



UK Centre for
Ecology & Hydrology

UKCEH Countryside Survey: Soil Handbook 2019-2023

Soil Cores

David A. Robinson, Bronwen Williams, Simon Smart,
Claire Wood, Angus Garbutt, Eleonora Fitos, Rebecca
Rowe, Bridget Emmett

Issue Number 2.3

Date 13/03/2023



Title UKCEH Countryside Survey: Soil Handbook 2019-2023

CEH reference NEC06941

CEH contact details Angus Garbutt
UK CEH Bangor, Environment Centre Wales, Deiniol Road,
Bangor, Gwynedd, LL57 2UW

t: 01248 374500
e: ag@ceh.ac.uk

Author David A. Robinson, Bronwen Williams, Simon Smart, Claire Wood, Angus Garbutt, Eleonora Fitos, Rebecca Rowe, Bridget Emmett

Date 13/03/2023

Version History

| Version | Updated By | Date | Changes |
|---------|----------------|------------|--|
| 1.0 | David Robinson | 25/1/2019 | Edited from GMEP Vegetation and Soils Handbook, v. 16.1. |
| 1.1 | Eleonora Fitos | 31/1/2019 | Added in figures for demonstrating soil sampling |
| 1.2 | Rebecca Rowe | 9/4/2019 | Additional edits following on from Surveyor meeting |
| 1.3 | David Robinson | 2/5/2019 | Final edits prior to survey |
| 1.4 | David Robinson | 9/12/2020 | Added avalanche rod for peat |
| 1.5 | Eleonora Fitos | 10/12/2019 | Additional edits following wash up notes |

| | | | |
|-----|----------------------------|------------|--|
| 1.6 | Eleonora Fitos | 13/03/2020 | Update postage part |
| 1.7 | Eleonora Fitos/Claire Wood | 19/03/2020 | Update with scanning process |
| 1.8 | David Robinson | 02/07/2020 | Adding notes to soil posting |
| 1.9 | Eleonora Fitos | 03/07/2020 | Updating UK CEH contact details |
| 2.0 | Angus Garbutt | 08/04/2021 | Change date on front page. No other revisions |
| 2.1 | David Robinson | 20/07/2021 | Updates from surveyors |
| 2.2 | David Robinson | 28/11/2022 | Better description of short and compressed core, what to do. |
| 2.3 | David Robinson | 13/03/2023 | Soil specific RA added as an appendix to bring together. |

Contents

| | | |
|-------|--|----|
| 1 | Introduction to Vegetation and Soil sampling Plots | 4 |
| 2 | Soil Sampling Procedure | 5 |
| 2.1 | Equipment | 5 |
| 2.1.1 | Soil plastic core samples | 9 |
| 2.2 | Taking the cores | 10 |
| 2.2.1 | X plot sample layout..... | 10 |
| | Cores & Labels | 11 |
| 2.2.2 | Sampling procedure for all cores (White, Black and Grey Core Sampling) 12 | |
| 2.2.3 | Scanning soil labels | 15 |
| 2.3 | Soil sample storage and dispatch..... | 15 |
| | | 4 |

1 Introduction to Vegetation and Soil sampling Plots

The new rolling UKCEH-Countryside Survey involves taking soil cores and recording vegetation at former Countryside Survey squares to provide data needed to assess soil change in the landscape over time. It serves as a research platform to better understand soil function and change at the national scale. All the squares surveyed in 1978 will be resurveyed together with a selection of additional squares from the 1998 and 2007 survey. In total ~500 squares will be surveyed over a 5yr rolling programme with about 100 squares surveyed a year. Soil and vegetation measurements are only taken from the X plots in each square. There are five X- plots in each square, randomly located in the dominant vegetation, away from field boundaries. This forms the NERC soil and vegetation research platform as part of UKCEH-Countryside Survey, a part of UK-SCaPE.

This work was supported by the Natural Environment Research Council award number NE/R016429/1 as part of the UK-SCaPE programme delivering National Capability.

