MERLEWOOD RESEARCH AND DEVELOPMENT PAPER

Number 55

RECORDING SOIL PROFILE DESCRIPTIONS FOR COMPUTER RETRIEVAL

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R. & D. 74/55
September 1974.

CONTENTS

1. INTRODUCTION

Traditionally, pedologists record soil profile descriptions on forms which contain boxes for site characteristics such as altitude, slope, aspect, geology, and columns in which the observer can enter certain properties of the individual horizons, e.g. colour, texture, type and quantity of stones and roots. Observers generally use standard terms, such as those given by Clarke (1941, 1971), or in the handbook of the Soil Survey of England and Wales. However, the information contained in such record sheets can only be recovered by reading each sheet, and this limits the recovery of information, especially if a large number of profiles is being examined. Muir and Hardie (1962) described a system using conventional edge-punched cards to record soil data, and Rudeforth and Webster (1973) used punched feature (optical coincidence) cards for the same purpose. However, both of these systems require manual sorting to recover the information.

Soil profile descriptions are the basic building blocks for a whole range of pedological and ecological studies, for example in monitoring changes in soils and vegetation which occur naturally in time, or in response to management, in studying relationships between soils and vegetation in natural and semi-natural habitats, as well as in land capability and land use studies. It is therefore essential that, once the soil profile description is recorded, the information is readily and speedily accessible.

The examination of records containing soil profile information, and the extraction of pre-selected types of information, is a good example of the routine file-handling work which can be handled speedily and efficiently by even a small electronic computer. However, in order to introduce the information into the computer and subsequently to recover it, it is necessary for the information to be suitably coded. There does not appear to be any published method for recording soil profile descriptions in such a way that they can be easily coded for computer storage and retrieval, although several papers have been published on subsequent handling of the information (e.g. John, Lavkulich, and Zoost, 1972; John, van Laerhoven, and Sprout, 1972). We have designed a soil profile description sheet which records information in such a way that it can be punched on to paper tape. We think that this recording sheet has certain other advantages over the traditional soil profile recording sheet. For example, the observer is forced to make decisions between standard descriptive terms. This makes it easier to compare profiles, especially if they have been recorded by different people.

The standard descriptive terms must, of course, be used in the same way by all observers. The amount of coding which the observer has to do in the field is kept to a minimum. However, it is advisable that the observer should familiarize himself with the soil profile recording form and coding systems before using them in the field.

The computing system at Merlewood Research Station consists of a PDP 8/I with 16K of core store, and with disk and DEC (magnetic) tape facilities. During most of the working day, the system runs in the time-sharing mode with up to six people using it at the same time. An easy-to-learn conversational language called BASIC, which has been developed specifically for time-sharing systems, is used. The programs to handle the soil profile descriptions have been written in this language. This paper describes the format of our new profile recording sheet and outlines the way in which the coded information is punched on to paper tape and then transferred to DECtape for storage, and the way in which programs written in BASIC can be used to retrieve, tabulate and sort the information. Some practical examples are given of how the system is developing and of how flexible and interactive the system is likely to be when it is completed. A detailed manual describing the coding and punching of the data and the use of the computer programs is being prepared.

We have used the descriptive terms currently used by the Soil Survey of England and Wales (Handbook in press) as far as possible. A comparison of our terms and theirs, as well as those used by F.A.O., is given in Appendix 6.

The classification currently being used by the Soil Survey of England and Wales was recently outlined by Avery (1973), and is given in Appendix 3. In this classification, soils are given key numbers at the differing levels of classification (Soil Major Group, Group, and Sub-Group provide three levels used), e.g.

5 Brown soils	5.4 Brown earths (sensu stricto)	5.43 gleyic brown earth

and this therefore provides a suitable code for use in computer storage or processing. It is our intention to attempt to use this classification for a trial period and to enter data into the computer using the numerical code outlined above, but the full soil name may be inserted when completing the profile sheet, and the code entered later. Some of our colleagues will almost certainly continue to use soil names derived from other systems,

and for the interim the intention is to recode these names according to Avery's Groupings at the editorial stage. Where alternative classification systems are used the source should be noted.

It should be stressed that in the approach as outlined, any alternative preferred classifications or codings for vegetation type, parent material, solid geology or soils could be substituted by the user. Those used here were simply adopted during our initial trials with the form and, in the case of soils and vegetation, our aim was to utilise a published system for a discussion period. As with the soil name, a descriptive name or phrase can be used initially for "parent material" and "solid geology" and the relevant code entered later or during editing.

We regard this paper very much as a working document. When the method described here has been used in the field for some time, it is likely that some improvements will be made. The authors would welcome constructive comments from anyone interested in using the method for recording and retrieving soil profile descriptions. Soil scientists in other organizations would no doubt find it possible to adapt the programs for other computing systems.

2. THE SOIL PROFILE RECORD SHEET

The soil profile record sheet (Appendix 1) contains boxes of two types. In one type of box, the observer is required to enter a word, code, or number, while in the second type the observer enters only a tick. The record sheet begins with a short section of boxes which contain the features necessary for an adequate description of the site, a number of whole profile features, together with two boxes for description of the L layer of the profile and three for the F layer, followed by a box for the number of horizons described. The rest of the record sheet contains boxes for describing features in each horizon, the boxes for each horizon being arranged vertically. The method of filling in the boxes will now be considered in detail. We have adopted the convention that depth is measured from the observable surface, e.g. from the top of the L layer, if present.

The boxes in the first block of the sheet are filled in as shown below.

term 'alphanumeric characters' refers to combinations of letters and numbers, the number of characters allowed includes spaces. The maximum permissible content of each box is given. The computer stores alphanumeric information in units of 6 characters; ordinary numbers are stored in floating

point form. Altitude, slope, aspect, and rainfall, are stored in alphanumeric form, so that if the information is not available, a suitable code can be entered.

Site no. or code	:	6 alphanumeric characters
Site name	:	18 alphanumeric characters
Observer	:	12 alphanumeric characters
Day	:	floating point number. Note that this is day in year, so that March 3rd in a non-leap year would be day 62
Year	:	floating point number
Profile number	:	floating point number
km east	:	floating point number. This is the number of kilometres the sampling point lies to the east of zero on the National Grid. Each of the 1" Ordnance Survey maps gives some of the eastings figures with 6 digits, this number being in metres east of zero. The railway station at Grange-over-Sands would thus be given on the Ordnance Survey map as 341200, the three digits underlined being those normally given in the usual six-figure Nat. Grid Ref. The corresponding value in km to be entered in the box would be 341.200. If the observer feels sufficiently confident, his sampling point can thus be given to the nearest metre. This system is chosen in preference to the normal Nat. Grid Ref. because it is an absolute measure of location, and could be used to give co-ordinates in a computer plot. The observer can, if necessary, leave this box to be filled in later, and write the Nat. Grid Ref. at the top of the form.
km north	:	floating point number. This is similar to the km east above. The value for Grange railway station being 478200, i.e. 478.200 km.
Altitude (m)	:	6 alphanumeric characters
Slope ^{o}	:	6 alphanumeric characters
Aspect ^{o}	:	6 alphanumeric characters
Rainfall (mm)	:	6 alphanumeric characters
Profile texture	:	12 alphanumeric characters. Suggested codes for this are given in Appendix 2.
Soil parent material	:	12 alphanumeric characters. Suggested codes for this are given in Appendix 2.

Solid geology	:	6	alphanumeric characters. A suggested coding system is given in Appendix 2.
Location drainage	:		floating point number. We use a code given in Appendix 2.
Profile drainage	:		floating point number. We use a code given in Appendix 2.
Soil group or sub-group	:	6	alphanumeric characters. Suggested code numbers for this are given in Appendix 3, based on the classification of Avery (1973). If the major soil group is unknown, a suitable code can be entered and changed later if necessary.
Main plant species	:		can contain up to eight alphanumeric codes. If a species can be identified with certainty, we enter the code number used by the Biological Records Centre (see their list). If only the genus can be identified with certainty, we enter the shortened form of the name as used on the B.R.C. field recording card. If a fuller description of the vegetation is required, a separate sheet can be filled in. A code can be inserted in the main plant species box to indicate that such a sheet is available.
Vegetation type	:	6	alphanumeric characters. Suggested codes for this are given in Appendix 4.
L layer thickness (cm)	:		floating point number
L layer composition	:		This refers to the recognisable plant species of the layer. Use the plant species code or the shortened generic name. Up to eight alphanumeric codes.
F layer thickness (cm)	:		floating point number
Nature of F layer	:	12	alphanumeric characters. Suggested words are given in Appendix 4.
F layer composition	:		Up to eight alphanumeric codes for the plant species if recognisable. If not recognisable, enter "unrecognisable".
No. of horizons	:		floating point number

There follows a series of boxes, arranged vertically, which refer to the properties of the individual horizons:

Sample code	:	6	alphanumeric characters. This is the code used for the sample collected for chemical analysis.
Horizon symbol	:	6	alphanumeric characters. Suggested symbols are given in Appendix 5. If the observer is not absolutely certain of the nature of each

horizon, it is better to number them 1, 2, 3. The numbers can be changed to codes later, for instance if chemical and mechanical analyses become available.

Horizon depth cm (start) : The depth to the top of the horizon, stored as a floating point number

Horizon depth cm (end) : The depth to the base of the horizon, stored in alphanumeric form to allow the use of a + sign when the lower limit cannot be determined

Lower boundary sharpness : A two-digit code, see Appendix 5.

