8FCS 8160

Thornbury, North and East

Agricultural Land Classification

July 1997

Resource Planning Team
Bristol
FRCA Western Region

Job Number 2/97

MAFF Reference EL 34/1208

THORNBURY, NORTH AND EAST

AGRICULTURAL LAND CLASSIFICATION SURVEY

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AGRICULTURAL LAND CLASSIFICATION SURVEY

INTRODUCTION

1. This report presents the findings of a semi-detailed Agricultural Land Classification (ALC) survey of 462 ha of land on the northern and eastern edges of Thornbury, South Gloucestershire. Field survey was based on 198 auger borings and 11 soil profile pits, and was completed in March 1997. During the survey six soils samples were analysed for particle size distribution (PSD).

2. The survey was conducted by the Resource Planning Team of FRCA Western Region (formally of ADAS Taunton Statutory Group) on behalf of MAFF in its statutory role in the preparation of South Gloucestershire District Local Plan.

3. Information on climate, geology and soils, and from previous ALC surveys was considered and is presented in the relevant section. The published regional ALC map (MAFF, 1977) shows the site at a reconnaissance scale as being mostly Grade 2, with areas of Grade 3 land on the edge of the site at Grovesend, Milbury Heath, Longman's Grove, Duckhole and near Thorn Hall. The site previously had a detailed survey carried out in 1975 at a scale of 1:25 000 (ADAS, 1975). However, the current survey uses the Revised Guidelines and Criteria for grading the quality of agricultural land (MAFF, 1988) and supersedes any previous ALC survey. Grade descriptions are summarised in Appendix I.

4. At the time of survey land cover was mainly permanent and ley grassland. There were small areas of horticulture at Lower Morton and cereals around Buckover. An area of 21.1 ha of agricultural land within the survey area was not surveyed because of access restrictions. Other land which was not surveyed included woodland, school sports fields, agricultural buildings and residential areas.

SUMMARY

5. The distribution of ALC grades is shown on the accompanying 1:20 000 scale ALC map. The detail of information shown at this scale is appropriate to the intensity of field survey but could be misleading if enlarged or applied to small areas. Areas are summarised in the Table 1.

Table 1: Distribution of ALC grades: Thornbury, North and East

Grade	Area (ha)	% Surveyed Area (393.2 ha)
2	112.3	28.6
3a	107.9	27.4
3b	151.9	38.6
Agricultural land not surveyed	21.1	5.4
Other land	68.8	-
Total site area	462.0	100.0

6. Of the agricultural land surveyed 56 % was mapped as "best and most versatile", with half of this being Grade 2 (very good quality land) and half being Subgrade 3a (good quality land). The Grade 2 land is well drained and has a minor workability limitation and is mainly found in the western part of the site around Lower Morton and Pound Farm. There are also three smaller areas near Grovesend, Buckover and Crossways.

7. The Subgrade 3a land is mapped throughout the site. Mainly it has a moderate wetness limitation due to restricted drainage in the subsoils but there are also better drained areas where the overall limitation is due to workability, and drought or soil depth limitations where the soil is shallower over bedrock.

8. The remainder of the site is mapped as Subgrade 3b (moderate quality land). There are two distinct limitations within these mapping units. Around Upper Morton the soil is very shallow and there is a moderate depth limitation. The rest of the mapping units have restricted drainage in the subsoil leading to a moderate wetness limitation.

CLIMATE

9. Estimates of climatic variables for this site were derived from the published agricultural climate dataset "Climatological Data for Agricultural Land Classification" (Meteorological Office, 1989) using standard interpolation procedures. Data for key points around the site are given in Table 2 below.

10. Since the ALC grade of land is determined by the most limiting factor present, overall climate is considered first because it can have an overriding influence by restricting land to a lower grade despite more favourable site and soil conditions. Parameters used for assessing overall climate are accumulated temperature, a measure of relative warmth and average annual rainfall, a measure of overall wetness. The results shown in Table 2 indicate that there is no overall climatic limitation.

