Humbleburn OCCS
Humbleburn
County Durham
Survey of Restored Land
August 1996

Resource Planning Team
Leeds Statutory Group
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SOIL SURVEY REPORT ON RESTORED LAND AT HUMBLEBURN OCCS, HUMBLEBURN, CO DURHAM

1. Introduction

This report presents the findings of soils survey of 37.5 ha of land at Humbleburn OCCS, Co. Durham. This site offered an opportunity to study the physical properties of soils on an OCCS before soil stripping (pre-working), immediately after restoration (prior to subsoiling), and during the aftercare period, under different cropping regimes, combining arable and grass. The site is operated by Ivor Hutchinson, who is a mineral operator/farmer, with RPS Clouston acting on his behalf as the soils and restoration consultant. A map of the site follows section 8 of this report.

2. Site Description

2.1 Location

Humbleburn OCCS is located approximately 3 km south-east of Stanley, directly north of the B6532. It has a centroid grid reference of NZ220504.

2.2 Site

At the time of the present survey in July 1996 no crops were present and subsoiling was underway. The site was level to gently sloping (0° - 3°).

2.3 Climate Data

Table 1

Factor	Units	Values
Grid reference	N/A	NZ220504
Altitude	m, AOD	145
Accumulated Temperature	day°C (Jan-June)	1203
Average Annual Rainfall	mm	707
Field Capacity Days	days	179
Moisture Deficit, Wheat	mm	84
Moisture Deficit, Potatoes	mm	67

The combination of rainfall and temperature at this site means that there is an overall climatic limitation of Grade 2.

2.4 Preworking ALC and soil physical characteristics description

A preworking ALC and soils survey for Ivor Hutchinson was undertaken by ADAS on a commercial basis in 1990. The area of interest was classified as all Subgrade 3b. Soils in 1990 consisted of well developed fine to medium sub-angular blocky sandy loam topsoils (mean depth 25 cm), over a variable depth of moderately developed sub-angular blocky sandy clay loam upper subsoil (25 - 35/50 cm), in turn over a medium to coarse angular and prismatic clay loam/clay subsoil, with sandy loam and sandy clay

loam pockets. This land was limited to Subgrade 3b by a combination of soil wetness and gradient restrictions.

3. Soil Handling

3.1 Soil Stripping

Most of the soils on the part of the site subject to this report (see map) were stripped and put into storage during 1993. A residual area of about 3 ha was stripped in April/May 1994.

3.2 Restoration

Approximately half of the site was restored in the period August-October 1995, the remainder being completed in the period April - June 1996. Most of the soils were therefore in storage for 2 - 3 years.

3.3 Working Method

All soil stripping and replacement was undertaken with bulldozers and dumptrucks. The machinery used was as follows:

Volvo A35 Dumptrucks (35 ton capacity)
D7H Bulldozer: used for spreading soil materials
D6D Bulldozer: used for grading subsoil prior to topsoil replacement.

Subsoil in the area restored in 1995 (See Map 1) was spread in two separate layers of 450 mm, each layer being ripped and stonepicked to its full depth. All stone in excess of 300 mm was removed. Topsoil was then spread at a thickness of 230-250 mm.

The soil heaps were measured prior to the 1996 restoration season and it was discovered that sufficient soil remained for a maximum depth of only 750 mm. The soil material was inspected and found to be sandy clay loam in texture, with small amounts of stone. It was decided that the subsoil could be tipped in a single layer provided it was ripped to the maximum depth of the ripper (600 mm). Again, all stone in excess of 300 mm in size was removed from the subsoil.

The subsoil surface was graded with the D6 bulldozer prior to topsoil replacement. Topsoil was spread in strips, dumptrucks running on the surface of the subsoil parallel to the tipping area. The compaction caused by the dumptrucks was alleviated by ripping and light grading with the D6 prior to topsoil placement.

