

Surveys of Cnoc Coinnich, Cruach nan Capull and Cruach nam Mult

7, 8 and 9 May 2016

The Teams:

Cruach nan Capull

Surveyors – John Barnard and Graham Jackson of G&J Surveys.

Guest surveyors – C Crocker, R Cooper, M Thompson, W Robinson and P D Cottam

Cnoc Coinnich and Cruach nam Mult

Surveyors – John Barnard and Graham Jackson of G&J Surveys.

1) Introduction

These surveys were part of the continuing project with the Scottish Mountaineering Trust (SMT) to measure accurate heights for several Scottish mountains.

Cruach nan Capull (Hill Number 1432, Section 19C, OS 1:50000 Map 63, OS 1:25000 Map OL37S 362N 363S, Grid Ref. NS095795) is listed as a Graham (a hill at or above 2000ft (609.6m) with greater or equal to 150m of drop) in the Database of British and Irish Hills (DoBIH). With a map height of 611m, it is quite possible that when measured accurately, the hill could be less than the criterion height of 609.6m, since heights measured by photogrammetry have an associated uncertainty of +/-3m.

Cruach nam Mult (Hill Number 1433, Section 19C, OS 1:50000 Map 56, OS 1:25000 Map OL37N 363N, Grid Ref. NN168055) is also listed as a Graham and has a map height of 611m and similarly could be less than 2000ft if its height were measured accurately.

Cnoc Coinnich (Hill Number 1423, Section 19C, OS 1:50000 Map 56, OS 1:25000 Map OL37N 363N, Grid Ref. NN233007) is a 761m Graham. This hill is just 1m lower than the criterion height for a Corbett (762m) and therefore an accurate determination of its height could well lead to its reclassification as a Corbett.

The aim of these surveys was to resolve these uncertainties and obtain accurate heights for the summits of Cnoc Coinnich, Cruach nan Capull and Cruach nam Mult. This was achieved using a Leica NA730 surveyor's optical level and staff to determine accurate summit locations and a survey grade Leica Viva GS 15 Professional GNSS (Global Navigation Satellite System) receiver to determine accurate heights. The data sets collected were submitted to Ordnance Survey for verification. The results of the surveys will lead to their heights being included on Ordnance Survey mapping and enable the SMC and others to provide the officially recognised heights in their future publications.

2) Equipment used and Conditions for Survey

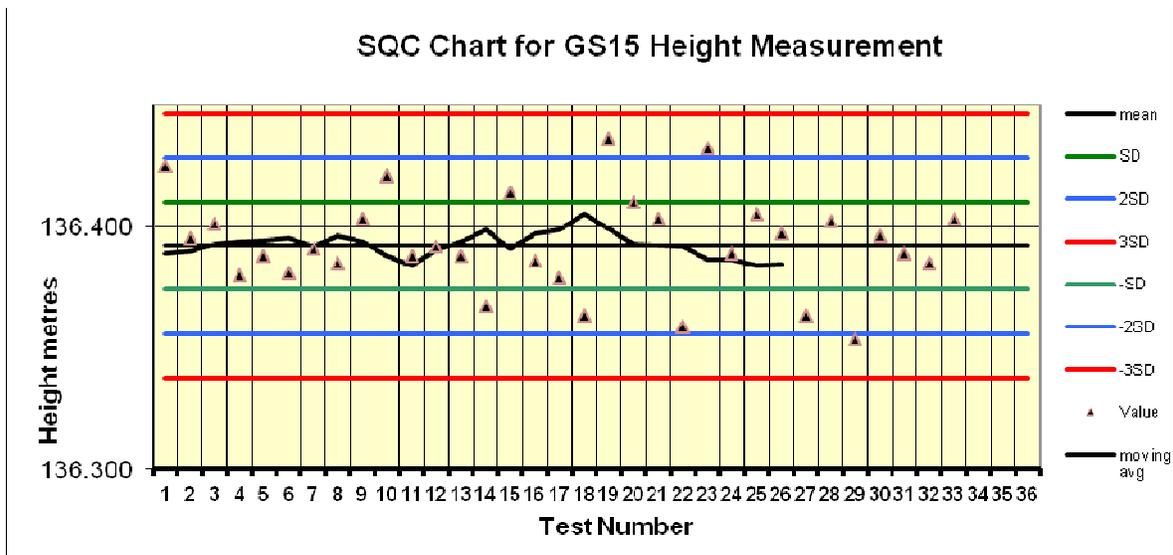
The summit positions were identified using a Leica NA730 Professional Automatic level (X30 telescopic system)/tripod system and a "1m" E-staff extendable to 5m as required by Ordnance Survey.