11. Climatic variables also affect ALC grade through interactions with soil conditions. The most important interactive variables are Field Capacity Days (FCD) which are used in assessing soil wetness and potential Moisture Deficits calculated for wheat and potatoes, which are compared with the moisture available in each profile in assessing soil droughtiness limitations. These are described in later sections

Table 2: Climatic Interpolations: Thornbury, North and East

Grid Reference		ST 641 916	ST 651 913	ST 654 897
Altitude (m)		16	43	69
Accumulated Temperature (day °C)		1521	1491	1461
Average Annual Rainfall (mm)		837	837	841
Overall Climatic Grade		1	1	1
Field Capacity Days		183	183	183
Moisture deficit (mm):	Wheat	101	98	96
	Potatoes	93	89	85

Table 2: ... continued

Grid Reference		ST 664 904	ST 650 921	ST 654 907
Altitude (m)		75	35	43
Accumulated Temperature (day °C)		1454	1499	1491
Average Annual Rainfall (mm)		841	833	839
Overall Climatic Grade		1	1	1
Field Capacity Days		184	183	183
Moisture deficit (mm):	Wheat	95	99	98
	Potatoes	84	90	89

RELIEF

12. Altitude ranges from 13 metres Above Ordnance Datum (AOD) at Lower Morton to 100 metres AOD at Milbury Heath with mainly level (0-1°), gently sloping (2-3°) and moderately sloping (4-7°) gradients. There are two small areas of land, below Milbury Heath and Longman's Grove, which are strongly sloping (8-11°). These gradients will have a moderate limitation on the agricultural use of the land.

GEOLOGY AND SOILS

13. The underlying geology of the site is shown on the published geology map (IGS, 1981). This shows the southern part of the site, from The Knapp to the north of Crossways Farm, to be underlain by Thornbury Beds of the Upper Silurian Era. The rest of the site is mainly underlain by Dolomitic conglomerate, although there are areas of Keuper Marl to the north of Gravesend and around Longman's Grove. Some Estuarine alluvium is mapped near Park Farm.

14. The soils which were found during the current survey showed evidence of parent materials similar to those of the published geology map. However, differences in their distribution were noted. The area of Dolomitic Conglomerate appeared to be confined to Upper Morton and the Tintern Sandstone Group was not identified. Between Grovesend and Crossways there did not appear to be any distinction between the Thornbury Beds and the Dolomitic Conglomerate.

15. Soils were mapped by the Soil Survey of England and Wales at a reconnaissance scale of 1:250 000 (SSEW, 1983) and this shows that they belong to four main soil associations. The Brockhurst 2 Association is mapped around Newton, Lower Morton and Park Farm. To the south of Newton, as far as Knapp Farm, the Crwbin Association is mapped. Around Crossways soils from the Hodnet Association are mapped and to the south, near Buckover and Grovesend the Bromsgrove Association is mapped. Small areas of soils from the Fladbury 1 and Worcester Associations are mapped near Park Farm and around Longman's Grove respectively.

16. The Brockhurst 2, Bromsgrove and Hodnet Associations are described as being reddish loamy and clayey soils with slowly permeable subsoils developed over Permo-Triassic mudstones. Soils from the Bromsgrove Association are well drained reddish loamy soils over soft sandstone but may be associated with loamy soils with slowly permeable subsoils. The Fladbury 1 soils are stoneless clayey soils variably affected by groundwater while the Crwbin soils are very shallow and well drained over limestone.

17. The soils found during the recent survey were very similar to those mapped by the Soil Survey of England and Wales. The area of Crwbin soils was slightly more extensive than shown on the reconnaissance level map and the soils from the Bromsgrove Association were found throughout the site.

AGRICULTURAL LAND CLASSIFICATION

18. The distribution of ALC grades found by the current survey is shown on the accompanying 1:20 000 scale map and areas are summarised in Table 1. The detail of information shown at this scale is appropriate to the intensity of field survey but could be misleading if enlarged or applied to small areas.