Following the replacement of all soils, the whole site was subsoiled at a depth of 450 mm using wing tines at 600 mm centres. A D7 bulldozer was used for this operation.

4. Aftercare Programme

4.1 Fields 6 and 8

1996-97	Oilseed rape
1997	Underdrainage after harvest
1997/98	Winter cereal

4.2 Field 5

1996/97	Oilseed rape
1997/98	Winter barley
1998	Underdrainage after harvest

4.3 Field 4

1996/98	Grass ley to be established
1998	Underdrainage

The field margins in the arable fields (5, 6 and 8) are to be sown with the same grass seeds mix as field 4. A strip of some 6m would be sown around each headland.

The success of the arable cropping regime will be reviewed after harvest 1998. A decision will then be taken regarding management during the remaining 3 years of the aftercare period.

It is proposed to hold aftercare meetings in late spring of each year to discuss cropping for the following harvest year. A further meeting will be held post-harvest each year to review other matters relating to aftercare, including the development of soil structure.

5. Survey Methodology

Due to the hard compacted nature of the soils at this stage of the restoration and the dry conditions prevailing, only soil pits were dug and described, and a provisional ALC grade attributed in accordance with the published MAFF ALC guidelines and criteria (MAFF, 1988) and Second Revision (Draft - May 1996). It is hoped that a detailed auger boring survey of the site can be undertaken in the Autumn when soil conditions are more conducive to such work. This will allow a better picture of soil type distribution to develop. One pit was examined in each fields 4, 5, 6 and 8. A total of four soil pits were dug, with the aid of a mechanical digger, until overburden was encountered. Samples were taken for bulk density measurements and particle size distribution (PSD).

Although not worked for OCC field 8 was included in the survey. This field was used for soil storage following the removal of its topsoil. Field 7 was never worked due to geological problems.

6. Survey Results

6.1 Provisional ALC grade for pits

It is assumed here that pits are representative of the soil conditions across the whole field. A better impression of overall soil patterns will follow the auger boring survey. ALC gradings given are provisional as soils have only recently been replaced, underdrainage has not been installed and aftercare is not complete. A more long term picture of land quality will emerge following the successful completion of these operations. Note that pit 2 was an undisturbed profile, the details of which are not relevant to this report.

6.1.1 Pit 1 field 5a (See Appendix I for full profile description)

Pit 1 has a permeable sandy loam topsoil overlying a massively structured slowly permeable clay loam subsoil. The slowly permeable layer occurs at 29 cm depth, making these soils poorly drained (Wetness Class IV) (See Appendix II). This land is restricted to Subgrade 3b by moderate soil wetness and workability limitations.

6.1.2 Pit 3 field 4b (See Appendix I for full profile description)

Pit 3 has a permeable sandy loam topsoil overlying a slowly permeable, massively structured sandy clay loam subsoil. These soils are poorly drained (Wetness Class IV) (See Appendix II). The slowly permeable layer starts at 24 cm depth and this land is restricted to Subgrade 3b by moderate soil wetness and workability limitations.

6.1.3 Pit 4 field 6 (See Appendix I for full profile description)

Pit 4 has a permeable clay loam topsoil overlying a slowly permeable massively structured medium clay loam subsoil. These soils are poorly drained (Wetness Class IV). The slowly permeable layer starts at 27 cm depth and this land is restricted to Subgrade 3b by moderate soil wetness and workability limitations. Although this area of subsoil (Field 6) was restored in two layers no discernible difference in the upper and lower subsoil profile was found and it was therefore described as one subsoil, although two bulk density samples were taken from between 27 cm and 70 cm depth and at greater than 70 cm depth.

6.1.4 Pit 5 field 8 (See Appendix I for full profile descriptions)

Pit 5 has a permeable sandy clay loam topsoil overlying a slowly permeable massively structured sandy loam subsoil with many heavy clay loam lenses. These soils are poorly drained (Wetness Class IV). The slowly permeable layer starts at 26 cm depth, and this land is restricted to Subgrade 3b by moderate soil wetness and workability limitations.

