Victoria OCCS
Fir Tree
County Durham

Report on Soil Conditions.
November 1998

Resource Planning Team
Northern Region
FRCA, Leeds

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Victoria OCCS, Fir Tree, County Durham.
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Introduction

1. This report presents the findings of a soils inspection of Victoria OCCS at Fir Tree in County Durham in November 1998. The site comprises 5 grass fields and has a centroid grid reference of NZ 150339. A map of the site is attached to this report. Victoria is presently in its fifth year of aftercare following extraction of coal by open cast methods. Prior to coal extraction the land had been in coniferous forestry use for about 60 years.

2. The mineral operator responsible for the site, Coal Contractors, commissioned ADAS to carry out a survey of the land to identify why grass yields were low. At the annual aftercare meeting, FRCA offered to undertake their own independent survey of soil conditions, before advising the planning authority on the need for remedial action. The ADAS survey concluded that topsoils were compacted across all 5 fields, but especially in fields 1, 2 and 3 as shown on the attached map. Sward composition and development were better in fields 4 and 5 than the other 3 fields. Annual meadow grass was evident in fields 1, 2 and 3. ADAS found all soils to be poorly structured below 40cm depth and went on to recommend fields 1, 2 and 3 should be reseeded following surface loosening.

Inspection Technique

3. The inspection carried out by FRCA in November consisted of the examination of 5 soil profile pits. One pit was dug in the centre of each field using a mechanical excavator. Profiles were generally dug to at least 80cm depth. At each pit the soil colour, depth, stoniness, texture, moisture content, structure, consistence, porosity, root and earthworm abundance and bulk density were examined for every soil horizon. Descriptions of each profile pit are given in the appendix at the back of this report.

Site Background

4. Meteorological data for the site can be interpolated from a published 5km grid datasets (Met. Office, 1989).

Table 1: Climatic and altitude data

Factor	Units	Values
Grid reference	N/A	NZ 150339
Altitude	AOD	160
Accumulated Temperature	day°C (Jan-June)	1195
Average Annual Rainfall	mm	736
Field Capacity Days	days	197
Moisture Deficit, Wheat	mm	79
Moisture Deficit, Potatoes	mm	61
Overall climatic grade	N/A	Grade 3a

5. Climatic data suggests that conditions are relatively cool and wet at Fir Tree. Fields 1, 2 and 3 also have a northerly aspect which will reduce the actual accumulated temperature or growing season, below the interpolated figures given above. Calculations suggest that restored soils at Fir Tree will be unsuitable for trafficking machinery or the grazing of livestock, between early October and the end of April in a normal year (Thomasson 1982). Any such activity carried out during this period when soils are normally wet is likely to lead to compaction and poaching. This is especially significant on recently restored soils which need to be managed with special care if soil structure is to develop properly.

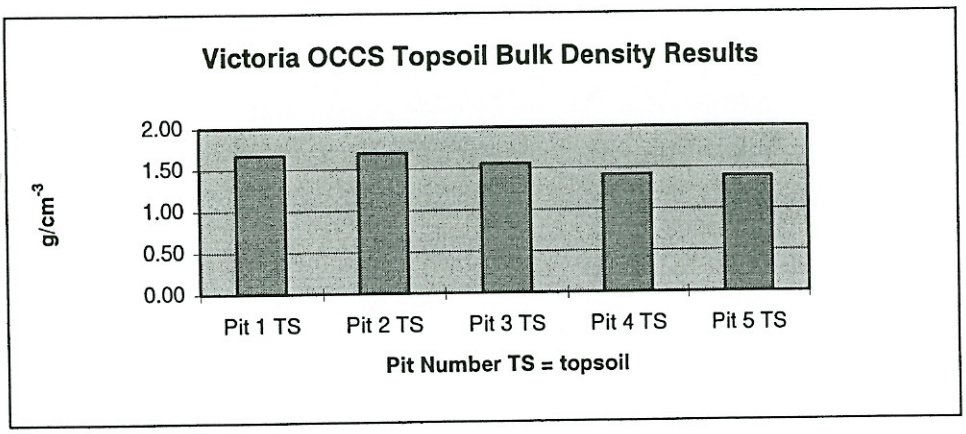
6. Soils on the site are reported to have been replaced using a wheeled motor scraper. The site has been underdrained following soil replacement. The survey found topsoils were mostly medium or heavy clay loam over a clay subsoil. This is typical of soil textures in this part of Durham where soils are generally derived from boulder clay drift. This land in an undisturbed state would generally be classed as ALC Subgrade 3b or Grade 4, subject to a soil wetness and workability problem.