Grade 2

19. The Grade 2 mapping units are subject to a minor workability limitation which may affect cultivations and harvesting. The profiles are well drained and were assessed as Wetness Class I (see Appendix 2). Typically there are medium clay loam topsoils over porous medium clay loam, sandy clay loam and clay subsoils, as shown by soil profile Pits 2, 4 and 11. The topsoil texture reduces the amount of time that the land is in a workable condition. The mapping units tend to be quite uniform although there are a few small areas which are less well drained where there may be a moderate wetness limitation. They were relatively stone free and have no drought limitation.

Subgrade 3a

20. The land mapped as Subgrade 3a tends to have a moderate wetness limitation. This will restrict moderate or high yields to a narrow band of crops as well as limiting cultivation windows. There are three types of profile within the mapping unit. Two of them have gleyed horizons above a slowly permeable subsoil and the other has deep reddish slowly permeable subsoils but no actual gleyed horizon.

21. Pits 8 and 9 are representative of profiles which are not gleyed but have a reddish clayey slowly permeable subsoil. The slowly permeable layers do not however extend to below 100 cm so the profiles were assessed as Wetness Class III. They have medium clay loam topsoils, which in conjunction with the local climate, leads to a moderate wetness limitation.

22. Pit 7 and other borings have similar profiles to those mentioned in Paragraph 21 but the reddish clayey slowly permeable layer extends to below 100 cm. With the slowly permeable layers starting below 48 cm these profiles were also assessed as Wetness Class III, giving a moderate wetness limitation.

23. A few borings within these mapping units have a gleyed horizon present but the slowly permeable layer starts lower down the profile, below 48 cm, so they were still assessed as Wetness Class III.

Subgrade 3b

24. The land mapped as Subgrade 3b around Upper Morton has a moderate depth limitation. These profiles have a medium clay loam topsoil overlying slightly fractured bedrock. The Dolomitic conglomerate occurs within 20-30 cm. This will not only dramatically reduce the amount of easily available water in the soil but it will also restrict the range and type of cultivations which can be satisfactorily carried out.

25. Most of the remaining land which is mapped as Subgrade 3b has a moderate wetness limitation. This will reduce yields to moderate or low levels depending on the crop as well as affecting the timing and type of cultivation and harvesting. These profiles can have gleying present above 40 cm but even where there is no gleyed horizon with the reddish clayey slowly permeable layers starting above 48 cm and continuing to below 100 cm they were assessed as Wetness Class IV.

26. Land mapped as Subgrade 3b below Longman's Grove and Milbury Heath has a moderate limitation to its agricultural use due to its gradient. The gradients found during the survey of 8-11° will restrict the safe and accurate use of some agricultural machinery, thus restricting cropping practises.

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June 1997

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APPENDIX I

DESCRIPTION OF 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 include 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 and horticultural crops can usually be grown but on some land in the 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.

Grade 3 - good to moderate quality agricultural land

Land with moderate limitations which affect the choice of crops, timing and type of cultivation, harvesting or the level of yield. Where 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 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 most 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 very severe limitations which restrict use to permanent pasture or rough grazing, except for occasional pioneer forage crops.

Source: MAFF (1988) Agricultural Land Classification of England and Wales Revised Guidelines and Criteria for Grading the Quality of Agricultural Land, MAFF Publications, Alnwick.

APPENDIX II

DEFINITION OF SOIL WETNESS CLASSES

Soil wetness is classified according to the depth and duration of waterlogging in the soil profile.

Wetness Class I

The soil profile is not wet within 70 cm depth for more than 30 days in most years.

Wetness Class 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 not wet within 40 cm depth for more than 30 days in most years.

Wetness Class 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 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 and 90 days in most years.

Wetness Class IV

The soil profile is wet within 70 cm depth for more than 180 days but not within 40 cm depth for more than 210 days in most years or, if there is no slowly permeable layer within 80 cm depth, it is wet within 40 cm depth for 91-210 days in most years.