Absolute heights were measured using a Leica Geosystems Viva GS15 Professional receiver. This instrument is dual-frequency and multi-channel, which means it is capable of locking on to a maximum of 12 GPS and 8 GLONASS satellites as availability dictates, and receives two signals (at different frequencies) from each of these satellites. The latter feature reduces inaccuracies that result from atmospheric degradation of the satellite signals. As a stand-alone instrument it is

capable of giving position and height to an accuracy of about two metres and five metres respectively. Despite the on-board features of the Viva GS15 receiver, there are still sources that create residual errors. To obtain accurate positions ($\pm 0.01\text{m}$) and heights ($\pm 0.05\text{m}$), corrections were made to the GNSS (Global Navigation Satellite System) data via imported RINEX data from Ordnance Survey and this dataset was post-processed using Leica Geo Office 8.3 software. Confirmation of heights was carried out by Mark Greaves, Geodetic Analyst of Ordnance Survey.

Note that small hand-held GPS receivers used for general navigation can only receive up to 12 GPS satellites and each at a single frequency and therefore these instruments have a poorer positional accuracy of $\pm 5\text{metres}$ and a height accuracy of no better than $\pm 10\text{ metres}$. Some recently produced hand held GPS Garmin receivers can also receive signals from GLONASS satellites which greatly improve the speed at which these units can achieve a satellite “fix”.

The Leica NA730 level is routinely checked to make sure that the line of sight is correct when the instrument is set up horizontally; there is a standard surveying method to do this described in the users’ manual for these instruments. We also regularly check the functioning of the Leica Viva GS15 GNSS receiver against Statistical Quality Control (SQC) charts generated for a marked position. The chart associated with height measurement is shown below. The mean height above ODN (Ordnance Datum Newlyn) for a fixed point (measured on 20 different occasions for 30mins of data collection at each time) was calculated to be 136.392m. Further height measurements have been made on separate occasions over a period of 18 months using the same process parameters. The penultimate and last measurements were carried out before and after the surveys described in this report. The results shown on the graph are all within a range of \pm three SD (Standard Deviation), in this case one SD is $\pm 0.018\text{m}$ and the moving average is within 1SD. This demonstrates that our Leica Viva GS15 GNSS receiver is giving consistently precise results within the expected errors for the measurements (all points are within a range of 0.07m of one another).



In addition, we check the instrument periodically by taking measurements on an Ordnance Survey Fundamental Bench Mark, processing the data and comparing it with the OS derived values. Height should agree within about 0.02-0.03m.

Checks were carried out on 24 April 2016 and 17 May 2016 at the Daresbury Fundamental Bench Mark and the results in the table below show excellent agreement between the Ordnance Survey measurement and our own.

Processing	Date	Height(m)
OS measurement		73.24
JB/GVJ GeoOffice 8.3	24-04-2016	73.23
JB/GVJ GeoOffice 8.3	17-05-2016	73.22

Conditions for the survey of Cnoc Coinnich which took place between 10.00hrs and 13.00hrs GMT on 8 May, were fair. The temperature was about 10 degrees Celsius on the summit with a wind speed of 25mph gusting to 35mph. On the ascent there was a brief shower of rain, but by the conclusion of the survey it was sunny and warm with temperatures of 21 degrees Celsius at Lochgoilhead. Visibility was poor at first due to low cloud but this soon cleared and enabled us to confirm the summit position with the level and staff.

Conditions for the survey of Cruach nan Capull which took place on 7 May between 10.00 hrs and 13.00hrs GMT were fair. The temperature was 10 degrees Celsius, although a strong breeze of 25mph gusting frequently to 45mph made it feel much colder. It was also overcast, so once the summit position had been determined with level and staff and data collection had begun, shelter from the wind was a priority. The cloud base was well above 600m for the whole of the survey.

Conditions for the survey of Cruach nam Mult were, by contrast, very different. This took place on 9 May between 08.00hrs GMT and 11.00hrs GMT. The weather was sunny and 15 degrees Celsius in the early morning, but the temperature was tempered by a breeze of 15mph gusting to 25mph. However, during the morning the temperature rose and by the time the survey was completed it was 20 degrees Celsius.