Munsell colour (ground) :
Munsell colour (ped face) : Each of these consists of two boxes, each of 6 alphanumeric characters. In the first box should be entered the hue (e.g. 7.5 YR). In the second box should be entered the value and chroma, separated by an oblique stroke (e.g. 5/6).

Mottles : In this array of boxes it is only necessary to place a tick in the appropriate box for (a) frequency, (b) size, and (c) prominence, but note that the vertical columns are linked, each vertical column carrying the characteristics of one set of mottles. The final box in each column is for mottle colour. This can be either the Munsell colour or a term such as yellowish, ochreous, black, greenish, bluish. Colour is stored as 12 alphanumeric characters. In each horizon, four sets of mottles can be described. If this is not sufficient, additional descriptions can be put in the appropriate COMMENT box. The nature of the mottle boundary edge can also be put in the COMMENT box if required.

Field texture : An array of boxes with three columns and five rows, one row for each class (Loam, Silt, etc.). To indicate the texture, the observer should place a tick in the appropriate box, starting from the left. Thus, a sandy loam would have a tick in the 'Sand' box of the first column plus a tick in the 'Loam' box of the second column, the third column remaining empty. A silty clay loam would have a tick for silt, a tick for clay, and a tick for loam in the first, second and third columns respectively. In Appendix 1, the second and fifth horizons are loamy sand.

Organic matter : Place a tick in the Low, Moderate, High, or Peaty box as appropriate.

Overall stoniness : This refers to the percentage cover of the exposed soil face. See F.A.O. percentage cover charts.

Individual stone types : To describe the stones in more detail, three arrays of boxes are used. The first array gives the frequency, the second gives the shape, the third gives the lithology. The vertical

columns of the three arrays are linked in the following way. If a soil contains few, medium, rounded stones, the code number for medium (3) is placed in the 'few' box of the first column (Figure 1). We always start with 'few' and work up to 'abundant'. Another code number 3 is placed in the 'rounded' box of column one. As shown in Figure 1, this is punched as 1363, the final 3 is not essential to the code, but it is used as a check to ensure that the observer is entering the information correctly. In the field, it might be possible to fill in the record box incorrectly if only a tick was necessary. Finally, the geological code for the stone lithology (if recognisable) is entered in the left-hand box for 'LITHOLOGY'. The remaining stone boxes are filled in similarly. Space is provided for four stone size/shape combinations. However, if it is essential to record more, they can be entered in the appropriate horizon 'COMMENTS' box.

Porosity : tick appropriate box

Soil structure : this is divided into two main categories (1) Structureless soils - for these the appropriate box is ticked, (2) Structured soils - for these, boxes are subdivided into (a) ped shape, (b) ped strength, (c) ped size. A tick is placed in the appropriate box, first for the dominant feature, then for the feature to which the soil breaks. Using our terminology, 'angular fine' is equivalent to 'granular' and 'angular large' or 'angular medium' is equivalent to 'blocky'.

For the remaining properties, it is necessary only to place a tick in the appropriate box, except for the boxes describing the roots, which are completed in a similar way to those for stones. The terms used to describe abundance of roots are based on percentage cover (Appendix 6). See F.A.O. percentage cover charts.

The last page of the record sheet contains spaces for comments. These spaces can be used to amplify previous entries in the record, and to note such things as the presence of slickensiding in Bt horizon; manganese and iron staining on stones; also crusts, efflorescences, veins, streaks, and tubes, or presence of an iron pan.

3. HANDLING THE CODED INFORMATION

A. Data preparation stage

The soil profile description sheets are received in the office after completion and checking by the field worker. It is desirable that each soil team

should have someone who has been trained to act as an editor, as it is important at this stage that the forms should be edited before going to the punch operator. The editor will check that all the appropriate boxes have been completed correctly and that no anomalies have occurred in entering the data on to the form in the field. It is probably only feasible to expect to pick up major errors at this stage; more sophisticated internal checks on the data are better performed by the computer. A flow chart for the handling of the data is given in Figure 2.

The editor passes the forms to the punch operator, who punches the data on to 8-hole paper tape in standard ASCII code in non-parity form. The punch operator completes a batch of forms and then takes away the sheets of punched data to check them for punching errors. Even with the most experienced operator, punching errors are likely to occur and must be expected in any data processing scheme. If the error is such that it will hinder the loading of the paper tape into the computer, then a corrected version of the data is generated on a new tape; if not, the error is noted for editing at a later stage. An example of the punched data is shown in Figure 3.

B. Data loading stage

The next stage involves the use of the Merlewood PDP 8/I computer operating in the time-sharing mode. The BASIC program, SOLENT loads the data into the computer from the low speed reader on the teletype, which acts on-line as a computer terminal. The program instructs the computer to take in a quantity of data and to store it in the appropriate place on the DEC (magnetic) tape. Generally, several profile descriptions will be entered at a single session which will normally last between one and two hours. As each profile description is entered, the program lists the location on the DECtape where the description resides. Full details of the computer procedures and programs are given in a separate operations manual, and only a general outline is given here.

A program is available which re-arranges the coded information into the form shown in Figure 4. This assists the checking of the punched information against the original form.

C. Data listing stage

We feel that it is very important for the field worker to gain some positive proof that his data are correctly stored on DECtape. Therefore, immediately

a batch of soil profile descriptions is entered, another program, PROFILE, is used to produce an understandable listing of the data. We have made an effort to reproduce the coded data, as entered on the forms, in such a way that it is useful to the field worker. We have assumed that the field worker does not wish to be presented with lists of coded data which he has to decode. The computer has done this decoding for him. We have adopted a similar style of presentation to that of the soil scientist writing out a soil profile description in full by hand (Figure 5). This listing of the description is returned to the field worker for further checking and for his own personal reference.

D. Data retrieval stage

This stage is under active development at the time of writing (May, 1974). In developing a data retrieval system, we have two main purposes. One is to store sets of data in a standard format, the second is to organise the data in such a way that sets of data can be retrieved under a variety of different headings. A generalised flow chart for an information retrieval system is shown in Figure 6.

Two examples are given below to indicate how data can be retrieved from the bank, although many other possibilities can be explored. In the first example (Figure 7) the program searches the bank for frequency of large stones, and for field texture. The printout gives the number of horizons in the bank in which the various combinations occur. A search such as this can be carried out for a variety of features.

In the second example, the data bank can be searched for a combination of keywords, in this case profile drainage, major soil group, and parent material. When these have been specified, the program searches all the profile data stored in the bank and prints out the name and number of each profile having the given combination (Figure 8).

4. FURTHER DEVELOPMENTS

This paper is very much a working document, and we expect the system to evolve as we gain experience in its use. One aim will be to reduce the soil profile recording sheet from four foolscap pages to one folding card, which would be much more convenient.

At present, the information is punched either directly into the computer or on to paper tape. We hope soon to be able to use 80-column punched cards, to widen the possible range of use.

It is not very clear at present exactly how the information in the COMMENT boxes will be dealt with, chiefly because we do not know exactly what sort of information observers are likely to put into these boxes. This will depend on our experience in the use of these forms.

Programs for searching the records and recovering information can be written as required, and it will be interesting to see the types of search which are needed when we have sufficient soil profiles stored.

Acknowledgements

We are grateful to Miss A. Hatton and Mr. P. Stevens for carrying out field trials of the recording sheet, and for valuable comments. We also thank Mrs. D. M. Howard for assisting at various stages, and Dr. D. Ball for various useful suggestions.

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INDIVIDUAL STONE TYPES

A. QUANTITY

Few	1	3		Ø	Ø
Common	2				
Abundant	3		1		

B. SHAPE

Angular	4		1		
Sub-angular	5				
Rounded	6	3			
Platy	7				

SIZE CODING

0 = Absent
1 = Gravel
2 = Small
3 = Medium
4 = Large
5 = Very large

C. LITHOLOGY

S S X	M Q X	O	O

Col. 1.

1 3 6 (3)

few, medium, rounded stones of type SSX

Col. 2.

3 1 4 (1)