Wetness Class V

The soil profile is wet within 40 cm depth for 211-335 days in most years.

Wetness Class VI

The soil profile is wet within 40 cm depth for more than 335 days in most years.

Notes: The number of days specified is not necessarily a continuous period.

'In most years' is defined as more than 10 out of 20 years.

Source: Hodgson, J M (In preparation) Soil Survey Field Handbook, Revised Edition.

APPENDIX III

ABBREVIATIONS AND TERMS USED IN SURVEY DATA

Soil pit and auger boring information collected during ALC survey is held on a computer database and is reproduced in this report. Terms used and abbreviations are set out below. These conform to definitions contained in the Soil Survey Field Handbook (Hodgson, 1974).

1. **Terms used on computer database, in order of occurrence.**

GRID REF: National 100 km grid square and 8 figure grid reference.

USE: Land Use at the time of survey

WHT:	Wheat	**SBT:**	Sugar Beet	**HTH:**	Heathland
BAR:	Barley	**BRA:**	Brassicas	**BOG:**	Bog or Marsh
OAT:	Oats	**FCD:**	Fodder Crops	**DCW:**	Deciduous Wood
CER:	Cereals	**FRT:**	Soft and Top Fruit	**CFW:**	Coniferous Woodland
MZE:	Maize	**HRT:**	Horticultural Crops	**PLO:**	Ploughed
OSR:	Oilseed Rape	**LEY:**	Ley Grass	**FLW:**	Fallow (inc. Set aside)
POT:	Potatoes	**PGR:**	Permanent Pasture	**SAS:**	Set Aside (where known)
LIN:	Linseed	**RGR:**	Rough Grazing	**OTH:**	Other
BEN:	Field Beans	**SCR:**	Scrub		

ASPECT: The aspect of the land.

GRDNT: Gradient as estimated or measured by hand-held optical clinometer.

GLEY, SPL: Depth in centimetres to gleying or slowly permeable layer.

AP (WHEAT/POTS): Crop-adjusted available water capacity.

MB (WHEAT/POTS): Moisture Balance. (Crop adjusted AP - crop potential MD)

DRT: Best grade according to soil droughtiness.

If any of the following factors are considered significant, 'Y' will be entered in the relevant column.

M.REL:	Microrelief limitation	**FLOOD:**	Flood risk	**EROSN:**	Soil erosion risk
EXP:	Exposure limitation	**FROST:**	Frost prone	**DIST:**	Disturbed land
CHEM:	Chemical limitation				

LIMIT: The main limitation to land quality: The following abbreviations are used.

OC:	Overall Climate	**AE:**	Aspect	**EX:**	Exposure
FR:	Frost Risk	**GR:**	Gradient	**MR:**	Microrelief
FL:	Flood Risk	**TX:**	Topsoil Texture	**DP:**	Soil Depth
CH:	Chemical	**WE:**	Wetness	**WK:**	Workability
DR:	Drought	**ER:**	Erosion Risk	**WD:**	Soil Wetness/Droughtiness
ST:	Topsoil Stoniness				

TEXTURE: Soil texture classes are denoted by the following abbreviations:-

S:	Sand	**LS:**	Loamy Sand	**SL:**	Sandy Loam
SZL:	Sandy Silt Loam	**CL:**	Clay Loam	**ZCL**	Silty Clay Loam
ZL:	Silt Loam	**SCL:**	Sandy Clay Loam	**C:**	Clay
SC:	Sandy clay	**ZC:**	Silty clay	**OL:**	Organic Loam
P:	Peat	**SP:**	Sandy Peat	**LP:**	Loamy Peat
PL:	Peaty Loam	**PS:**	Peaty Sand	**MZ:**	Marine Light Silts

For the sand, loamy sand, sandy loam and sandy silt loam classes, the predominant size of sand fraction will be indicated by the use of the following prefixes:-

F: Fine (more than 66% of the sand less than 0.2mm)
M: Medium (less than 66% fine sand and less than 33% coarse sand)
C: Coarse (more than 33% of the sand larger than 0.6mm)

The clay loam and silty clay loam classes will be sub-divided according to the clay content:
M: Medium (< 27% clay) **H:** heavy (27 - 35% clay)

MOTTLE COL: Mottle colour using Munsell notation.