2 Soil Sampling Procedure

2.1 Equipment

Rucksack or box (1) that can be kept in the van with spares. Field kit bag (2) to carry the coring device and tools for coring in the field. Main body of the coring device (3) in which the plastic cores are inserted. The handle (4) and crossbar (7) are used for extracting the core. (Figure 1) The plastic block or equivalent (6) can be placed on top of the metal lid (5) to reduce noise and vibration when driving the core into the ground with the hammer. (Figure 2)

The knife (9) is used for cutting through roots prior to coring, or for cutting peat cores. We have two types of guard, a magnetic (10) and a plastic (8). (Figure 1)



1) Bag for van & spares



2) Bag for field kit



3) Corer
4) Handle
5) Metal cap
6) Hammer block
7) Crossbar



8) Knife guard
9) Knife for peat & roots
10) Magnetic knife guard

Figure 1. Coring

The rulers (11) and (12) can be used to measure the depth from the base of the cross bar to the ground if the core won't go in 15cm (see Figure 8). A trowel/long handle spoon (13) for sampling unconsolidated material, e.g. sand or gravel (see methods) is provided. Two hammer options 3lb (14) and a 4lb (15) hammer depending on user preference, a lever or crowbar (16) to extract cores that are difficult to pull out. Scissors (20) to remove excess grass or vegetation from the surface of the core. An extruder (21) can be used to push out any core that gets stuck in the coring device (3).

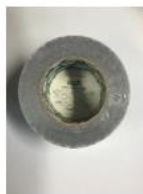
(Figure 2)



- 11) 30cm ruler
- 12) 15cm ruler
- 13) Trowel
- 14) 3lb hammer
- 15) 4lb hammer



- 16) Lever or crowbar
- 17) Gloves
- 18) Cloth for cleaning cores
- 19) Pliers
- 20) Scissors for cutting grass
- 21) Extruder for pushing cores out
- 22) Screwdriver



- 23) Tape

- Permanent marker
- 24) 2*thin
- 25) 2*fat

Figure 2. Tools

Trays (small or big) for working with loose soil e.g. sand, soil with lots of stones or wet, boggy, peaty soil – to capture any loose material without contamination.



Figure 3. Tray for collecting soil

Electric Cool Box (28): which should be kept cool by charging whenever the vehicle is being driven (connected to the vehicle lighter socket (27)) or plugged in with the mains cable (26) at the accommodation to keep the samples cool. (Extension cable is provided for the more convenient use.)

Fridge (Figure 5): Optionally a small fridge is provided for the accommodation so that cores can be kept cool that haven't been posted or returned.



- 26) Mains cable
- 27) Car cigarette lighter cable
- 28) Cool box
- 29) 3 cold blocks

Figure 4. Cool box for cold storage



Figure 5. Fridge for accommodation

Table 1 - Packing list for tools

| Tool | ✓ |
|--|----------|
| Electric Cool Box | |
| Mains cable and car cigarette lighter cable for cold box | |
| Extension cable | |
| Cold blocks (3) | |
| Corer + metal cap + handle + crossbar + hammer block (heavy and lightweight version) | |
| Hammer (3lb) | |
| Hammer (4lb) | |
| Scissors | |
| Knives + knife guards | |
| Wood muddler/Extruder | |
| Lever/Crowbar | |
| Trowel/long handle spoon | |
| Tray (large) | |
| Ruler (15cm) | |
| Ruler (30cm) | |
| Pliers | |
| Screwdriver | |
| Gloves | |
| Cloths | |
| Tape | |
| Permanent markers | |
| Bag/plastic box for van & spares | |
| Bag for field kit | |
| Avalanche rod for peat (3m) | |

2.1.1 Soil plastic core samples

In each X plot five 15 cm cores will be taken (two white cores, two grey and one black). The X plot quadrats have four guide lines laid out north, south, east and west of a central point. The location of the xplot in the computer marks the southern corner of the large xplot. Once this is located, the centre of the xplot can be determined. The cores will be taken in line with the **WEST** line out from the centre post of the quadrat. This positions the core 15 cm outside the central 2x2m quadrat used for vegetation sampling.

1978 15cm SOUTH

1998 15cm NORTH

2007 15cm SOUTH

2019-23 15cm WEST

Dealing with obstacles at sampling site

Sampling procedures for each core are detailed below. If there are problems taking any of the soil samples or a specific comment needs to be made regarding the sampling then a note must be placed in the computer (e.g. "large tree roots - 1st soil core taken 1 m W of the Western corner of the 2 by 2 m quadrat").