3) **Character of the Hills**

Cnoc Coinnich lies about 4km to the East of Lochgoilhead. The village is reached by single track but good roads either from the A815 Dunoon road taking the B839 via Hell's Glen or via the A83 from Arrochar and taking the B828 at the Rest and be Thankful. From the village car park (free of charge) we followed the Cowal Way which soon enters forestry above Donich Water and eventually crosses a tributary burn via a bridge. From here the Cowal Way takes the right fork in the path and after a further $\frac{3}{4}$ km turns sharp right through a wide break in the trees rising 150m before leaving the trees. Although becoming indistinct at this point, white posts lead the way to 500m, where the path is left to follow the NW ridge of Cnoc Coinnich to its sharp summit. A cairn perched on the edge of a crag marks the highest point, although a rocky area a further 50m South appears to be as high. The hill falls quite steeply on its East side and affords good views of Loch Long with Loch Lomond just glimpsed beyond Tarbet and Ben Lomond rising behind. Indeed Cnoc Coinnich may be ascended via the Cowal Way from Loch Long.

Cruach nan Capull lies about 8km WNW of Dunoon and is reached from the B836 where there is a pull-in for three or four cars at NS099822 400m further West along the road from the entrance to Corrachave farm. We followed the route given in the SMC guide 'The Grahams & the Donalds'. The road to the farm bifurcates and the left fork is taken and the forest track then followed, after fording a wide stream, for 1.5km to a tiny, but obvious, cairn at NS 09724 80825 (Garmin users). Here a wide grassy track turns back into the trees and zigzags its way in a southerly direction to 350m, whereupon it turns North and leaves the trees at NS 09472 80415 (Garmin users) at a height of 380m. On our visit red and white plastic tape had been tied to the trees just here, to guide people descending the hill to the start of the path. Nearby are two large light-coloured stones on a low dyke. It is useful to record a grid reference just here to ensure the start of the path is readily found on the descent. After leaving the forest we followed the steep NW ridge of Cruach nan Capull to its

summit, which affords extensive views in all directions. The summit area itself is rather flat and featureless with a cairn and several embedded rocks in the summit area. There is also a knoll 50m NNW which vies for summit position.

Cruach nam Mult appears to be defended by steep crags in Hell's Glen and forestry in all other directions. Again we followed the route given in the SMC guide, parking at a wide pull-in at the summit of the road through Hell's Glen. This is also the starting point for Stob an Eas. The forest road is followed SW for over 1km to its conclusion at a stream. Note that the forestry to the North has now been cut down. By turning left into the trees a faint but obvious path is found and followed up hill, first bearing SE then South, then SE again. There are two tiny cairns en route to aid walkers. One is at NN15933 06236 (Garmin users) and the other at NN 16014 06046 (Garmin users), the latter being where the path exits the trees. Note these grid references have been taken in thick forestry and so are probably only useful to four digits in easting and in northing. It should also be noted that a tree has fallen over the path at one point, although the path's continuation can be seen beyond. Once out of the forest grassy and heathery slopes are easily followed to the summit which comprises two knolls 90m apart with an obviously lower one in between. From the summit there are fine views to Stob an Eas and Beinn an Lochain to the NE, Beinn Bheula to the South and Inveraray with Ben Cruachan in the distance to the NW.

4) Survey of Cnoc Coinnich

The first task for the survey was to identify the highest point using the Leica NA730 automatic level and staff. The initial staff measurements showed the highest ground to be between the edge of the crag and the cairn. However, the ground here appeared to rise as it went under the cairn and so the summit cairn was partly dismantled in this area to search for higher ground. Further staff measurements showed the ground to rise at first under the cairn but then drop away the further the cairn was dismantled. A staff reading was then recorded for the highest point and on the outcrop 40m South. Once the survey had been completed, the cairn was carefully rebuilt.

Staff readings for these positions were:-

Edge of crag by cairn = 0.403m

Outcrop 40m South = 1.640m

Therefore the edge of the crag is $1.640 - 0.403 = 1.237\text{m}$ higher than the outcrop to the South

Next the Leica GS15 was set up on a tripod on the summit at the edge of the crag. The height of the receiver above the ground was then measured with the integral tape. The vertical offset from measuring point to the ground was 0.414m (see photograph in Appendix) plus 0.255m for the tribrach/hook system. GNSS data were collected for 2hr with an epoch time of 15 seconds.