MOTTLE ABUN: Mottle abundance, expressed as a percentage of the matrix or surface described.

F: few <2% **C:** common 2 - 20% **M:** many 20 - 40% **VM:** very many 40%+

MOTTLE CONT: Mottle contrast

F: faint - indistinct mottles, evident only on close inspection
D: distinct - mottles are readily seen
P: Prominent - mottling is conspicuous and one of the outstanding features of the horizon.

PED. COL: Ped face colour using Munsell notation.

GLEY: If the soil horizon is gleyed a 'Y' will appear in this column. If slightly gleyed, and S' will appear.

STONE LITH: Stone Lithology - One of the following is used.

HR:	All hard rocks and stones	**SLST:**	Soft oolitic or dolimitic limestone
CH:	Chalk	**FSST:**	Soft, fine grained sandstone
ZR:	Soft, argillaceous, or silty rocks	**GH:**	Gravel with non-porous (hard) stones
MSST:	Soft, medium grained sandstone	**GS:**	Gravel with porous (soft) stones
SI:	Soft weathered igneous or metamorphic rock		

Stone contents are given in % by volume for sizes >2cm, >6cm and total stone >2mm.

STRUCT: The degree of development, size and shape of soil peds are described using the following notation

Degree of development	**WK:**	Weakly developed	**MD:**	Moderately developed
	ST:	Strongly developed		

Ped size	**F:**	Fine	**M:**	Medium
	C:	Coarse	**VC:**	Very coarse
Ped Shape	**S:**	Single grain	**M:**	Massive
	GR:	Granular	**AB:**	Angular blocky
	SAB:	Sub-angular blocky	**PR:**	Prismatic
	PL:	Platy		

CONSIST: Soil consistence is described using the following notation:

L:	Loose	**VF:**	Very Friable	**FR:**	Friable	**FM:**	Firm
VM:	Very firm	**EM:**	Extremely firm	**EH:**	Extremely Hard		

SUBS STR: Subsoil structural condition recorded for the purpose of calculating profile droughtiness:

G: Good **M:** Moderate **P:** Poor

POR: Soil porosity. If a soil horizon has poor porosity with less than 0.5% biopores >0.5mm, a 'Y' will appear in this column.

IMP: *If the profile is impenetrable to rooting a 'Y' will appear in this column at the* appropriate horizon.

SPL: Slowly permeable layer. If the soil horizon is slowly permeable a 'Y' will appear in this column.

CALC: If the soil horizon is calcareous with naturally occurring calcium carbonate exceeding 1% a 'Y' will appear this column.

2. Additional terms and abbreviations used mainly in soil pit descriptions.

STONE ASSESSMENT:

VIS:	Visual	**S:**	Sieve	**D:**	Displacement

MOTTLE SIZE:

EF:	Extremely fine <1mm	**M:**	Medium 5-15mm
VF:	Very fine 1-2mm>	**C:**	Coarse >15mm
F:	Fine 2-5mm		

MOTTLE COLOUR: May be described by Munsell notation or as ochreous (OM) or grey (GM).

ROOT CHANNELS: In topsoil the presence of 'rusty root channels' should also be noted.