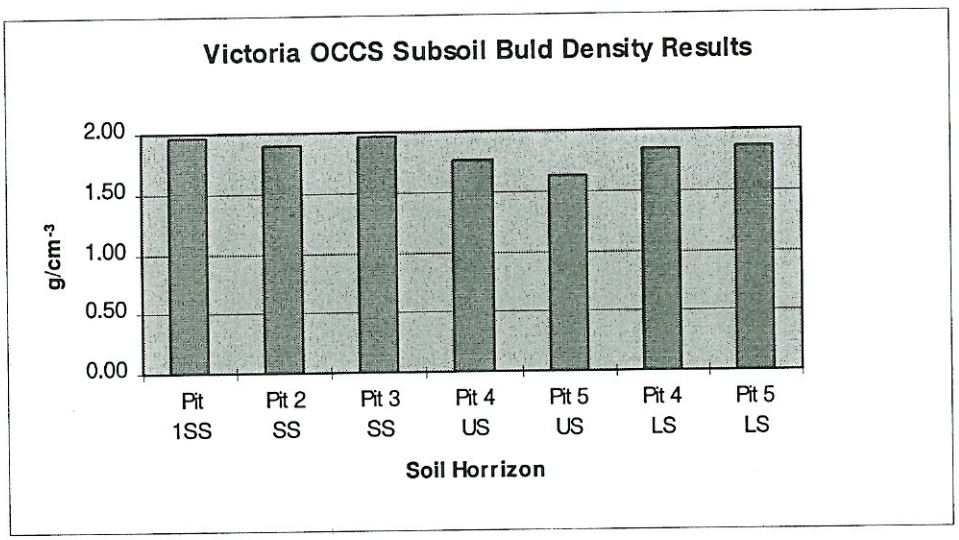
Results of Soil Survey

7. Full soil profile descriptions are attached in Appendix 1 at the back of this report. They show the following key features.

- Roots were well established in the topsoil in all 5 pits.
- Topsoils displayed reasonable structural development but had high bulk density values compared with unrestored soils. This was especially apparent in pits 1, 2 and 3. Bulk density values are shown in chart form below.
- Topsoils in pits 2 and 3 showed signs of significant gleying, such as grey colours and mottling.
- The topsoil in pit 2 was similar in texture and colouration to a subsoil.
- All subsoils were very poorly structures and have very high bulk density values. Compaction was measured to be highest in fields 1, 2 and 3. Due to these conditions the mechanical excavator had difficulty in digging through subsoil horizons in most of the pits.
- Root penetration into the subsoil was generally limited.
- Water was observed entering the profile pit from a saturated topsoil in fields 1, 2 and 4 suggesting the subsoil has very low permeability.

Charts showing bulk density values





Conclusions

8. These observations are not particularly unusual for a recently restored, heavy textured soils in a relatively cool and wet part of the country. The major limitation to agricultural use on this land is topsoil wetness and workability. This is caused by a compacted subsoils reducing the percolation of water through the profile. If the land is not managed delicately during the aftercare period, damage to the soil structure is likely to follow. Damage to the topsoil when it is wet via poaching or machinery compaction is a significant risk. Once the topsoil is damaged, plant growth and subsequent crop yields are likely to be reduced.

9. From the evidence gathered in the profile pits it would appear topsoils and subsoils in fields 1, 2 and 3 are the most compacted. Remedial action should include measures to reduce compaction through the profile. However research indicates subsoil compaction is always difficult to alleviate through subsoiling below about 45cm depth. Subsoiling will be most effective if carried out during late summer or early autumn when the subsoil is dry. Special attention needs to be paid to avoiding trafficking or the grazing of livestock when the soils are wet.

SOURCES OF REFERENCE

Thomasson TRE (1982) Soils and climatic aspects of workability and traffickability. Proceedings of the 9th ISTRO Osijek Yugoslavia 551-7

Met. Office (1989) *Climatological Data for Agricultural Land Classification*. Met. Office: Bracknell.