If there is unusual vegetation, cow pat, boulder etc. move minimum distance WEST along the xplot line to get a more homogenous sensible location and record the problem in the computer and on a note in a sample bag giving the distance moved and the reason why.

2.2 Taking the cores

2.2.1 X plot sample layout

Step1: Once the X plots has been located (see method section in veg handbook) locate the coring positions as shown in Figure 6a below. This should be on the due **WEST** line of the X plots 15cm outside the 2x2m vegetation quadrat.

There are five plastic Cores for each plot (1-Black (Analysis), 2-White (Storage), 2-Grey (Biology)): Each core type needs to be taken from a specific location as shown in Figure 6a (layout for soil sampling in relation to veg plots). These cores will be per-labelled (see below).

Location in respect of 2 by 2 m X-plot quadrat (2019-2023 WEST)

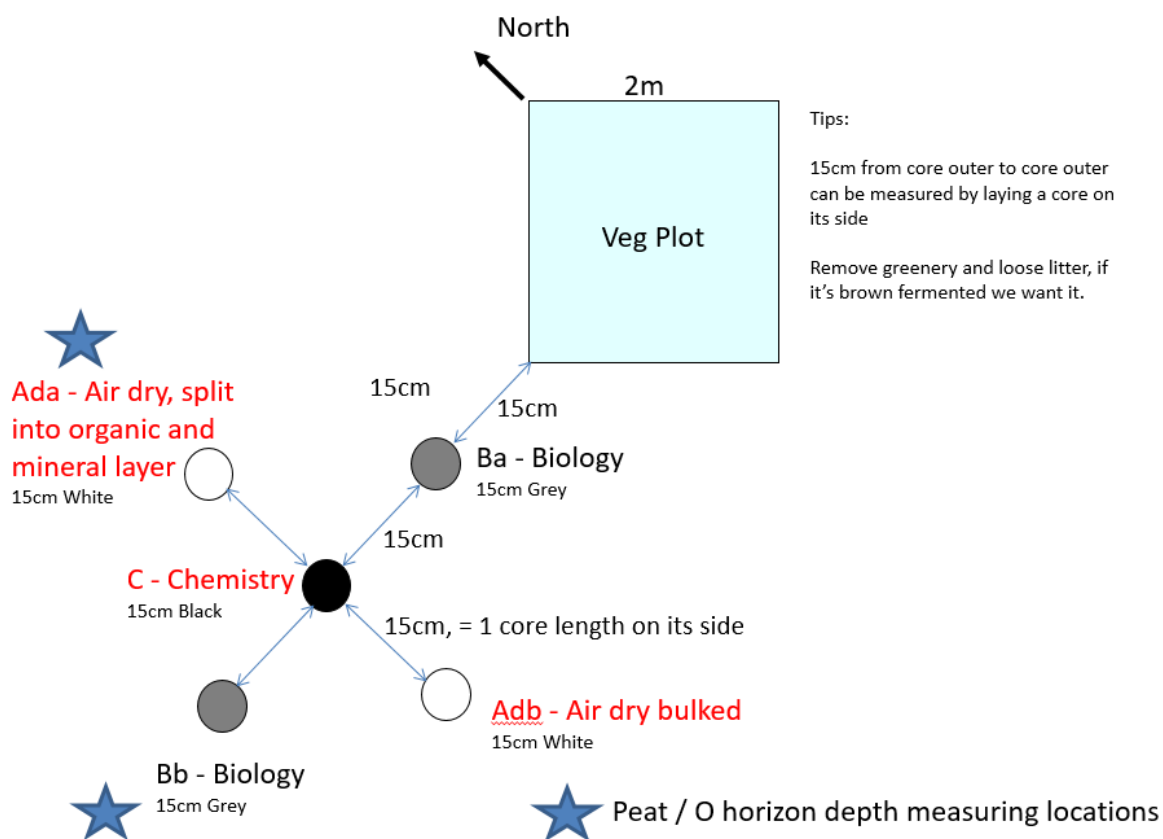


Figure 6a. – The veg plot soil sampling layout is shown above

Step 2: In peaty soil, use the avalanche rod to test the peat/O horizon depth at 3 locations marked with a star and record in the software if depth is over 2cm. In each case press as far as it goes without major resistance which should be equivalent to the depth of organic layer. Measure the depth with the tape measure or using the scale on the pole.