MANGANESE CONCRETIONS: Assessed by volume

N:	None		**M:**	Many	20-40%
F:	Few	<2%	**VM:**	Very Many	>40%
C:	Common	2-20%			

STRUCTURE: Ped Development *

WA:	Weakly adherent	**M:**	Moderately developed
W:	Weakly developed	**S:**	Strongly developed

POROSITY:

P:	Poor	- less than 0.5% biopores at least 0.5mm in diameter
G:	Good	- more than 0.5% biopores at least 0.5mm in diameter

ROOT ABUNDANCE:

The number of roots per $100cm^2$:		Very Fine and Fine	Medium and Coarse
F:	Few	1-10	1 or 2
C:	Common	10.25	2 - 5
M:	Many	25-200	>5
A:	Abundant	>200	

ROOT SIZE

VF:	Very fine	<1mm	**M:**	Medium	2 - 5mm
F:	Fine	1-2mm	**C:**	Coarse	>5mm

HORIZON BOUNDARY DISTINCTNESS:

Sharp:	<0.5cm	**Gradual:**	6 - 13cm
Abrupt:	0.5 - 2.5cm	**Diffuse:**	>13cm
Clear:	2.5 - 6cm		

HORIZON BOUNDARY FORM: Smooth, wavy, irregular or broken.*

* See Soil Survey Field Handbook (Hodgson, 1974) for details.

SITE NAME	PROFILE NO.	SLOPE AND ASPECT	LAND USE		PARENT MATERIAL
Thornbury	Pit 1 (ASP 129)	3° East	Permanent Grass	Av Rainfall: 837 mm ATO: 1491 day °C	Dolomitic Conglomerate
JOB NO.	DATE	GRID REFERENCE	DESCRIBED BY	FC Days: 183 Climatic Grade: 1 Exposure Grade: 1	PSD SAMPLES TAKEN
2/97	22/1/97	ST 6540 9110	HLJ		None

Horizon No.	Lowest Av. Depth (cm)	Texture	Matrix (Ped Face) Colours	Stoniness: Size,Type, and Field Method	Mottling Abundance, Contrast, Size and Colour	Mangan Concs	Structure: Ped Development Size and Shape	Consistence	Structural Condition	Pores (Fissures)	Roots: Abundance and Size	Calcium Carbonate Content	Horizon Boundary: Distinctness and form
1	23	MCL	75YR43	<1% HR (vis)	None	None	-	-	-	-	MF + VF	-	Clear smooth
2	27	MCL	75YR44	90% HR (vis)	None	None	-	-	M*[1]	Good *[2]	MF + VF	-	-

Profile Gleyed From: Not gleyed

Depth to Slowly Permeable Horizon: No SPL

Wetness Class: I

Wetness Grade: 2

Available Water	Wheat:	53 mm
	Potatoes:	53 mm
Moisture Deficit	Wheat:	98 mm
	Potatoes:	89 mm
Moisture Balance	Wheat:	-46 mm
	Potatoes:	-36 mm

Droughtiness Grade: 3b (Calculated to 80 cm)

Final ALC Grade: 3b

Main Limiting Factor(s): Depth and drought

Remarks: *[1] assumed
*[2] assumed
NB MDP will not improve even if calculated below 80 cm

SITE NAME	PROFILE NO.	SLOPE AND ASPECT	LAND USE		PARENT MATERIAL
Thornbury	Pit 2	Flat	Ploughed	Av Rainfall: 837 mm ATO: 1491 day °C	Dolomitic Conglomerate
JOB NO.	DATE	GRID REFERENCE	DESCRIBED BY	FC Days: 183 Climatic Grade: 1 Exposure Grade: 1	PSD SAMPLES TAKEN
2/97	22/1/97	ST 6373 9152	HLJ		None

Horizon No.	Lowest Av. Depth (cm)	Texture	Matrix (Ped Face) Colours	Stoniness: Size,Type, and Field Method	Mottling Abundance, Contrast, Size and Colour	Mangan Concs	Structure: Ped Development Size and Shape	Consistence	Structural Condition	Pores (Fissures)	Roots: Abundance and Size	Calcium Carbonate Content	Horizon Boundary: Distinctness and form
1	28	MCL	05YR43	<1% HR (vis)	None	None	-	-	-	-	CF + VF	-	Clear smooth
2	90	SCL	05YR44	<1% HR (vis)	None	Few	MMSAB*	Friable	Good	Good	FF + VF	-	-

