 metre contours based on NZMA 260 D46 Riverton.

The survey technique was simply to walk along the tram formation, taking GPS readings every few hundred metres whenever possible. Readings and notes were taken at individual features and at the junctions of branches. The forest canopy did interfere with GPS reception, with the late mornings found to be particularly bad as few satellites were directly overhead at that time. In some instances, no readings could be made for several hours, and one branch line was followed but

not mapped. It was found that some of the tram lines had been kept clear, presumably by hunters or possum trappers.

The results of the survey are shown in Figure 2. When compared with a number of contemporary plans, the results agreed well (Figure 3). These contemporary plans are almost certainly of varying accuracy, and can only have been produced by traversing along the tram lines.

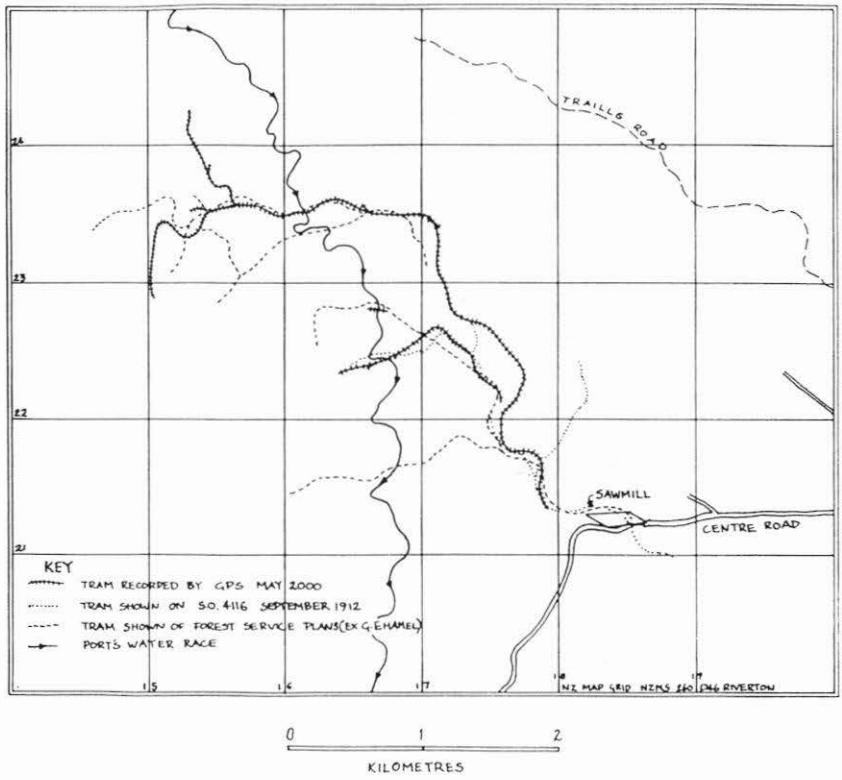

Figure 3. Overlay of GPS survey of Buchanan's Tram with contemporary plans of tram line.

Tram Extent

Buchanan's Tramway ran from the old mill site beside Centre Road roughly north-west into the Longwoods (Figure 2), and also possibly continued east to meet More's Pourakino Tram to ultimately link up with the Government

Railway at the Longwood Station (Hamel 1983: 102). Some five miles (8km) of the line and branches were mapped, with a number of other branches and spur lines being observed but not followed. Other junctions were certainly missed either in undergrowth or in cut-over areas.

Hamel in 1983 commented that "the tramline up into the bush from the mill branched three times about half a mile above the mill and all three branches climbed up above Port's water race, the northern branch being the most extensive" (Hamel 1983: 102). It is not clear whether Hamel was referring to old Forest Service maps or to information from Forest Service personnel when making this observation. The present field survey supported this layout in general, although more than three branches exist. Certainly, a number of branch lines do cross Port's Race, the northern one of which itself branched at least three times above the race (see Figure 2).

Tram Features

The line was 3 ft. gauge, constructed with wooden rails spiked down to closely set sleepers. Light iron rails were observed in a few places, such as on the outside of a couple of sharp bends. Cuttings were commonly used but embankments were not apparently employed, timber trestles being constructed instead. This appears to have been common bush tram practice (Mahoney 1991: 79). Streams were bridged in the same fashion, often a trestle over a stream gully obviously also acting as the bridge over the stream. Most of the trestles and bridges have rotted away entirely, and all have completely collapsed. The surviving features do not photograph well, as any remaining timbers are often heavily moss encrusted, and visually blend into the background.

Some very steep gradients were walked, although the grades were not measured. Mahoney has noted grades as steep as 1 in 10 that were worked by locomotive and 1 in 6 by rail tractor (Mahoney 1991: 79; 1998: 68). As discussed above, at least two rail tractors were operated on the tram. In several places it was observed that longitudinal timbers had been laid along the formation on steep grades, with the sleepers then being laid on top of these timbers. This was presumably to help create a rigid line that would not creep or sag if there was slight soil movement beneath it.