Peat or organic layer depth (cm)

If the soil has an organic layer (~30% of soils) we would like to know the depth. After the soil cores are taken, use the Avalanche rod to press into the soil 20cm out from beyond the soil cores to measure the O horizon depth (Figure 6b). The poles extend to 3m, **don't push into clay**, they are hard to extract. **RECORD ALL MEASUREMENTS IN CM**



▼ Peat depth

Peat depth 1
Rod depth of organic layer (cm)

Peat depth 2
Rod depth of organic layer (cm)

Peat depth 3
Rod depth of organic layer (cm)

Figure 6b. – Screen shot for peat depth

Step3: Locate the bags with the labels for this X plot and the correct coloured core to go in the bag, they should be brought together in a single bag. The five core type are listed below and labels will be as shown in Figure 7.

Cores & Labels

- Core 'C' (Chemistry): 1x LONG BLACK 15cm long x 5cm dia.
- Core 'Ada' and 'Adb' (Storage): LONG WHITE 15cm long x 5cm dia.
- Core 'Ba' and 'Bb' (Biology): LONG GREY 15cm long x 5cm dia.

Coding on the labels: each plot bag will contain the 5 labels for the cores for the plot.

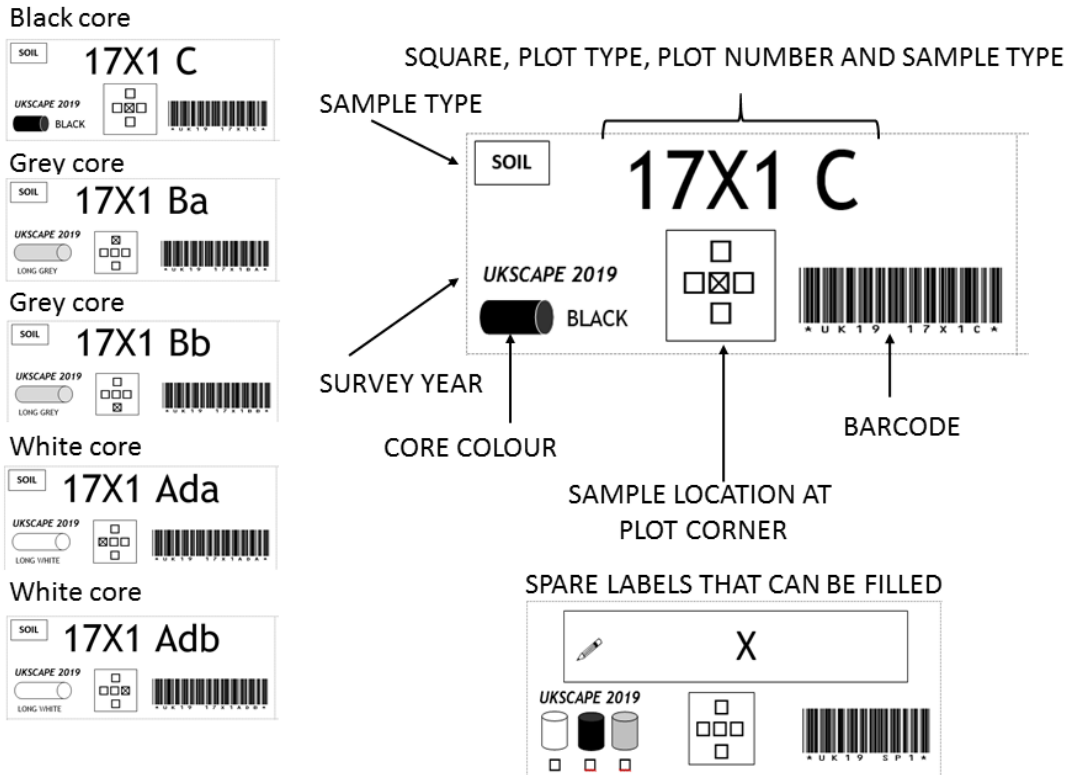


Figure 7. Format of bag label

2.2.2 Sampling procedure for all cores (White, Black and Grey Core Sampling)

Clear the surface of green vegetation and fresh green plant material

In the forest this means loose leaves and needles, it does not include the fermented needles/leaves (these are included in the sample): See guide at the end on forest floor sampling. (Figure 12). In a peat soil, the top is regarded as the point the sphagnum changes to brown, no green.