Profile Gleyed From: Not gleyed

Depth to Slowly Permeable Horizon: No SPL

Wetness Class: I

Wetness Grade: 2

Available Water	Wheat:	190 mm
	Potatoes:	130 mm
Moisture Deficit	Wheat:	98 mm
	Potatoes:	89 mm
Moisture Balance	Wheat:	92 mm
	Potatoes:	41 mm

Droughtiness Grade: 1 (Calculated to 120 cm)

Final ALC Grade: 2

Main Limiting Factor(s): Workability

Remarks: * some coarse

SITE NAME	PROFILE NO.	SLOPE AND ASPECT	LAND USE		PARENT MATERIAL
Thornbury	Pit 3 (ASP 33)	Flat	Ley	Av Rainfall: 837 mm ATO: 1491 day °C	Dolomitic Conglomerate
JOB NO.	DATE	GRID REFERENCE	DESCRIBED BY	FC Days: 183 Climatic Grade: 1 Exposure Grade: 1	PSD SAMPLES TAKEN
2/97	29/1/97	ST 6373 9194	PRW/HLJ		H1 MSL S:66; Z: 18; C:16 H2 MSL S:71; Z:14; C:15

Horizon No.	Lowest Av. Depth (cm)	Texture	Matrix (Ped Face) Colours	Stoniness: Size,Type, and Field Method	Mottling Abundance, Contrast, Size and Colour	Mangan Concs	Structure: Ped Development Size and Shape	Consistence	Structural Condition	Pores (Fissures)	Roots: Abundance and Size	Calcium Carbonate Content	Horizon Boundary: Distinctness and form
1	25	MSL	10YR32	<1% HR (vis)	None	None	-	-	-	Good	MF+VF	-	Clear smooth
2	56	SCL*[4]	10Y61 10YR62	<1% HR (vis)	CDFO (10YR56)	Few	MCPr*[1]	Friable	Moderate	Poor	CF+VF*[2]	-	Clear smooth
3	90	LMS	05YR46	<1% HR (vis)	FFFO (75YR56)	None	WCSAB	Very friable	Moderate	Poor*[3]	CF+VF	-	-

Profile Gleyed From: 25 cm

Depth to Slowly Permeable Horizon: 25 cm (to 56 cm)

Wetness Class: IV

Wetness Grade: 3b

Available Water	Wheat:	119 mm
	Potatoes:	102 mm
Moisture Deficit	Wheat:	98 mm
	Potatoes:	89 mm
Moisture Balance	Wheat:	21 mm
	Potatoes:	13 mm

Droughtiness Grade: 2 (Calculated to 120 cm)

Final ALC Grade: 3b

Main Limiting Factor(s): Wetness

Remarks: Water coming in at 75 cm
*[1] close to weak
*[2] mainly ex-ped
*[3] borderline
*[4] very variable texture, enough clay in places to be an SPL and to have a SCL texture overall

SITE NAME	PROFILE NO.	SLOPE AND ASPECT	LAND USE		PARENT MATERIAL
Thornbury	Pit 4 (ASP 10)	1° North	Permanent Grass	Av Rainfall: 837 mm ATO: 1491 day °C	Dolomitic Conglomerate
JOB NO.	DATE	GRID REFERENCE	DESCRIBED BY	FC Days: 183 Climatic Grade: 1 Exposure Grade: 1	PSD SAMPLES TAKEN
2/97	29/1/97	ST 6388 9224	PRW/HLJ		None

Horizon No.	Lowest Av. Depth (cm)	Texture	Matrix (Ped Face) Colours	Stoniness: Size,Type, and Field Method	Mottling Abundance, Contrast, Size and Colour	Mangan Concs	Structure: Ped Development Size and Shape	Consistence	Structural Condition	Pores (Fissures)	Roots: Abundance and Size	Calcium Carbonate Content	Horizon Boundary: Distinctness and form
1	24	MCL	10YR32	None (vis)	None	None	-	-	Moderate	Good	CF + CVF	-	Clear wavy
2	42	SCL	7.5YR43 (7.5YR42)	<1% HR (vis)	None	Few medium	WCSAB	Friable	Moderate	Good	CF + CVF	-	Clear smooth
3	55	C	7.5YR42	10 cm layer of 80% HR on top of Horizon 4	None	Few medium	MCSAB	Friable	Moderate	Good	FF + FVF	-	Abrupt smooth
4	80	C	5GY61	None (vis)	None	None	Massive to WCSAB	Firm	Poor (moderate)	Poor	FF	-	-