abundant, gravelly, angular stones of type MQX

Cols. 3, 4 No more stones present in this horizon

Figure 1. An example of entries into the stones boxes for one horizon

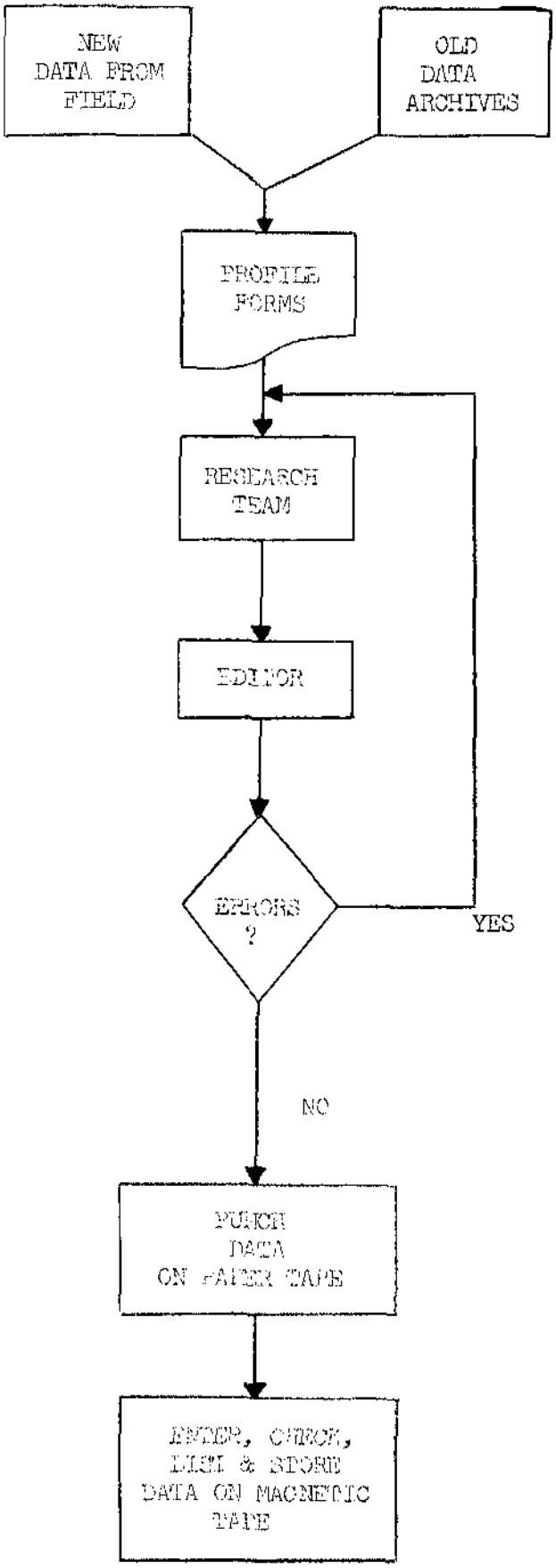


Figure 2. System flow chart for the creation of a data bank.

```
1,CHADDESLEY WOODS
P.A.STEVENS
186,1973,1
391,273,128,12,280,762
S,5S,SZX,1,1.5,5.51
1484   1619    687
1D14A,2,3
MATTED
1484
1484
5

C,A,5,16,15,7.5YR,3/2,0,0
100,0,100,0,100,0,100,0
20023,1262,XQX,1363,XQX,1262,SSX,1363,SSX,31
0,22A11
1,3262,3363,3464,3565,1111

CW1/2,A/B,16,25,36,5YR,4/4,0,0
100,0,100,0,100,0,100,0
32023,1262,XQX,1363,XQX,1262,SSX,1363,SSX,31
0,22A11
1,3262,3363,3464,3565,1111

CW1/3,B1,25,52,36,5YR,4/8,0,0
100,0,100,0,100,0,100,0
20013,1262,XQX,1363,XQX,1262,SSX,1363,SSX,31
0,22A11
1,3262,3363,3464,3565,1111

CW1/4,B2,52,80,36,5YR,4/6,0,0
100,0,100,0,100,0,100,0
20013,1262,XQX,1363,XQX,1262,SSX,1363,SSX,31
0,22A11
1,3262,3363,3464,3565,1111

CW1/5,C,80,98,+,5YR,5/6,0,0
100,0,100,0,100,0,100,0
32013,1262,XQX,1363,XQX,1262,SSX,1363,SSX,31
0,22A11
1,3262,3363,3464,3565,1111
```

FIGURE 3. AN EXAMPLE OF PROFILE DATA PUNCHED IN CODED FORM.

PROFILE DESCRIPTION RECORDS 100-101

```
1
CHADDESLEY WOODS
P.A.STEVENS
186
1973
1
391
273
128
12
280
762
S
SS
SZX
1
1.5
5.51
1484  1619   687
1D14A
2
3
1484  1484

5

HORIZON A:  5 - 16 CMS

  15 7.5YR  3/2  0  0

100   0     100   0     100   0     100   0
20023 1262  XQX   1363  XQX   1262  SSX   1363  SSX   31
0     22A11
1     3262  3363  3464  3565  1111
```

FIGURE 4. CODED DATA RE-ARRANGED FOR CHECKING.

1....CHADDESLEY WOODS

ALTITUDE	128
SLOPE(DEGREES)	12
ASPECT(DEGREES)	280
KM EAST	391
KM NORTH	273
RAINFALL(MM)	762
VEGETATION TYPE	1D14A

PROFILE NO 1
DATE 186 1973

PROFILE TEXTURE	SANDY
PARENT MATERIAL	FLUVIOGLACIAL DEPOSITS
SOLID GEOLOGY	SHALE,MUDSTONE
LOCATION DRAINAGE	SHEDDING
PROFILE DRAINAGE	WELL DRAINED TO MODERATELY WELL DRAINED
MAJOR SOIL GROUP	TYPICAL BROWN SAND

THICKNESS OF L LAYER(CM)	3
THICKNESS OF F LAYER(CM)	2
NATURE OF F LAYER	MATTED

A.....5 TO 16 CMS.

SHARP,UNDULATING BOUNDARY
MOTTLING ABSENT
SAND,MODERATE ORGANIC MATTER CONTENT,7.5YR3/2
OVERALL STONINESS, STONY
STONES:
FEW,SMALL ,ROUNDED,XQX
FEW,SMALL ,ROUNDED,SSX
FEW,MEDIUM,ROUNDED,XQX
FEW,MEDIUM ,ROUNDED,SSX
HIGH POROSITY
SINGLE GRAIN
CUTANS ABSENT
MOIST AND LOOSE
INDURATION ABSENT
CEMENTATION ABSENT
ROOTS:
FEW SMALL WOODY
FEW MEDIUM WOODY
FEW LARGE WOODY
FEW VERY LARGE WOODY
CONCRETIONS ABSENT
NO REACTION WITH ACID
LARGE EARTHWORMS NOT OBSERVED

FIGURE 5. A DECODED SOIL PROFILE DESCRIPTION.

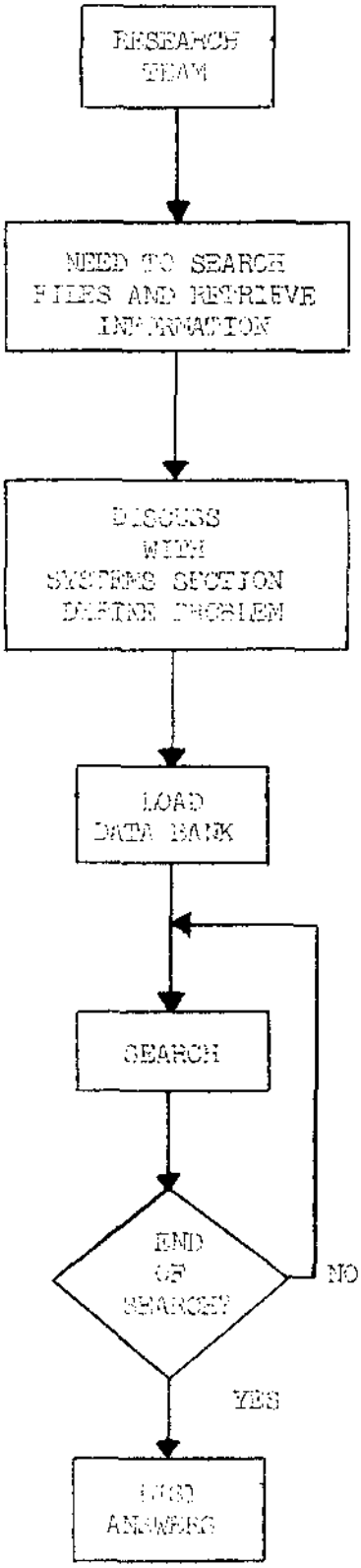


Figure 6. System flow chart for an information retrieval system.

READY

RUN

RUN

----------OCCURENCE OF LARGE STONES BY HORIZONS----------

	ABSENT	FEW	COMMON	ABUNDANT
ORGANIC SOIL	1	0	0	0
SAND	0	0	0	0
SANDY LOAM	2	4	0	0
LOAM	2	2	0	0
SILTY LOAM	9	1	0	0
CLAY LOAM	0	0	0	0
CLAY	0	0	0	0

FIGURE 7. PRINTOUT SHOWING THE NUMBER OF HORIZONS IN THE DATA BANK HAVING THE INDICATED COMBINATIONS OF LARGE STONES AND FIELD TEXTURE.

READY

```
RUN

DTA UNIT NO? 1
SEARCH ON;PROFILE DRAINAGE,MAJOR SOIL GROUP,PARENT MATERIAL

ENTER CODES FOR  SEARCHING? 2,5.4,5S

CHADDESLEY WOODS// 1 2


END OF SEARCH

SEARCH ON;PROFILE DRAINAGE,MAJOR SOIL GROUP,PARENT MATERIAL

ENTER CODES FOR  SEARCHING? 3,5.3,5S

CHADDESLEY WOODS// 3  3
CHADDESLEY WOODS// 4  3

END OF SEARCH

SEARCH ON;PROFILE DRAINAGE,MAJOR SOIL GROUP,PARENT MATERIAL

ENTER CODES FOR  SEARCHING? 3,5.1,5S

CHADDESLEY WOODS// 7  3

END OF SEARCH

SEARCH ON;PROFILE DRAINAGE,MAJOR SOIL GROUP,PARENT MATERIAL

ENTER CODES FOR  SEARCHING? 2,5.6,5S


END OF SEARCH

SEARCH ON;PROFILE DRAINAGE,MAJOR SOIL GROUP,PARENT MATERIAL

ENTER CODES FOR  SEARCHING? NO
```

FIGURE 8. PRINTOUT FROM A PROGRAM SEARCHING FOR SELECTED KEYWORDS.