4.1) Results for Cnoc Coinnich

The data for the Leica Viva GS15 were processed using Leica GeoOffice 8.3 using the seven nearest base stations: (Lochgilphead - LOCG 40km, Killin - KILN 47km, Glasgow - GLAS 49km, Oban - OBAN 49km, Drumalbin - DRUM 92km, Campbeltown - CAML 94km and Edinburgh - EDIN 100km). We used Broadcast Ephemeris data received by the GPS during the survey rather than Precise Ephemeris data, since we have found this makes little difference to the height results. The computed Tropospheric model was chosen for the calculations to suit the data collection times and the wide difference in height between the base stations and the summit of the mountain. The total vertical offset used was 0.255m (standard for short tripod assembly) plus 0.414m, for the height above the survey point as measured by the tape. This gives a total vertical offset of 0.669m which was used within the GeoOffice 8.3 processing parameters.

As far as is possible, the base stations are evenly distributed around the survey point and heights measured from each base station were within +/-0.05m of the mean result for the summit of Cnoc Coinnich.

The results for Cnoc Coinnich are tabulated below:

Processing	Feature	Easting	Northing	Height(m)
Leica GeoOffice 8.3	Rock under cairn	223351.154	700754.781	763.506

The data for the summit of Cnoc Coinnich recorded by hand-held Garmin GNSS receivers were:-

Garmin Oregon 450	NN 23355 00747	Accuracy: averaged	Height = 770m
Garmin Montana 600	NN 23354 00747	Accuracy: averaged	Height = 760m
Garmin Etrex 20	NN 23353 00748	Accuracy: averaged	Height = 766m

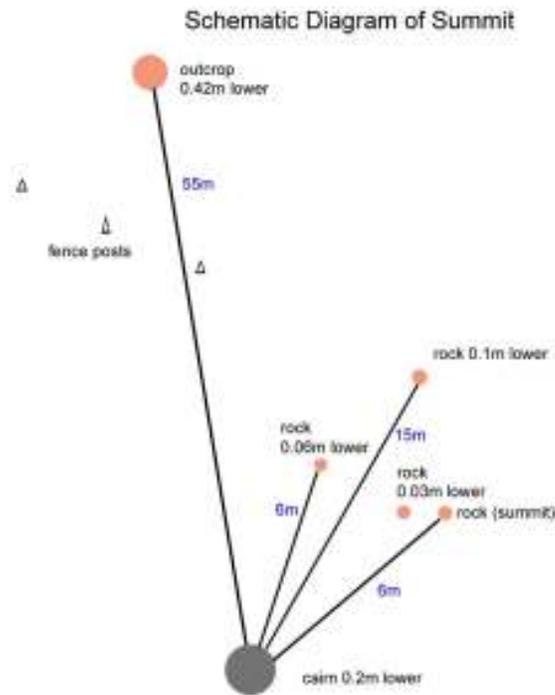
The data for the outcrop 40m S of the summit recorded by hand-held Garmin GNSS receivers were:

Garmin Oregon 450	NN 23365 00704	Accuracy: averaged	Height = 768m
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The height of Cnoc Coinnich is 763.51m

5) Survey of Cruach nan Capull

A diagram of the summit area of Cruach nan Capull is shown below (North to top). A photograph



of this area with the Leica GS15 set up over the summit position is also shown in Appendix 2. The Leica NA730 level was set up at a convenient position near to the cairn and staff readings were taken for all the features of interest. A rock about 6m NE of the cairn was identified as the highest point and the heights of other features relative to it are shown in the diagram. Note there are several embedded rocks NE of the cairn that are very close in height all being 0.1m-0.2m higher than the ground at the cairn. The outcrop 55m North of the cairn is 0.42m lower than the summit; to the unaided eye it appeared to be at least as high as the summit.

Next the tripod was set-up over the summit position and the Leica Viva GS15 was then fixed to it with a clamp and tribrach (the “short tripod” configuration). The height of the receiver above the ground was then measured with the integral tape. The vertical offset from measuring point to the ground was 0.376m (see photograph in Appendix 2) plus 0.255m for the tribrach/hook system. GNSS data were collected for 2hr with an epoch time of 15 seconds.