Mineral soils cut off the surface vegetation – do not pull out plants.

Mineral soil sampling method

- Ensure the coring device is clean.
- Insert first core in corer device, hold the corer upright with the bevelled end on the soil surface while you cut round the bottom edge with the knife; cut vertically down into the soil through any roots and push in a little to prevent bouncing when hammered. Use the hammer (3lb, 4lb) to drive the corer into the soil until the horizontal cross bar is flush on the soil surface, the soil should rise in the core accordingly. (Figure 8)

- If there is not enough depth of soil, move the sampling points slightly and start again.

Short cores

- **If on the second attempt a full core is still not possible** (due to rocks or large roots) then **measure the depth from the base of the cross bar to the ground to determine the core depth missing, and log in the computer.** Simply measuring the depth of the hole is not sufficient as the corer is several cm longer than the core, so depth will not be equivalent. (Figure 10).
- **Please write an ‘S’ on the bag label that allows us to differentiate between compressed (“comp”) soil and soil/short cores (“short”) in the lab already.** This is so we can work out the correct bulk density and do not mistake it with a compressed (“comp”) core.

Compressed cores

Sometimes a core will be compressed by the time you have hammered the corer into the ground and the core crossbar is flush with the ground. If this happens, please write a **‘C’ on the bag label**. When it gets back to the lab we can correct the length, knowing it was not short, but simply got compressed.

Remember to write ‘S’ for “short” (due to rocks, roots etc) or a ‘C’ for “comp” (compressed) on the paper label of the bag and record in the field computer. You can always add a paper note in the plastic bag if your sample does not have the full 15cm length. This is so we can work out the correct bulk density in the lab using the correct length.

- Use the handle to twist and pull the core to one side to break the soil at the bottom, pull the coring device out. (Figure 9). If extraction is difficult twisting the core or using the handle of the hammer, the crowbar or wood muddler can be used (see Figure 9). (We do encourage you to use the two latter one to save the handle of the hammer from any damage (Figure 9).
- If the soil is too loose and the bottom part of the soil core won't come out with the corer device use your hand or the long handle spoon to dig out the bottom of the sample from the hole.
- If the soil is very sandy and likely to fall out, use the trowel to dig underneath and hold the sample in and work over a tray when pulling out the plastic core to keep the sample safe. (Figure 10) Push the core out of the coring device, cap the top with a **RED** cap as it comes out. (**Roger red hat, top**) Slide the remaining core out with the soil end in the air, trim the soil and fit the **BLACK** cap on the bottom.

Organic soil

- **For organic soils clear the surface of vegetation and fresh plant material.**
- The coring device may not work in organic or fibrous soil. In these circumstances (with an organic layer extending more than 15cm) place the

plastic core directly on the soil surface while you cut round the bottom edge with the knife; cut vertically down into the soil through any roots.

- Push plastic core firmly into the ground, continue to use the knife to cut ahead of the core, and push the core into the cut until the soil has come to the top of the core; you can use hammer to knock the core in.
- Cut under the core with the trowel, use pliers to twist the plastic core free from the soil if necessary, being careful not to lose soil from either end of the plastic core (especially in dry/sandy soils). The trowel can be used to dig the plastic core out or to stop soil falling from the bottom. If soil falls out, put it back in. (The trays can be useful while working with this type of soil by keeping the fallen out soil on a safe place, without contamination. (Figure 10)
- Carefully scrape/remove any lumps of soil from the exterior of the plastic core.
- If needed, cut the bottom end of the core sample until it is level with the end of the plastic core (Figure 10)

In **very peaty, boggy soil** cut the block out with the knife rather than using the core and try to hammer it in, since this causes a very big compression in the sample and/or ends up having only water in the plastic core. Make sure the cut core is as close to the required size as possible both in length and diameter.

Scree or rocky soils

Some plots may land on scree slopes or fine gravel where it is not possible to use the coring device. We are still interested and if possible use the trowel to dig out the fine material and place in the core collecting the gravel and any material in between. If the stones are too big then don't collect the material. Label clearly as scree.