Appendix 1

SOIL PROFILE DESCRIPTION

Draft 7 November 1973

Site No.	Site name	Observer	Day	Year	Profile No.
1	CHADDESLEY WOODS	P.A. STEVENS	186	1973	1

Km E 391	Profile texture S	Main plant species 1484, 1619, 687	
Km N 273	Parent material SS ~~SFS~~		
Altitude (m) 128	Solid geology SZX	Vegetation type 1D14A	F layer thickness (cm) 2
Slope° 12	Location drainage 1	L layer thickness (cm) 3	Nature of F layer MATTED
Aspect° 280	Profile drainage 1·5	L layer composition 1484	F layer composition 1484
Rainfall (mm) 762	Soil Group or Sub-Group 5·51		

No. of horizons 5

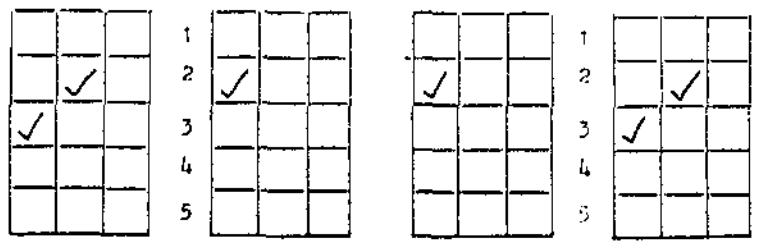
	CW 1/1	CW 1/2	CW 1/3	CW 1/4	CW 1/5
Sample code					
Horizon symbol	A	A/B	B1	B2	C
Horizon depth cms (start)	5	16	25	52	80
" " " (end)	16	25	52	80	98+
Lower boundary sharpness	16 5	36	36	36	
Munsell colour (ground)	7·5YR 3/2	5YR 4/4	5YR 4/8	5YR 4/6	5YR 5/6
Munsell colour (ped face)					

MOTTLING

		CW 1/1	CW 1/2	CW 1/3	CW 1/4	CW 1/5
A. FREQUENCY						
Absent	1	✓	✓	✓	✓	✓
Few	2					
Common	3					
Abundant	4					
B. SIZE						
Very fine	5					
Fine	6					
Medium	7					
Large	8					
C. PROMINENCE						
Faint	1					
Distinct	2					
Prominent	3					
D. COLOUR						

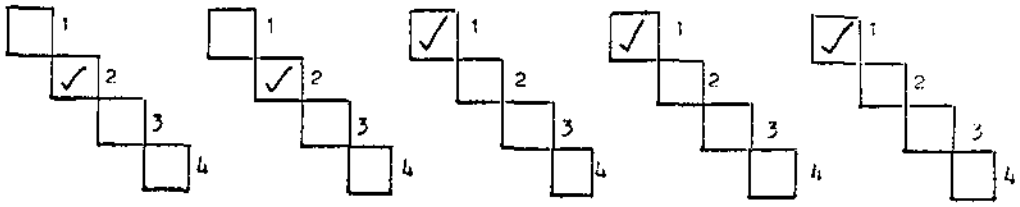
FIELD TEXTURE

Organic 1
Sand 2
Loam 3
Silt 4
Clay 5



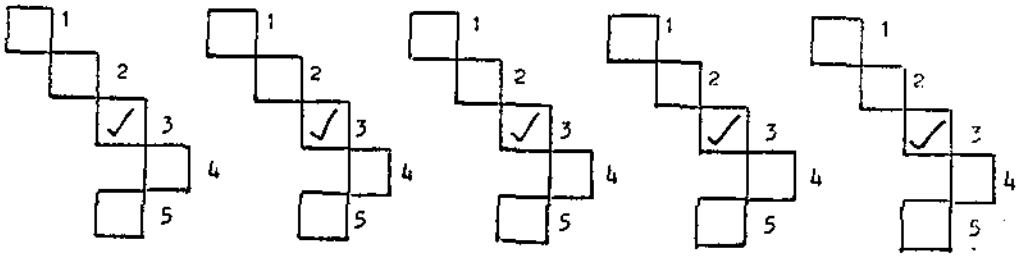
ORGANIC MATTER

Low
Moderate
High
Peaty



OVERALL STONINESS

Stoneless
Slightly stony
Stony
Very stony
Extremely stony



INDIVIDUAL STONE TYPES

A. QUANTITY

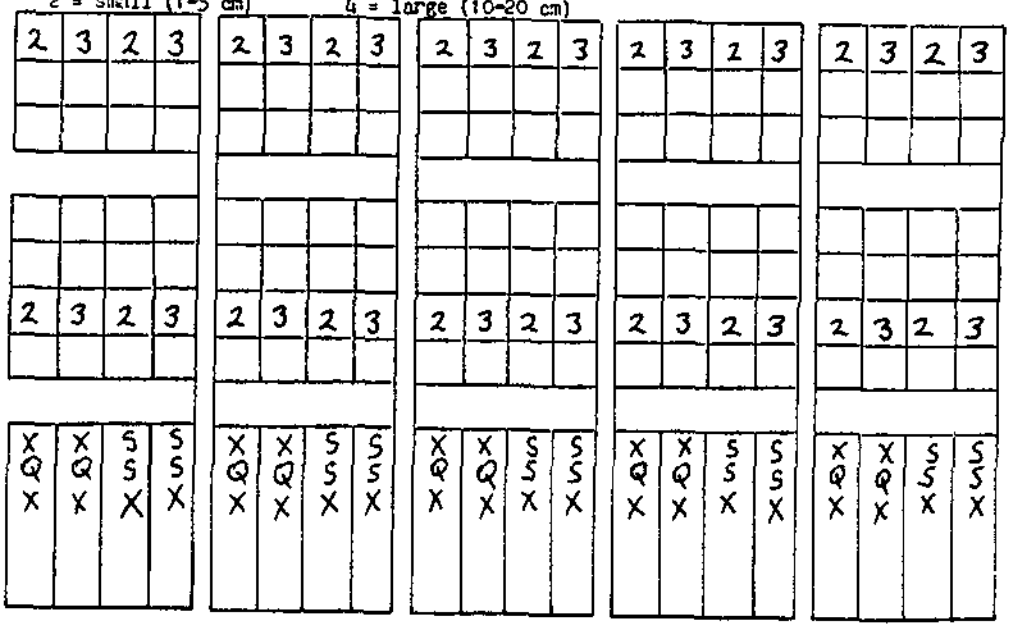
1 = gravel (0.2-1.0 cm) 3 = medium (5-10 cm) 5 = very large (>20 cm)
2 = small (1-5 cm) 4 = large (10-20 cm)

Few 1
Common 2
Abundant 3

B. SHAPE

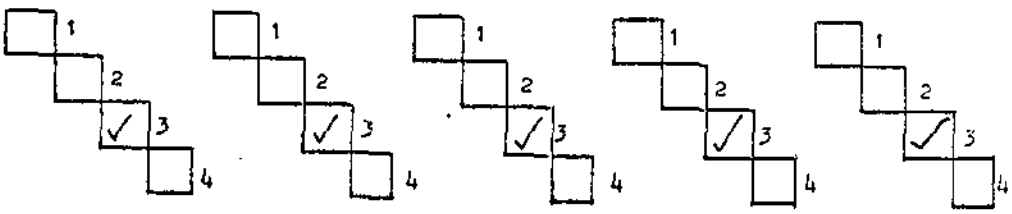
Angular 4
Subangular 5
Rounded 6
Platy 7

C. LITHOLOGY



POROSITY

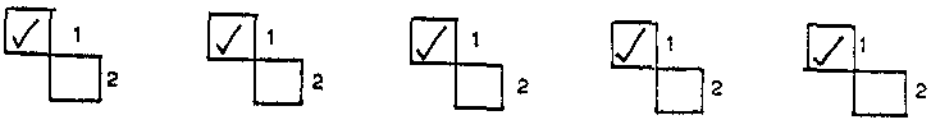
Low
Moderate
High
Very high



SOIL STRUCTURE

1. STRUCTURELESS SOILS

Single grain
Massive



C. STRUCTURED SOILS

D = DOMINANT B = BREAKING TO

A. PED SHAPE

		D	B
Crumb	1		
Subangular	2		
Angular	3		
Platy	4		
Prismatic	5		
Columnar	6		

B. PED STRENGTH

		D	B
Weak	7		
Moderate	8		
Strong	9		

C. PED SIZE

		D	B
Very fine	1		
Fine	2		
Medium	3		
Course	4		
Very course	5		

CUTANS

Present	1	
Absent	✓	2

MOISTURE ON SAMPLING

Dry	1	
Moist	✓	2
Wet		3
Waterlonged		4

HANDLING CONSISTENCY

A. WHEN DRY TO MOIST

Loose	✓	1
Very friable		2
Friable		3
Firm		4
Very firm		5
Extremely firm		6

B. WHEN MOIST TO WET

Loose		1
Greasy		2
Sticky		3
Plastic		4
Very plastic		5

INDURATION

Absent	✓	1
Weak		2
Moderate		3
Strong		4

CEMENTATION

Absent 1
Weak 2
Strong 3

ROOTS

0 = absent
1 = fine (<1 mm diam.)
2 = small (1–3 mm)
3 = medium (3–10 mm)
4 = large (10–30 mm)
5 = very large (>30 mm)

Fibrous	1																		
Fleshy	2																		
Woody	3	2	3	4	5	2	3	4	5	2	3	4	5	2	3	4	5	2	3	4	5
Rhizomatous	4																		
Rare	5																		
Few	6	2	3	4	5	2	3	4	5	2	3	4	5	2	3	4	5	2	3	4	5
Common	7																		
Abundant	8																		

CONCRETIONS

		Fe/Mn	Ca	Fe/Mn	Ca	Fe/Mn	Ca	Fe/Mn	Ca	Fe/Mn	Ca
Absent	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Few	2										
Common	3										
Abundant	4										

EFFERVESCENCE WITH ACID

No reaction 1
Reaction 2

LARGE EARTHWORMS, CASTS, OR BURROWS

Not observed 1
Observed 2

COMMENTS

Horizon No. 1

Few large fleshy roots
Shows signs of incipient podsolization, bleached sand grains. Also downward movement of organic materials without churning of the soil by earthworms etc.