6.1.5 Table 2

Pit No.*		Field	PSD (Soil Texture)	Bulk Density (g cm^{-3})
1	T/S	Field 5a	MSL	1.46
1	S/S	Single layer of S/S	HCL	29 - 70 cm = 1.78 70 - 110 cm = 1.74
3	T/S	Field 4b	MSL	1.59
3	S/S	Single layer of S/S	SCL	24 - 70 cm = 1.90 70 - 110 cm = 1.79
4	T/S	Field 6	MCL	1.35
4	USS	2 layers of S/S	MCL	27 - 70 cm = 1.78
4	LSS		MCL	70 - 125 cm = 1.83
5	T/S	Field 8	SCL	? Sample damaged in transit
5	S/S	Soil storage only	MSL	26 - 70 cm = 1.66 70 + cm - Too stony for sampling

* T/S = Topsoil
S/S = Subsoil
USS = Upper Subsoil
LSS = Lower Subsoil

7. Discussion

7.1 Restoration has achieved a relatively uniform distribution of soils across the site. Topsoils show broadly similar textures to the pre-working survey consisting of medium sandy loam to medium clay loam with a moderately developed medium to coarse subangular blocky structure. Little topsoil mixing seems to have occurred during restoration, 5% being the maximum. Subsoils are generally of a similar texture to the pre-working site, comprising of sandy clay loam, medium clay loam and heavy clay loam. Structures of the restored soils and that of Field 8 (Soil Storage) are generally massive. Roots are absent in restored subsoils, except on Field 6 where weeds have been allowed to establish and a few fine fibrous roots are present in the upper part of the subsoil.

7.2 The original moderately to well developed coarse angular to coarse prismatic subsoil structure has been lost, including Field 8 used for soil storage. However, the overall provisional ALC grade for the site remains the same, at Subgrade 3b. Again subject to a soil wetness limitation.

7.3 Little difference was found in areas of subsoil restored as a single layer and 2 x 450 mm layer restoration. Subsoil bulk density measurements varied between 1.76 - 1.90 g cm^{-3}. Bulk densities within the topsoils varied between 1.35 - 1.59 g cm^{-3}. These figures were obtained before subsoiling was undertaken.

All restored subsoils have a mean bulk density greater than 1.75 g cm^{-3} which according to the Soil Survey Field Handbook (Table 7 P.40), defines these subsoils as having a high packing density. Field 8, used for soil storage has a slightly lower mean bulk density of 1.66 g cm^{-3} and therefore a medium packing density.

7.4 Macrofauna such as earthworms were absent from the site in both topsoils and subsoils.

7.5 Evidence of a severe anaerobic problems, such as foul smelling, bluish-grey subsoil was not found.

8. Conclusion

8.1 Overall the restoration has produced a uniform distribution of soils of a similar texture to the pre-working site. As expected immediately after restoration subsoil structures are poor, with a massive structure being present over the site. Field 8 although not worked for OCC, was used for soil storage and showed a similar deterioration in structure after use. On the evidence of pit descriptions and bulk density measurements there seems to be little difference in physical characteristics between single and double layer tipping methods used on the subsoil.

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SOURCES OF REFERENCE

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APPENDIX I
SOIL PROFILE DESCRIPTIONS