5.1) Results for Cruach nan Capull

The data for the Leica Viva GS15 were processed using Leica GeoOffice 8.3 using the seven nearest base stations: (Lochgilthead – LOCG 24km, Glasgow – GLAS 50km, Oban– OBAN 59km, Campbletown – CAML 69km, Killin – KILN 71km, Girvan – GIRA 82km and Drumalbin – DRUM 91km). We used Broadcast Ephemeris data received by the GNSS receiver during the survey rather than Precise Ephemeris data, since we have found this makes little difference to the height results. The computed Tropospheric model was chosen for the calculations to suit the data collection times and the wide difference in height between the base stations and the summit of the mountain.

As far as is possible, the base stations are evenly distributed around the survey points and heights measured from each base station were within +/-0.07m of the mean result for the summit of Cruach nan Capull.

The results for Cruach nan Capull are tabulated below:

Hill	Feature	Easting	Northing	Height(m)
Cruach nan Capull	Embedded rock	209581.184	679550.245	611.968

The data for the summit of Cruach nan Capull recorded by hand-held Garmin GNSS receivers was:-

Garmin Montana 600	NS 09588 79544	Accuracy: averaged	Height = 609m
Garmin Etrex 20	NS 09588 79543	Accuracy: averaged	Height = 612m
Garmin Oregon 450	NS 09585 79544	Accuracy: averaged	Height = 620m

The data for the outcrop 55m North of the summit recorded by hand-held Garmin GNSS receivers was:-

Garmin Oregon 450	NS 09562 79589	Accuracy: averaged	Height = 615m
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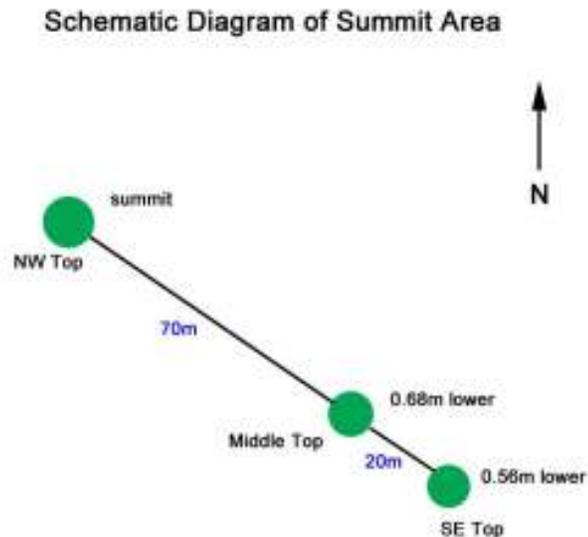
The data for the cairn recorded by hand-held Garmin GNSS receivers was:-

Garmin Oregon 450	NS 09583 79538	Accuracy: averaged	Height = 613m
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The height of Cruach nan Capull is 611.97m.

6) Survey of Cruach nam Mult

A diagram of the summit area of Cruach nam Mult is shown below:



The Leica NA730 was set up at a convenient position on the NW top and staff readings were taken of each top. The results are shown in the diagram. The OS 1:10k map shows a 611m spot height on the SE top and just a tiny 610m ring contour on the NW top suggesting the former to be the summit. In fact the SE top is 0.56m lower than the NW top, while the middle top is 0.68m lower. All three tops have no feature on their highest points which comprise rough grass.

Next the tripod was set-up over the summit position and the Leica Viva GS15 was then fixed to it with a clamp and tribrach (the “short tripod” configuration). The height of the receiver above the ground was then measured with the integral tape. The vertical offset from measuring point to the ground was 0.591m (see photograph in Appendix 2) plus 0.255m for the tribrach/hook system. GNSS data were collected for 2hr with an epoch time of 15 seconds.

6.1) Results for Cruach nam Mult

The data for the Leica Viva GS15 were processed using Leica GeoOffice 8.3 using the seven nearest base stations: (Lochgilphead – LOCG 36km, Oban– OBAN 40km, Killin – KILN 49km, Glasgow – GLAS 57km, Campbletown – CAML 95km, Arisaig - ARIS 96km and Drumalbin – DRUM 100km). We used Broadcast Ephemeris data received by the GNSS receiver during the survey rather than Precise Ephemeris data, since we have found this makes little difference to the height results. The computed Tropospheric model was chosen for the calculations to suit the data collection times and the wide difference in height between the base stations and the summit of the mountain.