Horizon No.

Horizon No.

Horizon No.

Horizon No.

Appendix 2: Suggested codes for profile texture, parent material, rock and stone types, location and profile drainage

The terms "Profile texture" and "Parent Material" are included in the first block of information in order to ensure some compatability with the data collection system soon to be introduced by the Soil Survey of England and Wales. They are approximately equivalent to "Lithology" and "Stratigraphy" as used by the Survey and, with Soil Group, will help to identify a soil down to series level, thus facilitating rapid location of closely similar soils from geographically distinct areas. The terms "texture" and "parent material" have been used on the record sheet as most ecologists are more familiar with them than with the alternatives used by the Survey.

PROFILE TEXTURE

The codes used to indicate texture can also be used as optional suffixes to enlarge upon the parent material:

C - clayey
Z - silty
S - sandy
L - loamy
P - stony (from pebbles)

"Mixed textures" are indicated by a combination of the symbols, e.g. silty clay loam, ZCL, stony sandy loam, PSL. Changes in texture with depth are recorded but separated by an oblique stroke, e.g. loam over clay loam, L/CL.

PARENT MATERIAL

"In situ" parent material

1 "In situ" bedrock

1H HARD
1W Weathered or soft (e.g. decomposed dolerite or clays)
1F Fragmented (e.g. in situ frost-shattered material)

"Transported" parent materials

2 Scree
- 2B Boulder scree (more than 25 cm)
- 2C Cobble scree (6-25 cm)
- 2P Pebble scree (1-6 cm)
- 2G Gravel scree (less than 1 cm)

3 Head

4 Till

5 Fluvio-glacial deposits

6 Raised beach

7 Loess

8 Blown Sand

9 Alluvium

10 Peat

Types 3 to 8 inclusive can be enlarged upon by using the texture code listed above, e.g. glacial outwash sands 5S, clay-textured till 4C, silty texture river alluvium 9RZ.

The parent material may be layered. In such a case, the codes for the two materials are recorded but separated by an oblique stroke, e.g. 8/3PZ, blown sand over stony, silty head.

SOLID GEOLOGY and STONE TYPE

A code consisting of up to three characters is used to designate rock type and is used for stone type and as part of the code for solid geology.

The initial division is into the three major families of rocks - igneous, sedimentary and metamorphic - and the first code character is the initial letter of the relevant family, i.e. I, S, or M. The sub-divisions within the families are mainly based on rock chemistry and grain size, and as far as possible, initial letters are used to derive the code.

We realise that this system is rather cumbersome, and leads to separate codes for rocks which will behave in a very similar way as soil parent materials, e.g. granite and gneiss. Consequently, the present approach may well be modified in the future. However, this system is useful for present purposes because it is flexible, and this flexibility is essential until we see the ways in which the data bank will be used. This system of coding allows for a considerable range of expertise in the observer. Thus, one recorder may be able to say little more than that a rock is igneous (IXX), whereas another may recognise it as a rhyolite (IFA).

A. Igneous Rocks:

1st character (Family)	2nd character (Grain size)	3rd character (Chemistry)
I	F (fine grained)	A (acid)
	M (medium grained)	B (basic)
	C (coarse grained)	I (intermediate)
		U (ultrabasic)
		M (ultramafic)
		K (calcareous)
		X (unknown or uncertain)

Examples:

Granite	- ICA
Basalt	- IFB
Dolerite	- IMB
Rhyolite	- IFA
Gabbro	- ICB
Andesite	- IFI
Diorite	- ICI
Peridotite	- ICU
Fine grained igneous of unknown chemistry	- IFX

B. Metamorphic Rocks

1st character (Family)	2nd character	3rd character Chemistry (optional)
M	Z (Slate)	A (acid)
	P (Phyllite)	B (basic)
	S (Schist)	I (intermediate)
	G (Gneiss)	U (ultrabasic)
	H (Hornfels)	M (ultramafic)
	A (Amphibolite)	K (calcareous)
	Q (Quartzite)	X unknown, or 'chemical
	M (Marble)	symbol' not required

The second character represents a mixture of things and as such it is unsatisfactory (in fact this whole family is rather unsatisfactory): thus some names infer grain size and texture, e.g. slate, schist, and gneiss, some texture alone, e.g. hornfels, and some chemistry, e.g. marble.

The third character is provided to allow sub-division of the schists, gneisses and hornfels, e.g. a calcareous schist MSK can be differentiated.

Because of the method of deriving the second character the first (M) is superfluous (insofar as it conveys no further information about the rock) but has to be included to maintain continuity.

Unknown metamorphic rock	MXX
Slate	MZX

C. Sedimentary Rocks

1st character (Family)	2nd character	3rd character (optional)
S	S (Sandstone)	K (calcareous)
	A (Arkose)	F (ferritic)
	G (Greywacke)	P (phosphatic)
	Z (Shale, Mudstone)	S (siliceous)
	K (Chalk, Limestone)	X (unknown or uncertain)
	D (Dolomite)	
	P (Conglomerate, Breccia)	
	C (Clay)	

As with the metamorphic rocks, the second character is derived directly from the rock name and therefore has differing basis, e.g. grain size and chemistry.

Clay (C) is included to allow differentiation between Palaeozoic shales and mudstones and the Mesozoic and Cainozoic clay deposits, e.g. London Clay and Gault Clay.

The third character would be used mainly to sub-divide sandstones.

It is realised that the above scheme does not specifically accommodate several types of sedimentary rocks and modifications are being tried.

The solid geology code is completed by an index letter used to indicate stratigraphy and separated from the rock type code by an oblique stroke. The index letters suggested are those used by the Geological Survey and are listed below; this facilitates transfer of data from printed geological maps in a ready coded form.

m	Holocene
l	Pleistocene
k	Pliocene
i	Eocene and Oligocene
h	Cretaceous
g	Jurassic
f	Triassic
e	Permian
d	Carboniferous
c	Devonian
b	Ordovician and Silurian
a	Cambrian
x	Pre-Cambrian
t	Torridonian

This code will be mainly used with sedimentary rocks; as it may commonly be omitted it is placed after the rock type code.

Examples of some full "solid geology" codes are as follows:

SZX/b	Ordovician or Silurian shale
SKZ/d	Carboniferous Limestone
SSS/x	Pre-Cambrian orthoquartzite
SCX/h	Cretaceous clay (e.g. Gault Clay)

LOCATION DRAINAGE

The following code numbers are used:

1 Shedding
2 Normal
3 Receiving
4 Flooding (freshwater)
5 Flooding (saltwater)
6 Flushed

The observer may find it more convenient to write the appropriate word on the form in the field. In the laboratory, the code number can be substituted by the observer, or by the editor. This reduces the amount of coding to be done in the field.

PROFILE DRAINAGE

This is a single digit code as follows:

1. Well-drained
2. Moderately well-drained
3. Imperfectly drained
4. Poorly drained
5. Very poorly drained

Intermediate conditions, such as "Well drained to moderately well drained" can be given as the midway point, e.g. 1.5.

Observers may find it more convenient to enter the appropriate word on the form in the field. The word can be replaced by the code number in the laboratory either by the observer, or by the editor. This would reduce the amount of coding to be done in the field.

APPENDIX 3 Codes for major soil groups (after Avery, 1973)

MAJOR GROUP	GROUP	SUB-GROUP
TERRESTRIAL RAW SOILS	1.1 Raw Sands	
	1.2 Raw Alluvial Soils	
	1.3 Raw Skeletal Soils	
	1.4 Raw Earths	
	1.5 Man-made Raw Soils	
HYDRIC RAW SOILS	2.1 Raw Sandy Gley Soils	
	2.2 Unripened Gley Soils	
LITHOMORPHIC (A/C/) SOILS	3.1 Rankers	3.11 Humic Ranker 3.12 Grey (Non-Humic) Ranker 3.13 Brown (Non-Humic) Ranker 3.14 Podzolic Ranker with greyish E 3.15 Stagnogleyic (fragic) Ranker
	3.2 Sand-Rankers	3.21 Typical Sand-Ranker 3.22 Podzolic Sand-Ranker 3.23 Gleyic Sand-Ranker
	3.3 Ranker-like Alluvial Soils	3.31 Typical Ranker-like Alluvial Soil 3.32 Gleyic Ranker-like Alluvial Soil
	3.4 Rendzinas	3.41 Humic Rendzina 3.42 Grey (Non-Humic) Rendzina 3.43 Brown (Non-humic) Rendzina 3.44 Colluvial (Non-Humic) Rendzina 3.45 Gleyic Rendzina 3.46 Humic Gleyic Rendzina
	3.5 Pararendzinas	3.51 Typical (Non-Humic) Pararendzina 3.52 Humic Pararendzina 3.53 Colluvial Pararendzina 3.54 Stagnogleyic Pararendzina 3.55 Gleyic Pararendzina
	3.6 Sand-Pararendzinas	3.61 Typical Sand-Pararendzina
	3.7 Rendzina-like Alluvial Soils	3.71 Typical Rendzina-like Alluvial Soil 3.72 Gleyic Rendzina-like Alluvial Soil
PELOSOLS	4.1 Calcareous Pelosols	4.11 Typical (Stagnogleyic) Calcareous Pelosol
	4.2 Non-Calcareous Pelosols	4.21 Typical (Stagnogleyic) Non-Calcareous Pelosol
	4.3 Argillic Pelosols	4.31 Typical (Stagnogleyic) Argillic Pelosol