Typical archaeological features observed along the tram lines were:

Remains of wooden rails and sleepers

3 ft. gauge. The rails and sleepers were cut or split from local timber (probably beech), and do not appear to have been laid to any formal specifications. In one place where sleeper preservation was very good, sleeper spacings (centre to centre) were measured, varying between 16 and 20 inches.

Cuttings

Measured range of 8ft to 10 ft wide, and up to 6ft. deep. Typically used in places where undulating ground or shallow ridge systems were being crossed, in order to maintain an even gradient. Surprisingly common in places given the effort that would have been required to construct them.

Embankments (not common)

None seen on Buchanan's Tram, but have been observed nearby on More's Trams in the Pourakino.

Trestles and bridges (always ruinous)

Little remained of most structures for measurement or description. They appear to have been constructed using two heavy main stringers, supported below by heavy posts with the tram line laid on top.

Skid sites

Generally appear as levelled areas beside the tram line, sometimes with the remains of skid logs on the ground.

Hauler sites

Located close to the tram line, these generally appear as a levelled area, often with some log cribbing evident. Lengths of discarded wire cable are often found lying about. At one site a portable steam engine boiler has been discarded (see Plate 1).

Junctions

Locations where the tram branched.

Depressions or ditches

A number of long narrow depressions or ditches were found, often about 3 to 6 feet wide and 3 feet deep. These were not water races as they ran up and down quite steep gradients. They were interpreted as shoe or hauler lines, being the troughs gouged out by logs being pulled into a hauler site from the bush.

Discussion

Buchanan's Tram

Buchanan's Tram appears to be typical of private bush tram operations, with steep grades, wooden rails and extensive use of timber trestles to avoid the

construction of earth embankments. Numerous lines branched off the main tram to provide access to large areas of the forest. While five miles of the tram have been walked so far, there are at least another seven branches to explore, and the ultimate extent of the system is unknown. At least two rail tractors are historically known to have hauled logs on the tram from the 1920s on, while a portable steam boiler confirms archaeologically that steam log haulers were used in the bush.

Plate 1. Boiler and log shoe lying besides Buchanan's Tram, Longwood Range.

Parts of the tram are steadily being destroyed, but as it post-dates 1900, there seems little chance of a more thorough survey being carried out. Nearby tram lines operated by other companies are also threatened, including Trail's tram where the Trails Tractor was given one of its first public demonstrations (Mahoney 1998: 143). While Paul Mahoney's 1998 book provides a good overview of bush tram technology, there has been little archaeological attention paid to these systems. The Port Craig tramway viaducts have been recently restored, but the focus has been more on the specific structures than the tramway system that they were part of. Also, work has recently been carried out by DoC on the Piako County Council tramway at Wairongomai, but that

system was build to serve gold mines, and was engineered to far more permanent specifications in very steep country.

GPS Surveying

This survey has illustrated that the remains of very extensive bush tramway systems do survive in the Longwoods Forest, and that they can be effectively and accurately surveyed using easily available hand-held GPS receivers now that the selective availability in the GPS system has been switched off. Difficulties were encountered in using GPS in south-facing forest environments, with particular problems being encountered in the mid and late mornings during the fieldwork. One branch line was walked but could not be recorded, as no GPS coverage was available at the time. Despite this, the results of the three days spent in the field were more accurate and comprehensive than possible using any previous survey technique.

Specific empirical observations regarding GPS usage were:

- Now a very effective tool for site location on 1:50,000 scale maps.
- Effective for site mapping at scales down to 1:25,000. Beyond that, at least when operating at the limits of reception in forest environments, some error is to be expected.
- Therefore, a very effective tool for mapping extensive water race and bush tramway systems, or any other similar site type.
- Not so effective for mapping internal detail in smaller sites (less than 1 km square). Can be used in these situations, but possible errors must be corrected by use of aerial photographs, tape & compass, etc.
- An invaluable tool when surveying extensive archaeological sites in environments where visibility is severely limited, such as in forest or bush.

However

- All readings should be viewed critically, as occasional large errors can still be encountered, presumably when individual satellite signals are gained or lost. Gross errors will often be obvious if a little caution is practised.

Conclusions

This survey has been both enlightening and frustrating. It has shown that hand-held GPS receivers can be a very effective tool in their own right for mapping extensive archaeological sites both accurately and quickly, provided some caution is shown when interpreting the results of such surveys. Internal detail

within sites, such as workings within a discrete mining site or house terraces in settlement sites, are best still tackled by more traditional survey techniques (or differential GPS if it is available).

It was, however, frustrating to see an intact bush tramway system being destroyed piece by piece. Of the three days in the field, a fair proportion was spent in trying to relocate the tram after it had entered a cut-over area. Paul Mahoney has termed bush tramways "an unrecognised historic resource" (Mahoney 1991), which in this instance is being destroyed without record. As many similar systems post-date 1900, there is no legal protection for them, and consequently no requirement for them to be recorded prior to destruction. As an archaeological site type that largely post-dates 1900, but has completely disappeared from use in the modem world, the loss of such systems without control or recording again highlights problems with the current 1900 cut-off date.

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