After finishing soil sampling **fill and cover up the sampling holes** since it can cause injuries to livestock e.g. sheep. Do not fill it with soil from different area or stones, dung since that can affect future surveys` results. Instead hammering in the top of the hole. (Figure 11)

When each sample is obtained, ensure the caps cover the sample, RED on top, BLACK on the bottom.

Carefully seal the sample in its bag and return to the plastic bag with the label on.

Remember to take a “short” (due to rocks, roots etc) or a “comp” (compressed) note on the plastic bag if your sample does not have the full 15cm length. This is so we can work out the correct bulk density in the lab and do not mistake them with each other.

Write the SQ number on the outside of the bag for frozen samples and how many plots were surveyed within the SQ.

2.2.3 Scanning soil labels

When the soil sampling is finished and the cores are sealed in the correct bags, scan the labels with the tablet (See Vegetation Handbook - 'plot specific headers' for X plots). Make sure you scan the correct ones into each option (see below). If there are any issues with this procedure (e.g. too heavy rain, camera issues etc.), you can manually type in the appropriate barcode from the label. (See Figure 7. UK19 17X1C). In the unlikely event of there being no barcode, create one based on the general logic of the other ones:

CS20 (**year**) 17 (**SQ number**) X1 (**X plot number**) C/Ba/Bb/Ada/Adb (**core type**)
alternatively, scan the labels later at the accommodation.

2.3 Soil sample storage and dispatch

Take all cores back to the accommodation or laboratory in cool box vehicle storage, if in accommodation, store in plug in cool box or in the small fridge provided.

Instructions for Posting:

- **Pack the same SQ cores in the same bag.**
- **Envelopes might split during postage so please parcel tape them if necessary.**
- **Post the soil samples as soon as possible, so the lab can organise their work efficiently.**
- **Do not post on Thursday or Friday or over the weekend, instead refrigerate the cores until Monday. Take to the nearest post office.**

Instructions from post office which explains why we wrap the samples:

- A leak-proof primary receptacle (Plastic core)
- A leak proof secondary receptacle (Sealed plastic bag), and
- An outer packaging of adequate strength for its capacity, mass and intended use, and with at least one surface measuring 100mm x 100mm. (Tyvek envelope)
- If there is any liquid (or the possibility of) then an absorbent material must be placed between the primary receptacle and the secondary receptacle so that any release or leak will not reach the outer packaging. (Use absorbent cloth)

The packaging described is that used for exempt patient specimens.

BLACK AND WHITE CORES

These cores are to be sent to UKCEH Bangor. They should be stored in a cold room (4 degrees).

UK Centre for Ecology & Hydrology, Environment Centre Wales, Deiniol Road, Bangor, Gwynedd, LL57 2UW

GREY BIOLOGY CORES

Grey cores must be placed in envelopes and posted directly to Lancaster. In Lancaster they are to be frozen in a normal freezer at -20 as soon as possible

UK Centre for Ecology & Hydrology, Lancaster Environment Centre, Library Avenue, Bailrigg, Lancaster, LA1 4AP



Figure 8. – Sampling for cores: If the core doesn't go in fully due to a hard layer or rock/root record the height from the crossbar to the ground surface in the software and take a "short" note on the plastic bag. This is so we can work out the correct bulk density and do not mistake it with a compressed ("comp") core.