MAJOR GROUP	GROUP	SUB-GROUP
BROWN SOILS	5.1 Brown Calcareous Earths	5.11 Typical Brown Calcareous Earth 5.12 Gleyic Brown Calcareous Earth 5.13 Stagnogleyic Brown Calcareous Earth
	5.2 Brown Calcareous Sands	5.21 Typical Brown Calcareous Sand 5.22 Gleyic Brown Calcareous Sand
	5.3 Brown Calcareous Alluvial Soils	5.31 Typical Brown Calcareous Alluvial Soil 5.32 Gleyic Brown Calcareous Alluvial Soil
	5.4 Brown Earths (sensu stricto)	5.41 Typical Brown Earth 5.42 Stagnogleyic Brown Earth 5.43 Gleyic Brown Earth 5.44 Ferritic Brown Earth 5.45 Stagnoglayic Brown Earth
	5.5 Brown Sands	5.51 Typical Brown Sand 5.52 Gleyic Brown Sand 5.53 Stagnogleyic Brown Sand 5.54 Argillic Brown Sand 5.55 Gleyic Argillic Brown Earth
	5.6 Brown Alluvial Soils	5.61 Typical Brown Alluvial Soil 5.62 Gleyic Brown Alluvial Soil
	5.7 Argillic Brown Earths	5.71 Typical Argillic Brown Earth 5.72 Stagnogleyic Argillic Brown Earth 5.73 Gleyic Argillic Brown Earth
	5.8 Paleo-Argillic Brown Earths	5.81 Typical Paleo-Argillic Brown Earth 5.82 Stagnogleyic Paleo-Argillic Brown Earth
PODZOLIC SOILS	6.1 Brown Podzolic Soils	6.11 Typical (Non-Humus) Brown Podzolic Soil 6.12 Humic Brown Podzolic Soil 6.13 Paleo-Argillic Brown Podzolic Soil 6.14 Stagnogleyic Brown Podzolic Soil 6.15 Gleyic Brown Podzolic Soil
	6.2 Humic Cryptopodzols	6.21 Typical Humic Cryptopodzols
	6.3 Podzols (sensu stricto)	6.31 Typical (Humo-Ferric) Podzol 6.32 Humus Podzol 6.33 Ferric Podzol 6.34 Paleo-Argillic (Humo-Ferric) Podzol 6.35 Ferri-Humic Podzol
	6.4 Gley-Podzols	6.41 Typical (Humus) Gley-Podzol 6.42 Humo-Ferric Gley Podzol 6.43 Stagnogley-Podzol 6.44 Humic (Peaty) Gley-Podzol
	6.5 Stagno-Podzols	6.51 Ironpan Stagno-Podzol 6.52 Humus-Ironpan Stagno-Podzol 6.53 Hardpan Stagno-Podzol 6.54 Ferric Stagno-Podzol

MAJOR GROUP	GROUP	SUB-GROUP
SURFACE-WATER GLEY SOILS (Stagnogley sensu lato)	7.1 Stagnogley Soils (sensu stricto Pseudogley)	7.11 Typical (Argillic) Stagnogley Soil 7.12 Pelo-Stagnogley Soil 7.13 Cambic Stagnogley Soil 7.14 Paleo-Argillic Stagnogley Soil 7.15 Sandy Stagnogley Soil
	7.2 Stagnohumic Gley Soils	7.21 Cambic Stagnohumic Gley Soil 7.22 Argillic Stagnohumic Gley Soil 7.23 Paleo-Argillic Stagnohumic Gley Soil 7.24 Sandy Stagnohumic Gley Soil
GROUND-WATER GLEY SOILS	8.1 Alluvial Gley Soils	8.11 Typical (Non-Calcareous) Alluvial Gley Soil 8.12 Calcareous Alluvial Gley Soil 8.13 Pelo-(Vertic) Alluvial Gley Soil 8.14 Pelo-Calcareous Alluvial Gley Soil 8.15 Sulphuric Alluvial Gley Soil
	8.2 Sandy Gley Soils	8.21 Typical (Non-Calcareous) Sandy Gley Soil 8.22 Calcareous Sandy Gley Soil
	8.3 Cambic Gley Soils	8.31 Typical (Non-Calcareous) Cambic Gley Soil 8.32 Calcaro-Cambic Gley Soil 8.33 Pelo-(Vertic) Cambic Gley Soil
	8.4 Argillic Gley Soil	8.41 Typical Argillic Gley Soil 8.42 Sandy-Argillic Gley Soil
	8.5 *Humic-Alluvial Gley Soils*	8.51 Typical (Non-Calcareous) Humic-Alluvial Gley Soil 8.52 Calcareous Humic-Alluvial Gley Soil 8.53 Sulphuric Humic-Alluvial Gley Soil
	8.6 Humic-Sandy Gley Soils	8.61 Typical Humic-Sandy Gley Soil
	8.7 Humic Gley Soils (sensu stricto)	8.71 Typical (Non-Calcareous) Humic Gley Soil 8.72 Calcareous Humic Gley Soil 8.73 Argillic Humic Gley Soil
MAN-MADE SOILS	9.1 Man-made Humus Soils	9.11 Sandy man-made Humus Soils 9.12 Earth Man-made Humus Soils
	9.2 Disturbed Soils	
PEAT (ORGANIC) SOILS	10.1 Raw Peat Soils	10.11 Raw Oligo-Fibrous Peat Soil 10.12 Raw Eu-Fibrous Peat Soil 10.13 Raw (Unripened) Oligo-Amorphous Peat Soil 10.14 Raw (Unripened) Eutro-Amorphous Peat Soil
	10.2 Earthy Peat Soils	10.21 Earthy Oligo-Fibrous Peat Soil 10.22 Earthy Eu-Fibrous Peat Soil 10.23 Earthy Oligo-Amorphous Peat Soil 10.24 Earthy Eutro-Amorphous Peat Soil 10.25 Earthy Sulphuric Peat Soil

Appendix 4: Codes for vegetation type, plant species, and nature of F layer

A. Vegetation type

The coding system recommended for general use is that of Fosberg, which is given by Peterken (1967). The source should be consulted for full details, including a key for the identification of the types. An abbreviated form of the classification is given below, with emphasis on the types most likely to be found in Britain. Some workers find the term 'savanna' difficult to accept in a British context, although there seems to be no logical objection to the term. Those who so prefer may mentally substitute the term 'parkland'.

1 CLOSED VEGETATION
(Crowns or peripheries of plants touching or overlapping)

1A Forest
(Closed woody vegetation, 5 m or more tall)

1A1 Evergreen forest (at least the canopy layer with no significant leafless period)

7 Evergreen narrow sclerophyll forest (needle-leaved forest)
(A) Resinous evergreen narrow sclerophyll forest (dominantly coniferous, e.g. Pinus, Picea forests)

1A2 Deciduous forest (at least the canopy layer bare of leaves for a period during cold or dry season)

1 Winter-deciduous orthophyll forest (hardwood forest, e.g. Fagus and Quercus forests)

2 Deciduous swamp forest (e.g. Alnus)

1B Scrub
(Closed woody vegetation 5 m or less tall)

1B1 Evergreen scrub

7 Straight evergreen narrow sclerophyll scrub (not especially gnarled, e.g. Juniperus)

8 Microphyllous evergreen scrub (often thorny)
(A) Green microphyllous evergreen scrub (e.g. Broom, gorse)

1B2 Deciduous scrub

1 Deciduous orthophyll scrub
(A) Mesophyllous deciduous orthophyll scrub (e.g. Salix, Crataegus)

2 Deciduous swamp scrub
(A) Mesophyllous deciduous orthophyll swamp scrub (e.g. Alnus)

1C Dwarf scrub
(Closed predominantly woody vegetation less than 0.5 m tall)

1C1 Evergreen dwarf scrub

2 Evergreen broad sclerophyll dwarf scrub
(A) Mesophyllous broad sclerophyll dwarf scrub (e.g. Arctostaphylos uva-ursi mat)

(B) Microphyllous evergreen dwarf scrub (Without significant peat accumulation, e.g. some Calluna?)

(C) Microphyllous evergreen dwarf heath (with peat accumulation, e.g. Empetrum heath, Loiseleuria heath)

1C2 Deciduous dwarf scrub

1 Deciduous orthophyll dwarf scrub
(A) Deciduous orthophyll dwarf scrub (without significant peat accumulation, e.g. lowbush Vaccinium scrub)

(B) Deciduous orthophyll dwarf heath (with peat accumulation, e.g. Vaccinium myrtillus heath).