As far as is possible, the base stations are evenly distributed around the survey points and heights measured from each base station were within +/-0.04m of the mean result for the summit of Cruach nam Mult.

The results for Cruach nam Mult are tabulated below:

Hill	Feature	Easting	Northing	Height(m)
Cruach nam Mult	No feature	216817.916	705639.607	611.222

The data for the summit of Cruach nam Mult recorded by hand-held Garmin GNSS receivers was:-

Garmin Oregon 450	NN 16824 05633	Accuracy: averaged	Height = 614m
Garmin Montana 600	NN 16823 05633	Accuracy: averaged	Height = 611m
Garmin Etrex 20	NN 16824 05635	Accuracy: averaged	Height = 612m

The data for the SE summit recorded by hand-held Garmin GNSS receivers was:-

Garmin Oregon 450	NN 16898 05584	Accuracy: averaged	Height = 613m
Garmin Montana 600	NN 16900 05585	Accuracy: averaged	Height = 612m
Garmin Etrex 20	NN 16899 05585	Accuracy: averaged	Height = 609m

The data for the middle summit recorded by hand-held Garmin GNSS receivers was:-

Garmin Oregon 450	NN 16879 05593	Accuracy: averaged	Height = 612m
Garmin Montana 600	NN 16880 05596	Accuracy: averaged	Height = 609m
Garmin Etrex 20	NN 16879 05595	Accuracy: averaged	Height = 611m

The height of Cruach nam Mult is 611.25m and this is the NW top.

7) Summary of Operating Conditions

Variable	GS15 on Cnoc Coinnich	GS15 on Cruach nan Capull	GS15 on Cruach nam Mult
Data collection summit (min)	121	126	123
Number of Base Stations used in Processing for all points	7	7	7
Epoch Time (sec)	15	15	15
Tropospheric Model	Computed	Computed	Computed
Cut off Angle (degs)	15	15	15

8) Discussion of Results

The summit positions of Cnoc Coinnich and Cruach nan Capull were on rock and consequently the height uncertainty associated with locating these positions was estimated to be no more than +/- 0.01m. That for Cruach nam Mult, which was short grass, was no more than 0.02m. The height uncertainty associated with the GNSS measurement from a 2hr dataset has been measured by us and is +/-0.05m for data processed in propriety software. The measurement uncertainty for the heights of each summit is therefore: $(0.05^2 + 0.01^2)^{0.5} = 0.05\text{m}$ (Cnoc Coinnich and Cruach nan Capull) and for Cruach nam Mult $(0.05^2 + 0.02^2)^{0.5} = 0.05\text{m}$.

9) Coordinate Recovery Analysis

In order to verify the accuracy and consistency of a GNSS dataset, Ordnance Survey recommends a procedure called Coordinate Recovery Analysis. Instead of processing the data with reference to all the nearest OS Base Stations under approximately 100km distance, as used in this report, the data is first processed with reference to only the nearest Base Station. The data is then reprocessed with the survey point taken as a Reference Point and all the remaining Base stations taken as survey points. These measured values for the OS Base Stations can then be compared directly with the actual OS values for Position and Height. (This has been carried out via an Excel Spreadsheet supplied to us by OS).

Although the spreadsheet calculates a number of different parameters, two important ones are presented in the tables below. “Height Difference **U** metres” is the vertical height difference between the heights of the Base Station as measured in this survey compared with the actual OS value. “Separation **D_{ij}** metres” is the distance in 3-d space between the measured and actual OS values for each Base Station.

The results for the three surveys are presented below.

Cnoc Coinnich:-

Base Station	Code	Distance to Survey Point km.	Height Difference U metres	Separation D_{ij} metres
Lochgilphead	LOCG	40		
Killin	KILN	47	0.000	0.017
Glasgow	GLAS	49	0.014	0.015
Oban	OBAN	49	-0.002	0.012
Drumalbin	DRUM	92	0.029	0.035
Campbletown	CAML	94	0.067	0.068
Edinburgh	EDIN	101	0.041	0.044
Girvan	GIRA	102	0.025	0.029
Arisaig	ARIS	104	-0.029	0.038
Fort Augustus	FAUG	109	-0.014	0.019

Cruach nan Capull:-

Base Station	Code	Distance to Survey Point km.	Height Difference U metres	Separation D_{ij} metres
Lochgilphead	LOCG	24		
Glasgow	GLAS	50	-0.003	0.006
Oban	OBAN	59	0.021	0.024