Figure 9. – Tips & tricks for pulling out the corer from hard/dry soil

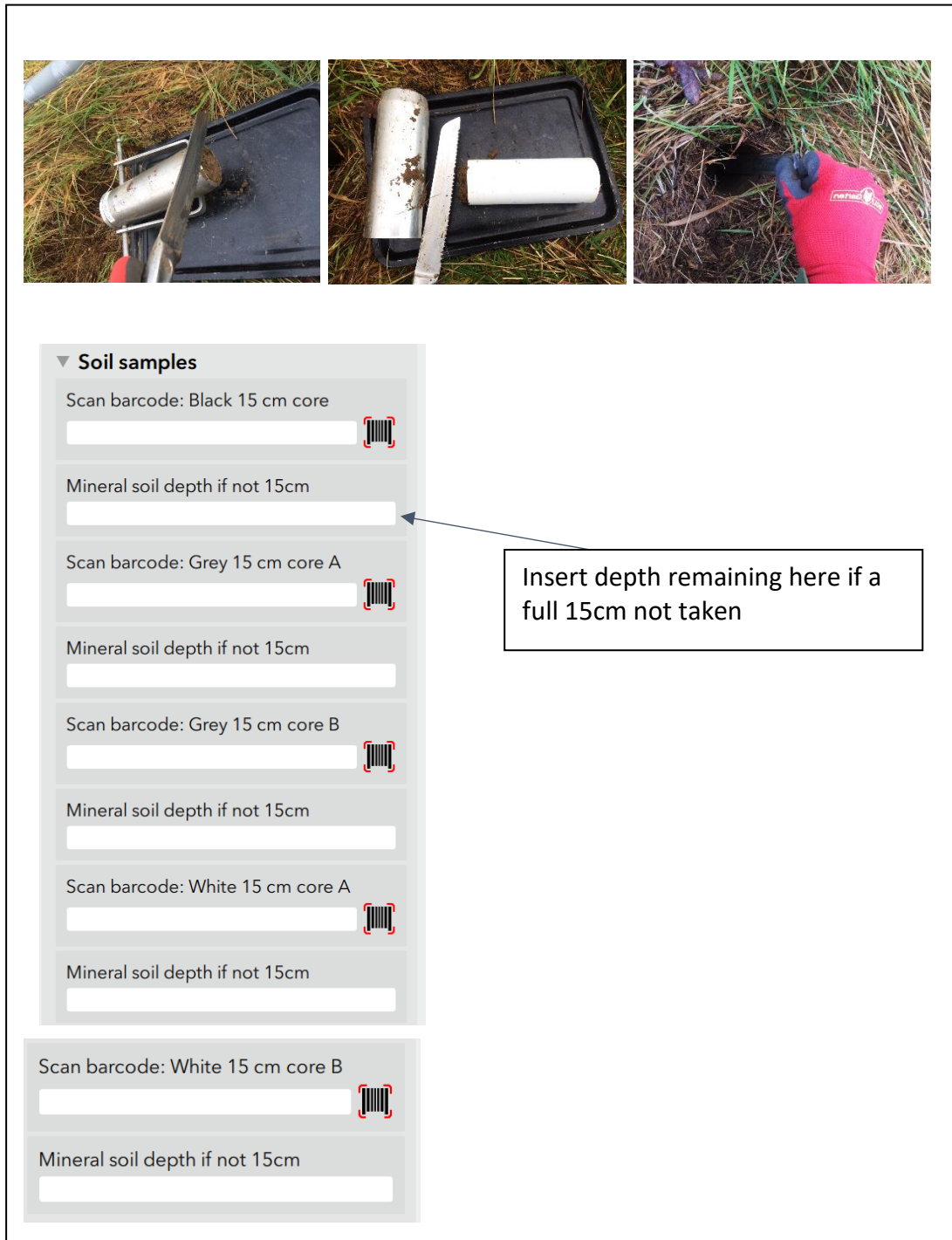


Figure 10. – Trim the core and measure the depth of hole if needed. If the core didn't fully penetrate to 15cm, record the depth from the bottom of the cross bar to the ground surface in the software and take a "short" note on the plastic bag. This is so we can work out the correct bulk density and do not mistake it with a compressed ("comp") core.



Figure 11. – Cover up the sampling hole so no animals are harmed

Brush the loose leaves and needles to the side, we don't collect this.

Litter – Relatively fresh organic residues, identifiable plant material, such as leaves, wood or twigs resting on the surface of the forest floor. Some discolouration or other signs of early decomposition may be visible, but the origins of plant residues are still easy to discern.



This is the material to be collected in the core:

F (Fermented, fibric, fragmented) – Decomposition of plant material is apparent, but the origins of plant residues are still distinguishable. Often, roots are present.



H (Humic) – Well-humified plant material so that plant residues are not recognizable, with the exception of some roots or wood. This material is in advanced stage of humification in which fine substances predominate over plant residues.