1D Open forest with closed lower layers
(Trees with crowns not touching, crowns mostly not separated by more than their diameters)

1D1 Evergreen open forest with closed lower layers

2 Open evergreen swamp
(A) Open narrow sclerophyll swamp (open conifer forest on swamp, e.g. Spruce)

4 Open evergreen narrow sclerophyll forest
(A) Resinous open evergreen narrow sclerophyll forest (e.g. *open conifer forests*)

1D2 Open deciduous forest with closed lower layers

1 Open deciduous orthophyll forest (e.g. open hardwood forest)

2 Open deciduous swamp
(A) Open broad orthophyll swamp (e.g. open hardwood forest swamp)

3 Open deciduous narrow sclerophyll forest (e.g. open Larix forest)

1E Closed scrub with scattered trees

1E1 Closed evergreen scrub with scattered trees (at least shrub layer evergreen)

1E2 Closed deciduous scrub with scattered trees

1 Deciduous orthophyll scrub with trees

1F Dwarf scrub with scattered trees

1F1 Evergreen dwarf scrub with scattered trees

1 Microphyllous evergreen dwarf scrub with trees (without significant peat formation, e.g. Calluna heath with Pinus)

2 Microphyllous evergreen heath with trees (with peat accumulation)

1F2 Deciduous dwarf scrub with trees

1 Deciduous heath with trees (with significant peat accumulation, e.g. Vaccinium phase of heath birch forest)

1G Open scrub with closed ground cover

1G1 Open evergreen scrub with closed ground cover

4 Open microphyllous evergreen scrub (e.g. broom, gorse)

1G2 Open deciduous scrub with closed ground cover

1 Open deciduous orthophyll scrub with closed ground cover (e.g. Betula, Salix)

1H Open dwarf scrub with closed ground cover

1H1 Open evergreen dwarf scrub with closed ground cover

3 Open evergreen microphyllous dwarf scrub (e.g. open Erica and Calluna heath lower phases)

1H2 Open deciduous dwarf scrub with closed ground cover

1I Tall savanna

(Closed grass or other herbaceous vegetation 1 m or more tall, with scattered trees)

1I1 Evergreen savanna (trees evergreen)

1 Evergreen orthophyll savanna (e.g. Bracken with scattered conifers?)

1I2 Deciduous tall savanna (trees deciduous)

1 Deciduous orthophyll savanna (e.g. Bracken with scattered hardwoods?)

1J Low savanna

(Herbaceous vegetation less than 1 m tall, with scattered trees)

1J1 Evergreen low savanna (trees evergreen)

1 Evergreen orthophyll low savanna (i.e. scattered conifers with low closed grass or herb layer)

1J2 Deciduous low savanna

1 Deciduous orthophyll low savanna (i.e. scattered deciduous trees with low closed grass or herb layer)

1K Shrub savanna
(Closed grass or other herbaceous vegetation with scattered shrubs)

1K1 Evergreen shrub savanna

3 Evergreen narrow sclerophyll shrub savanna
(A) Resinous evergreen narrow sclerophyll shrub savanna (e.g. Juniperus communis savanna)

1K2 Deciduous shrub savanna

1 Deciduous orthophyll shrub savanna (e.g. successional stages of deciduous shrub on grassland)

4 Mesophyllous deciduous thorn shrub savanna (e.g. Crataegus?)

1L Tall grass
(Closed herbaceous vegetation exceeding 1 m in height, predominantly graminoid)

1L1 Evergreen tall grass (shoots remaining green the year round)

2 Tall evergreen graminoid marsh (e.g. Scirpus, Typha)

1L2 Seasonal tall grass (turning brown in dry season or winter, often burned)

1M Short grass
(Closed herbaceous vegetation, less than 1 m tall, predominantly graminoid)

1M1 Evergreen short grass

1M2 Seasonal short grass

1 Seasonal orthophyll meadows (short grass, e.g. most temperate zone pastures)

2 Seasonal orthophyll marsh (e.g. salt marsh)

1N Broad-leafed herb vegetation
(Closed vegetation, predominantly of broad-leafed herbaceous plants)

1N1 Evergreen broad-leafed herb vegetation

1N2 Seasonal broad-leafed herb vegetation

2 Seasonal fern meadow (e.g. Bracken brake)

1O Closed bryoid vegetation

1O1 Closed bryophyte vegetation

1O2 Closed lichen vegetation

1P Submerged meadows

1P1 Evergreen submerged meadows

1P2 Seasonal submerged meadows

1 Seasonal watergrass (e.g. Zostera marina, temperate coasts)

1Q Floating meadows

2 OPEN VEGETATION
(Plants or tufts of plants not touching, but crowns not separated by more than their diameters; plants, not substratum, dominating landscape)

These are mostly steppe vegetation types and are not likely to be encountered in Britain, or at least only in exceptional circumstances

2I Open submerged meadows

2I2 Seasonal open submerged meadows

1 Seasonal watergrass (e.g. Zostera, open phases)

3 SPARSE VEGETATION OR DESERT
(Plants so scattered that the substratum dominates the landscape)

In Britain this type may be found in some situations, e.g. sand dunes

In dealing with forestry plantations, it is likely that some stretching of definition will be necessary, e.g. young trees may be classed as shrubs for convenience, but this will be obvious from the species list. It is also possible that additional subtypes may be necessary.

B. Plant species

For this we recommend the coding system used by the Biological Records Centre and given in their 'Provisional Check-list of British Vascular Plants.' Only the currently accepted name of the taxon should be used. Most of the plants likely to be encountered are listed (with codes) on the B.R.C. Record Card. If a species cannot be identified with confidence, a shortened form of the generic name (e.g. see B.R.C. recording card) can be entered.

C. Nature of F layer

The following terms are suggested:

loose	:	plant remains loose and freable, not coherent
layered	:	plant material in the F layer peels off in definite layers
matted	:	plant remains firmly matted into one layer
rooty	:	mostly dead roots
fibrous	:	consisting mostly of fibrous plant remains, e.g. midribs.

Appendix 5: Codes for horizon boundary sharpness and type, and horizon nomenclature

A. Horizon boundary sharpness and type

This is a 2-digit code, the first digit indicates CLARITY, as follows:

1. Sharp (changes within 2 cm)
2. Narrow (changes within 2 to 5 cm)
3. Merging (changes within 5 to 10 cm)
4. Diffuse (changes within more than 10 cm)

The second digit indicates the type of boundary, as follows:

5. Even
6. Undulating
7. Irregular
8. Tongued
9. Broken

B. Horizon nomenclature

This usage is recommended by the Pedology Section at the time of writing, it is in general conformity with a currently widely employed system, though it differs from the convention used in Britain by many workers in past years. It is based on capital letter "Master Horizons", small letter horizon sub-classes and a number of numerical indices (note that on the computer only capital letters are available).

Master Horizon Symbols

O - Horizon which, although it may contain some mineral admixture, is dominated by the organic fraction (loss-on-ignition values greater than 30%)

A - Horizon at or near the soil surface, consisting of an intimate mixture of organic and mineral material, failing to fulfil the definition of the O master horizon (loss-on-ignition values less than 30%)

E - Horizon below O or A horizons from which sesquioxides (Fe and Al) and/or clay have been removed

B - Sub-surface horizon of mineral material, modified by physical, chemical or biological alteration so that it is differentiated by structure, colour or texture from horizons above or below

C - Mineral matter which has been little altered by pedological processes other than gleying (due to waterlogging) or the accumulation of secondary salts (typically of Ca or Na)

R - Unaltered rock, which, even when moist, is too hard to be dug with a spade.

Intergrades between master horizons may be indicated as A/B, B/C, etc. Only suffixes given below as applicable to all horizons would be applied to such intergrade horizons.

Numerical Prefixes and Suffixes

Arabic number prefixes are used to indicate buried soil profiles or horizons. By convention, 1 is omitted, for example a sand-dune section might show horizons A, B, 2B, 2C, 3A, 3C.

Arabic number prefixes are used to indicate original geological (rather than pedological) discontinuities within the soil profile. For example, wind-blown sand may overlie boulder-clay giving a horizon sequence of A, E, B, IIC.

Arabic number suffixes are used where a master horizon is subdivided on grounds other than those indicated by addition of letter suffixes. In such cases one might have A1, A2, B1, B2, B3, C1. This usage could cause confusion with other horizon nomenclatures still found in use in which number suffixes were used in the way letters are here (e.g. Ba is equivalent to old A_2. Care should be taken in equating horizons from the literature with those indexed as recommended here).

Subordinate Horizon Symbols

Suffixes applicable to any Master Horizon

g - horizon dominated by structural and colour effects resulting from long-term waterlogging

h - horizons showing evidence in structural and colour effects of the influence of moderate periods of waterlogging

c - horizon containing residual calcium carbonate

k - horizon containing deposits of secondary calcium carbonate

n - horizon containing excess of sodium in the exchangeable cations, or free sodium chloride

x - horizon having a massive consistency due to induration

Suffixes applicable to O Horizons

O - horizon having a loss-on-ignition value greater than 60% and a thickness greater than 15 cm

l - horizon of little altered plant remains

f - horizon of partially broken down and decomposed plant remains which are still recognisable to the naked eye

h - horizon of decomposed humified plant remains with no original macroscopic structure recognisable

p - ploughed or otherwise cultivated horizon

Suffixes applicable to A Horizons

h - horizon visibly darkened by having a high content of organic matter while not fulfilling the requirements for the O master horizon

he - as for h, but also including bleached sand grains or rock fragments

p - defined as for O horizons

an - surface horizon artificially deepened or modified by the addition of material by man

Suffixes applicable to E Horizons

a - horizon which has suffered loss of sesquioxides

b - horizon which has suffered loss of clay-size material

Suffixes applicable to B Horizons

h - horizon with level of humic organic matter which is high compared to horizons above and below

s - horizon with levels of sesquioxides (Fe and/or Al) which are high compared to horizons above and below

t - horizons with clay content which is high compared to horizons above and below

f - thin iron pan

Suffixes applicable to C Horizons

r - horizon predominantly composed of scattered or weathered material derived from underlying solid rock (R horizon).

APPENDIX G. Comparison of descriptive forms used by I.T.E., Soil Survey of England and Wales, and F.A.O.