Restored Soil

Profile Pit 1 - Field 5a - Single Layer Tipped

Slope: 3°S
Land Use: Ploughed (before subsoiling)
Weather: Overcast

Depth cm (range)	Horizon Description
0-29 (26-32)	Very dark greyish brown (10 YR 3/2) medium sandy loam; no mottles; very slightly stony (3% medium and large rounded and subrounded hard stones); moist; moderately developed coarse subangular blocky and coarse/medium angular blocky structure; friable; >0.5% biopores; mean bulk density 1.46 gcm^{-3}; very few fine relic roots; no earthworms present; non-calcareous; moderately sticky; moderately plastic; no evidence of anaerobism; >5% topsoil/subsoil mixing; clear wavy boundary.
29-110	Very dark greyish brown (2.5Y3/2) heavy clay loam, with many distinct brownish yellow (10YR6/8) and light brownish grey 10YR6/2) mottles; very slightly stony (5% medium and large hard stones, with occasional extremely large hard stones); moist; massive structure; <0.5% biopores >0.5 mm; mean bulk density 1.76 gcm^{-3}; no roots; macrofauna absent; non-calcareous; moderately sticky; moderately plastic; no evidence of anaerobism.

Restored Soil

Profile Pit 3 - Field 4b - Single Layer Tipped

Slope: 3°S
Land Use: Ploughed
Weather: Sunshine

Depth cm (range)	Horizon Description
0-24 (21-26)	Very dark greyish brown (10YR3/2); unmottled; medium sandy loam; very slightly stony (2% medium and large rounded hard stones; slightly moist; moderately developed medium subangular blocky structure; friable; >0.5% biopores >0.5 mm; mean bulk density 1.59 gcm^{-3}; no roots; no earthworms present; non-calcareous; no evidence of anaerobism; <5% topsoil/subsoil mixing; abrupt wavy boundary.
24-110	Dark greyish brown (2.5Y4/2) sandy clay loam; many distinct brownish yellow (10YR6/6) mottles; very slightly stony (5% medium and large hard sandstones with coal and shale fragments); massive structure; very firm; <0.5% biopores >0.5 mm; mean bulk density 1.85 gcm^{-3}; no roots; macrofauna absent; non-calcareous; moderately sticky; moderately plastic; no evidence of anaerobism.

Restored Soil

Profile Pit 4 - Field 6 - 2 x 450mm Tipped

Slope: 3^0 S
Land Use: Fallow
Weather: Sunshine

Depth cm (range)	**Horizon Description**
0-27 (24-28)	Very dark greyish brown (10YR3/2); unmottled; medium clay loam; very slightly stony (2% small, medium and large hard stones); slightly moist; moderately developed medium and coarse subangular blocky structure; friable >0.5% biopores >0.5 mm; mean bulk density 1.35 gcm^{-3}; common fine fibrous roots; no earthworms present; non-calcareous; no evidence of anaerobism; <5% topsoil / subsoil mixing; abrupt wavy boundary.
27-125	Greyish brown (2.5Y5/2) medium clay loam; many diffuse brownish yellow (10YR6/6) and high brownish grey (10YR5/1) mottles; very slightly stony (2% small, medium and large hard stones); massive structure; extremely firm; <0.5% biopores >0.5 mm; Mean bulk density above 70cm depth = 1.78gcm^{-3} Mean bulk density below 7y0 cm depth = 1.83$gcm^{-3;}$ few fine fibrous roots; microfauna absent; non-calcareous; moderately sticky; moderately plastic; no evidence of anaerobism.

Unrestored Soils

Profile Pit 5 - Field 8 - Soil Storage Only

Slope: Level
Land Use: Ploughed
Weathered: Sunshine

Depth cm (range)	Horizon Description
0-26 (24-28)	Very dark greyish brown (10YR3/2) sandy clay loam; unmottled; very slightly stony (3% small, medium and large hard stones); slightly moist; moderately developed coarse subangular blocky structure; friable; >0.5% biopores >0.5 mm; mean bulk density *; few fine fibrous roots; no earthworms present; non-calcareous; moderately sticky; moderately plastic; no evidence of anaerobism; <5% topsoil /subsoil mixing abrupt wavy boundary.
26-135	Greyish brown (10YR5/2) medium sandy loam; with many heavy clay loam lenses; many distinct brownish yellow (10YR6/8) mottles; slightly stony (6% medium and large hard stones); slightly moist; massive structure; very firm; <0.5% biopores <0.5mm; mean bulk density 1.6 gcm^{-3} ; few fine fibrous roots; macrofauna absent; non-calcareous; moderately sticky; moderately plastic; no evidence of anaerobism.