Figure 12. – Guide to the organic layer sampling in forests

From: <http://forestfloor.soilweb.ca/definitions/soil-horizons/>

Appendix: Soil-sampling specific Risk Assessment

| RA Name / Description: | Soil sampling | | Assessor: | David Robinson / Sabine Reinsch | | | |
|---|--|---|--|---------------------------------|---------------------|---|--------------------------|
| Names of those involved: | Field surveyors taking soil samples | | Assessment Date: | 2023 | Review Date: | | |
| What are the Hazards | What harm is most likely to occur? | What are the present control measures in place? | Residual risk ratings for each hazard (After present control measures applied) | | | Any further actions necessary? | Action by whom and when? |
| | | | Likelihood of harm A-E | Severity of harm 1-5 | Risk Rating A1 – E5 | | |
| Animals (farm or wild) | Getting trodden on or pushed over, even bitten by farm animals Insect bites, or bites from adders causing swelling or other reactions | Avoid working in fields with animals through land owner contact and scheduling Dress in protective clothing; wear boots | D | 3 | D3 | Check the general field work risk assessment and Safe Systems of work | |
| Infections from soil borne pathogens and animal related diseases (e.g. Bovine tuberculosis) | Tetanus or infections in cuts | All scientists should have a tetanus up to date Gloves be worn when handling soils Follow the instructions in this handbook | A | 3 | A3 | Replenish gloves if running low | |
| Hammering cores into the ground | Hitting fingers Something flying up into face | Use slow dead blows Hold handle of sampler Optional: Wear goggles or glasses | C | 2 | C2 | | |
| Cutting roots with knives and vegetation with scissors | Cuts on fingers, arms or elsewhere | Use knife guards | C | 2 | C2 | When using knives, always point knife away from body and | |

| | | | | | | | |
|--|---------------------------|---|---|---|----|--|--|
| | | | | | | hand when putting back in the sheath Carry first aid kit to prevent contamination if you cut yourself | |
| Core extraction from the soil | Back injury | Do not crouch and use the small of your back to level a core out Follow the soil manual procedure and use the hammer as a lever, not your back to extract a core | C | 3 | C3 | Consult tips and tricks in this handbook if unsure | |
| Heavy backpack with equipment and soil cores | Back injury and tiredness | Plan the day, take some cores back to the car at lunch time or when possible | C | 3 | C3 | Manual handling training session during the training | |

| | | | Likelihood | | | | |
|------------------------|--|---|---|--|---|---|---|
| Hazard Severity | H&S Hazards | Environmental Hazards | A | B | C | D | E |
| | | | Very unlikely | Unlikely | Possible | Likely | Very Likely |
| | | | A freak combination of factors required for event to result | A rare combination of factors would be required for an event to result | Could happen when additional factors are present, but otherwise unlikely to occur | Not certain to happen, but an extra factor may result in it occurring | Almost inevitable that the event will occur |
| 1 Slight | Little or no health effect/injury | Little or no actual damage. | A1 | B1 | C1 | D1 | E1 |
| 2 Minor | Minor health effect/ injury | Within site boundary, short term impact recoverable by the work site | A2 | B2 | C2 | D2 | E2 |
| 3 Major | Significant health effect/injury | Beyond the site boundary unlikely to last beyond 1 month. Recovery may require external aid. | A3 | B3 | C3 | D3 | E3 |
| 4 Severe | Major health effect/serious injury | Beyond the site boundary unlikely to last beyond 12 months. Recovery requires external aid. | A4 | B4 | C4 | D4 | E4 |
| 5 Critical | Multiple serious injuries/long term disability/ fatality | Massive Uncontrolled release with significant impact extending well beyond the site boundary. | A5 | B5 | C5 | D5 | E5 |

Blank page



BANGOR
UK Centre for Ecology & Hydrology
Environment Centre Wales
Deiniol Road
Bangor
Gwynedd
LL57 2UW
United Kingdom
T: +44 (0)1248 374500
F: +44 (0)1248 362133

EDINBURGH
UK Centre for Ecology & Hydrology
Bush Estate
Penicuik
Midlothian
EH26 0QB
United Kingdom
T: +44 (0)131 4454343
F: +44 (0)131 4453943

LANCASTER
UK Centre for Ecology & Hydrology
Lancaster Environment Centre
Library Avenue
Bailrigg
Lancaster
LA1 4AP
United Kingdom
T: +44 (0)1524 595800
F: +44 (0)1524 61536

WALLINGFORD (Headquarters)
UK Centre for Ecology & Hydrology
Maclean Building
Benson Lane
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB
United Kingdom
T: +44 (0)1491 838800
F: +44 (0)1491 692424

enquiries@ceh.ac.uk

www.ceh.ac.uk