Appendix 1

Soil profile description

Profile Pit in Field 1

Land use:	Grass
Slope/Aspect:	3°NNE
Weather:	Wet autumn
Date:	4.11.98

Depth (cm)	Horizon Description
0-40	Very dark greyish brown (10YR3/2), with few distinct brownish yellow (10YR6/6) mottles; medium clay loam; 5% stones; moist; strongly developed medium subangular blocky; friable; <0.5% biopores; abundant fine fibrous roots; no earthworms; dry bulk density 1.67 gcm^{-3}; abrupt smooth boundary.
40-80	Greyish brown (2.5YR5/2), with many distinct light olive brown (2.5YR5/6) mottles; clay; 5% stones; slightly moist; massive; extremely firm; <0.5% biopores; few fine fibrous roots; no earthworms; dry bulk density 1.97 gcm^{-3}.
	Water seeping into pit at 40cm depth (foot of topsoil).

Profile Pit in Field 2

Land use:	Grass
Slope/Aspect:	4°NNE
Weather:	Wet autumn
Date:	4.11.98

Depth (cm)	Horizon Description
0-20	Greyish brown (2.5YR5/2), with common distinct dark yellowish brown (10YR3/6) and brownish yellow (10YR6/8) mottles; heavy clay loam; 4% stones; wet; weakly developed coarse angular blocky; extremely firm; <0.5% biopores; abundant roots in top 10cm common to 6-20cm, no earthworms; dry bulk density 1.69 gcm^{-3}; abrupt wavy boundary.
20-65	Dark grey (2.5YR4/1), with many distinct olive yellow (2.5YR6/8) mottles; clay, 4% stones; moist; massive; extremely firm; <0.5% biopores; few fine fibrous roots; no earthworms; dry bulk density 1.90 gcm^{-3}.

Water seeping into pit from top 10cm of profile.

Profile Pit in Field 3

Land use:	Grass
Slope/Aspect:	6°NNE
Weather:	Wet autumn
Date:	4.11.98

Depth (cm)	Horizon Description
0-25	Greyish brown (10YR5/2), with few brownish yellow (10YR6/6) mottled; heavy clay loam with 10% inclusions of clay subsoil; 4% stones; moist; weakly developed coarse subangular blocky; firm; <0.5% biopores; common fine fibrous roots, earthworms present; dry bulk density 1.56 gcm^{-3}; abrupt wavy boundary.
25-90	Grey (10YR5/1), with common distinct yellowish brown (10YR5/6) mottles; clay; 5% stones; very moist; massive; extremely firm; <0.5% biopores; few fine fibrous roots; no earthworms; dry bulk density 1.96 gcm^{-3}.

Profile Pit in Field 4

Land use:	Grass
Slope/Aspect:	2°E
Weather:	Wet autumn
Date:	4.11.98

Depth (cm)	Horizon Description
0-24	Dark greyish brown (10YR4/2), unmottled; medium clay loam; 4% stones; wet; moderately developed medium subangular blocky; friable; <0.5% biopores; abundant fine fibrous roots; no earthworms; dry bulk density 1.42 gcm^{-3}; abrupt smooth boundary.
24-44	Greyish brown (10YR5/2), with many distinct brownish yellow (10YR6/8) mottles; clay; 4% stones; moist; weakly developed coarse angular blocky; extremely firm; <0.5% biopores; common fine fibrous roots; no earthworms; dry bulk density 1.77 gcm^{-3}.
44-85	Dark greyish brown (10YR5/2), with many distinct brownish yellow (10YR6/8) mottles; clay; 4% stones; moist; massive; extremely firm; <0.5% biopores; few fine fibrous roots; no earthworms; dry bulk density 1.86 gcm^{-3}.
	Water seeping into pit from 10cm of profile on upslope side of pit.

Profile Pit in Field 5

Land use:	Grass
Slope/Aspect:	1°NNE
Weather:	Wet autumn
Date:	4.11.98

Depth (cm)	Horizon Description
0-22	Very dark greyish brown (10YR3/2), unmottled; medium clay loam; 10% inclusion of clay subsoil; 4% stones; moist; strongly developed medium subangular blocky; friable; <0.5% biopores; abundant fine fibrous roots; no earthworms; dry bulk density 1.39 gcm^{-3}; abrupt smooth boundary.
22-52	Grey (2.5YR5/1), with greyish brown (2.5YR3/2) and olive yellow (2.5YR6/8) mottles; clay; 4% stones; moist; weakly developed coarse angular blocky; firm; <0.5% biopores; common fine fibrous roots; no earthworms; dry bulk density 1.63 gcm^{-3}; abrupt smooth boundary.
52-86	Grey (2.5YR5/1), with olive yellow (2.5YR6/8) mottles; clay; 4% stones; moist; massive; extremely firm; <0.5% biopores; few fine fibrous roots; no earthworms; dry bulk density 1.86 gcm^{-3}.