* soil sample damaged in transit

APPENDIX I

DESCRIPTIONS OF THE GRADES AND SUBGRADES

Grade 1: Excellent Quality Agricultural Land

Land with no or very minor limitations to agricultural use. A very wide range of agricultural and horticultural crops can be grown and commonly includes top fruit, soft fruit, salad crops and winter harvested vegetables. Yields are high and less variable than on land of lower quality.

Grade 2: Very Good Quality Agricultural Land

Land with minor limitations which affect crop yield, cultivations or harvesting. A wide range of agricultural or horticultural crops can usually be grown but on some land of this grade there may be reduced flexibility due to difficulties with the production of the more demanding crops such as winter harvested vegetables and arable root crops. The level of yield is generally high but may be lower or more variable than Grade 1 land.

Grade 3: Good to Moderate Quality Land

Land with moderate limitations which affect the choice of crops, the timing and type of cultivation, harvesting or the level of yield. When more demanding crops are grown, yields are generally lower or more variable than on land in Grades 1 and 2.

Subgrade 3a: Good Quality Agricultural Land

Land capable of consistently producing moderate to high yields of a narrow range of arable crops, especially cereals, or moderate yields of a wide range of crops including cereals, grass, oilseed rape, potatoes, sugar beet and the less demanding horticultural crops.

Subgrade 3b: Moderate Quality Agricultural Land

Land capable of producing moderate yields of a narrow range of crops, principally cereals and grass, or lower yields of a wider range of crops or high yields of grass which can be grazed or harvested over most of the year.

Grade 4: Poor Quality Agricultural Land

Land with severe limitations which significantly restrict the range of crops and/or the level of yields. It is mainly suited to grass with occasional arable crops (e.g. cereals and forage crops) the yields of which are variable. In moist climates, yields of grass may be moderate to high but there may be difficulties in utilisation. The grade also includes very droughty arable land.

Grade 5: Very Poor Quality Agricultural Land

Land with severe limitations which restrict use to permanent pasture or rough grazing, except for occasional pioneer forage crops.

APPENDIX II

SOIL WETNESS CLASSIFICATION

Definitions of Soil Wetness Classes

Soil wetness is classified according to the depth and duration of waterlogging in the soil profile. Six soil wetness classes are identified and are defined in the table below.

Wetness Class	Duration of waterlogging[1]
I	The soil profile is not wet within 70 cm depth for more than 30 days in most years.[2]
II	The soil profile is wet within 70 cm depth for 31-90 days in most years **or**, if there is no slowly permeable layer within 80 cm depth, it is wet within 70 cm for more than 90 days, but only wet within 40 cm depth for 30 days in most years.
III	The soil profile is wet within 70 cm depth for 91-180 days in most years **or**, if there is no slowly permeable layer present within 80 cm depth, it is wet within 70 cm for more than 180 days, but only wet within 40 cm depth for between 31-90 days in most years.
IV	The soil profile is wet within 70 cm depth for more than 180 days but not wet within 40 cm depth for more than 210 days in most years **or**, if there is no slowly permeable layer present within 80 cm depth, it is wet within 40 cm depth for 91-210 days in most years.
V	The soil profile is wet within 40 cm depth for 211-335 days in most years.
VI	The soil profile is wet within 40 cm depth for more than 335 days in most years.

Assessment of Wetness Class

Soils have been allocated to wetness classes by the interpretation of soil profile characteristics and climatic factors using the methodology described in *Agricultural Land Classification of England and Wales: Revised guidelines and criteria for grading the quality of agricultural land* (MAFF, 1988).

[1] The number of days is not necessarily a continuous period.
[2] 'In most years' is defined as more than 10 out of 20 years.