INSTITUTE OF TERRESTRIAL ECOLOGY	SOIL SURVEY OF ENGLAND AND WALES	F.A.O.
Drainage Class		
Very poorly drained Poorly drained Imperfectly drained Moderately well drained Well drained		Very poorly drained Poorly drained Imperfectly drained Moderately well drained Well drained Somewhat excessively drained Excessively drained
Location (= site) Drainage		
Shedding Normal Receiving Flooding - freshwater Flooding - saltwater Flushed	Shedding Normal Receiving Regular Flooding - short term - long term Occasional Flooding - short term - long term Flush site Salt Water Flooding -regular short term - long term Salt Water Flooding - occasional short term - occasional long term	Not recorded
Lower Boundary Sharpness		
Sharp <2 cm Narrow 2-5 cm Merging 5-10 cm Diffuse >10 cm		Width of boundary: Abrupt <2 cm Clear 2-5 cm Gradual 5-12 cm Diffuse >12 cm
Nature of Boundary		
Even Undulating Irregular Tongued Broken		"Topography of Boundary" Smooth Wavy Irregular Broken
Colour		
Matrix, ped face and root channels recorded		
Mottles		
Colour Colours of up to four groups of mottles recorded as Munsell codes or descriptively	Recorded as Munsell code	(Also suggests recording this)

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Frequency (= Abundance)

	% cover
Absent	
Few	<2
Common	2–20
Abundant	>20

(When no definite matrix colour, matrix box left blank and mottles only recorded)

Size

	(mm)
Very fine	<2
Fine	2–5
Medium	5–15
Large	>15

Contrast with matrix colour

Faint
Distinct
Prominent

Boundary Sharpness

Not recorded

SOIL SURVEY OF ENGLAND AND WALES

	% cover
None	
Few	<2
Common	2–5
Common	5–20
Definite matrix colour	20–50
No definite matrix colour	>20
Definite matrix colour	>50

	(mm)
(Extremely fine	<1
(Very fine	1–2
Fine	2–5
Medium	5–15
Large	>15

Not recorded

Boundary Sharpness: Diffuse >2 mm
Clear <2 mm
Sharp = Knifedged

F.A.O.

	% cover
Few	<2
Common	2–20
Many	>20

(When no definite matrix, colours listed followed by word "mottled")

	(mm)
Fine	<5
Medium	5–15
Coarse	>15

Contrast:
Faint
Distinct
Prominent

Not recorded

Organic Matter (= Organic matter + peat)

	%
Low	<8
Moderate	8–25
High	25–40
Peaty	40+

	%
Non humose	<8
Slightly humose	8–13
Humose	13–25
Very humose	25–40
Organic	>40

Not recorded

Stones

Stoniness	% cover
Stoneless	<1
Slightly stony	1–5
Stony	5–20
Very stony	20–50
Extremely stony	>50

Stone quantity	% cover
Stoneless	<1
Slightly stony	1–5
Stony	5–20
Very stony	20–50
Extremely stony	50–75
Stone dominant	>75

"Stoniness" term to be used as a prefix to the textural class

% of large particles	Size of particles (cm) 0.2–7.5	7.5–25	>25
2–15	slightly gravelly	sl. stony	bouldery
15–50	gravelly	stony	bouldery
50–90	very gravelly	very stony	very bouldery
90	gravel	stones	boulders

Terms applied to "types" of stones present

INSTITUTE OF TERRESTRIAL ECOLOGY

Up to four stone "types" can be listed and for each of these, abundance, size, shape and lithology is noted.

Abundance

Few
Common
Abundant
(No quantitative limits fixed as yet)

Size

	(cm)
Gravel	0.2-1.0
Small	1-5
Medium	5-10
Large	10-20
Very large	20-60

Shape

Angular
Sub-angular
Rounded
Flaky

Lithology

Recorded as the code listed for rock types

SOIL SURVEY OF ENGLAND AND WALES

"Dominant" and "Subordinate" stones noted and for each size, shape and lithology recorded.

Not noted

	(cm)
Gravel	0.2-1.0
Small	1-5
Medium	5-10
Large	10-20
Very large	20-60
	60-200
	200-600
	> 600

Angular
Sub-angular
Rounded
Shaley
Tabular

Recorded using special code

F.A.O.

Handbook states that: "Ideally the description of such particles (i.e. 2 mm) should include information on their abundance, size, shape and nature.

	% volume
Very few	<5
Few	5-15
Frequent	15-40
Very frequent	40-80

	(cm)
Gravel	0.2-7.5
Stones	7.5-25
Boulders	> 25

Angular
Rounded
Flat

Recorded if known

"Pores"

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Total void quantity	
Non porous	<1
Low porosity	1-10
Medium porosity	10-20
High porosity	20-40
Very high porosity	>40

SOIL SURVEY OF ENGLAND AND WALES

Scheme 1	Pore quantity (dm^{-2})
None	
Very rare	<1
Rare	1-5
Few	5-10
Common	10-50
Abundant	100-500
Extremely abundant	>500

Pore size (mm)	
Very fine	<0.5
Fine	0.5-1.0
Medium	1-3
Large	3-5
Very large	> 5

Scheme 2	Total void quantity %
Non porous	<1
Slightly porous	1-5
Porous	5-10
Porous	10-20
Very porous	20-40
Extremely porous	>40

F.A.O.

Pore quantity (dm^{-2})	
Few	1-50
Common	51-200
Many	>200

Diameter classes (mm)	
Micro	< 0.075
Very fine	0.075-1.0
Fine	1-2
Medium	2-5
Coarse	>5

(Also suggest noting "continuity", "orientation", "distribution" and "morphology" of pores)

INSTITUTE OF TERRESTRIAL ECOLOGY	SOIL SURVEY OF ENGLAND AND WALES	F.A.O.
Initial division: Structured Structureless Massive Single grain		
Ped shape Crumb Sub-angular Angular Platy Prismatic Columnar	= Structure type Platy Prismatic Columnar Angular blocky Sub-angular blocky Granular Crumb Single grain Massive	= Form Platy Prismatic Columnar Angular blocky Sub-angular blocky Granular Crumb
Strength Weak Moderate Strong	= Structural degree Structureless Weak Moderate Strong	= Grade Structureless Weak Moderate Strong
Ped size	= Structure size	= Size

	platy	prism	block	crumb
Single grain				
Very fine	<1	<10	<5	<1
Fine	1–2	10–20	5–10	1–2
Medium	2–5	20–50	10–20	2–5
Coarse	5–10	50–100	20–50	5–10
Very coarse	>10	>100	>50	>10
Massive				

(Provision to record "dominant" structure and variation to .....")

Cutans		
Presence Absence	Absence Weak Moderate Strong	Thickness: Thin Moderately thick Thick Continuity: Patchy Broken Continuous Nature: (Qualitative in the field)
Moisture		
Dry Moist Wet Waterlogged	Dry Slightly moist Moist Wet Waterlogged	(No specific terms suggested)
Consistence		
(a) When dry/moist Loose Very friable	(1) Friability: Loose Very friable Friable	(a) When dry: Loose Soft Slightly hard

INSTITUTE OF TERRESTRIAL ECOLOGY	SOIL SURVEY OF ENGLAND AND WALES	F.A.O.
Friable Firm Extremely firm (b) When moist-wet: Loose Sticky Greasy Plastic Very plastic	Firm Very firm Extremely firm (ii) Plasticity: Non plastic Slightly plastic Plastic Very plastic	Hard Very hard Extremely hard (b) When moist: Loose Very friable Friable Firm Very firm Extremely firm (c) When wet: Non sticky Slightly sticky Sticky Very sticky Non plastic Slightly plastic Plastic Very plastic
Induration		
Absent Weak Strong Very strong	No equivalent provided	Not recorded
Cementation		
Absent Weak Strong	Weakly cemented) Crowned Cemented) with Very strongly cemented) consistence	Weakly Strongly Very strongly
"Roots"		
Majority of roots of one nature, abundance of each of four types of roots in each horizon	Total amount of roots: Quantity per 3 cm² None 0 Very few <1 Rare 1–5 Few 5–10 Common 10–100 Abundant 100–500 Extremely abundant >500	Quantity None Very few Few Common Frequent Abundant (Not rigidly defined)
Diameter mm Fine <1 Small 1–2 Medium 2–10 Large 10–30 Very large >30	Root size: mm diameter Fine <1 Small 1–3 Medium 3–10 Large 10–30 Very large >30	Size: Very fine <1 mm Fine 1–2 mm Medium 2–5 mm Coarse >5 mm
Woody Fibrous Fleshy Rhizomatous	Root nature: Woody Fibrous Fleshy Rhizomatous	(Not recorded)

INSTITUTE OF TERRESTRIAL ECOLOGY	SOIL SURVEY OF ENGLAND AND WALES	F.A.O.
Earthworms, Worm Channels and Casts		
Not observed Observed	No equivalent provided	Presence of worm channels recorded
$CaCO_3$		
Non calcareous (no effervescence) Calcareous (effervescence)	% Non calcareous <0.5 Very slightly calcareous 0.5-1.0 Slightly calcareous 1-5 Calcareous 5-10 Highly calcareous >10	Non calcareous)Related to Slightly calcareous)amount of Calcareous)effervescence Strongly calcareous)
Secondary Materials		
[illegible]	Type: [illegible] Depth (to two decimal points) Boundary [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]	Nodules are recorded and abundance, [illegible] hardness, shape, colour and [illegible] are noted. [illegible] (% volume) [illegible] <5 [illegible] 5-15 [illegible] 15-40 [illegible] frequent 40-80 [illegible]ant >80 Size [illegible]all <1 cm [illegible]rge >1 cm Hardness Shape Soft Spherical [illegible] Irregular Angular [illegible] and structure of pans