Campbletown	CAML	69	0.078	0.079
Killin	KILN	71	-0.003	0.020
Girvan	GIRA	82	0.008	0.020
Drumlabin	DRUM	91	-0.000	0.021
Edinburgh	EDIN	111	0.021	0.026
Arisaig	ARIS	116	-0.008	0.025
Stranraer	STRN	124	-0.011	0.026

Cruach nam Mult:-

Base Station	Code	Distance to Survey Point km.	Height Difference U metres	Separation D _{ij} metres
Lochgilphead	LOCG	36		
Oban	OBAN	40	0.006	0.015
Killin	KILN	49	-0.032	0.035
Glasgow	GLAS	57	-0.048	0.049
Campbletown	CAML	95	0.060	0.060
Arisaig	ARIS	96	0.002	0.011
Drumalbin	DRUM	100	-0.055	0.058
Fort Augustus	FAUG	105	-0.032	0.034
Girvan	GIRA	107	-0.039	0.046
Edinburgh	EDIN	109	-0.041	0.042

The results for Cnoc Coinnich, Cruach nan Capull and Cruach nam Mult show consistent datasets as all measured OS Base stations are within 0.08m distance and height of the OS actual values.

10) Ordnance Survey Verification

The results for these surveys were submitted for validation to Mark Greaves at Ordnance Survey. As shown in this report the height of Cnoc Coinnich's has been measured to be 763.51m. On 1:25000 and 1:50000 Maps Ordnance Survey report heights rounded to the nearest metre. Therefore with an uncertainty of +/-0.05m in the measurement the height could be either rounded down to 763m or up to 764m. Our GNSS dataset was reprocessed by Ordnance Survey using state of the art "Bernese Software" together with additional data; for example, precise ephemeris (actual detailed orbits for the satellites) etc. The height of Cnoc Coinnich was measured to be 763.504m, 0.002m lower than our calculation. Therefore Ordnance Survey has decided to round the height to 764m and this will appear on subsequent Ordnance Survey maps.

The heights for Cruach nam Mult and Cruach nan Capull have also been verified and accepted by Ordnance Survey. Rounded to the nearest metre, the new height of 612m will appear on maps for Cruach nan Capull.

11) Summary of Heighting Results

Cnoc Coinnich was measured to be **763.5+/-0.05m**, the summit being the outcrop on the East edge of the cairn at NN 23354 00747*. We recommend that Cnoc Coinnich be reclassified from a Graham to a Corbett.

Cruach nan Capull was measured to be **612.0+/-0.05m**, the summit being an embedded rock about 6m NE of the cairn at NS 09587 79544*. We recommend its classification as a Graham is retained.

Cruach nam Mult was measured to be **611.2+/-0.05m**, there being no feature on the summit at NN 16824 05634*. We recommend its classification as a Graham is retained.

The results have been accepted by Ordnance Survey and forwarded to OS Cartography for relevant map changes.

*grid references for use with Garmin hand-held receivers

12) Acknowledgements

Many people contributed to the success of these two surveys.

We would especially like to thank the Scottish Mountaineering Trust for generously supporting the work and Rab Anderson and Andy Nisbet of the Scottish Mountaineering Club for their guidance and encouragement.

We also wish to thank Mark Greaves of the Ordnance Survey, who accepted the data and forwarded the results to OS Cartography for map changes. We also thank Mark for his support and advice that has helped us carry out our mountain heighting work over the past seven years.

John Barnard and Graham Jackson 16 June 2016

Appendix 1 – Cnoc Coinnich



Leica Viva GS 15 collecting GNSS Data by the Summit Cairn



Close-up of Leica Viva GS15 set up by Cairn on Edge of Crag



Measuring the offset for the Leica Viva GS15 on Cnoc Coinnich



Close-up View of Bedrock at Summit Position

Appendix 2 – Cruach nan Capull



Summit of Cruach nan Capull with Leica Viva GS15 set up on Summit



Measuring the offset for the Leica Viva GS15 on Cruach nan Capull

Appendix 3 – Cruach nam Mult



Summit of Cruach nam Mult in Distance with Middle Top in Front and SE top in Foreground to Left of Rock



Measuring the offset for the Leica Viva GS15 on Cruach nam Mult



Leica Viva GS15 Set up on NW Summit with SE Summit in the Background