Profile Gleyed From: Not gleyed

Depth to Slowly Permeable Horizon: No SPL

Wetness Class: I

Wetness Grade: 2

Available Water Wheat: 131 mm

Potatoes: 109 mm

Moisture Deficit Wheat: 98 mm

Potatoes: 89 mm

Moisture Balance Wheat: 33 mm

Potatoes: 20 mm

Droughtiness Grade: 1 (Calculated to 120 cm)

Final ALC Grade: 2

Main Limiting Factor(s): Workability

Remarks: Horizon 4 is not an SPL because the few manganese seen in H2 and H3 are caused by the stone layer. No stone in adjacent borings therefore no depth limitation mentioned.

SITE NAME	PROFILE NO.	SLOPE AND ASPECT	LAND USE		PARENT MATERIAL
Thornbury	Pit 5 (ASP 54)	1° North	Permanent Grass	Av Rainfall: 837 mm ATO: *1491 day °C* FC Days: 183 Climatic Grade: 1 Exposure Grade: 1	Dolomitic Conglomerate
JOB NO.	DATE	GRID REFERENCE	DESCRIBED BY		PSD SAMPLES TAKEN
2/97	29/1/97	ST 6485 9180	PRW/HLJ		None

Horizon No.	Lowest Av. Depth (cm)	Texture	Matrix (Ped Face) Colours	Stoniness: Size,Type, and Field Method	Mottling Abundance, Contrast, Size and Colour	Mangan Concs	Structure: Ped Development Size and Shape	Consistence	Structural Condition	Pores (Fissures)	Roots: Abundance and Size	Calcium Carbonate Content	Horizon Boundary: Distinctness and form
1	20	MCL	7.5YR43	1% HR (VIS)	None	None	-	-	-	-	MF + VF	-	Clear smooth
2	25*[2]	MCL	7.5YR44	80% HR (VIS)	None	None	-	-	M*[1]	Good*[1]	MF + VF	-	-

Profile Gleyed From: Not gleyed

Depth to Slowly Permeable Horizon: No SPL

Wetness Class: I

Wetness Grade: 2

Available Water	Wheat:	49 mm
	Potatoes:	50 mm
Moisture Deficit	Wheat:	98 mm
	Potatoes:	89 mm
Moisture Balance	Wheat:	-49 mm
	Potatoes:	-39 mm

Droughtiness Grade: 3b (Calculated to 80 cm)

Final ALC Grade: 3b

Main Limiting Factor(s): Drought and depth

Remarks: *[1] assumed
*[2] 24-28 cm in pit
NB: MBP will not improve even if calculated below 80 cm

SITE NAME	PROFILE NO.	SLOPE AND ASPECT	LAND USE		PARENT MATERIAL
Thornbury	Pit 6 (ASP 42)	1°	Permanent Grass	Av Rainfall: 837 mm ATO: 1491 day °C	Dolomitic Conglomerate
JOB NO.	DATE	GRID REFERENCE	DESCRIBED BY	FC Days: 183 Climatic Grade: 1 Exposure Grade: 1	PSD SAMPLES TAKEN
2/97	29/1/97	ST 6500 9195	PRW/HLJ		None

Horizon No.	Lowest Av. Depth (cm)	Texture	Matrix (Ped Face) Colours	Stoniness: Size,Type, and Field Method	Mottling Abundance, Contrast, Size and Colour	Mangan Concs	Structure: Ped Development Size and Shape	Consistence	Structural Condition	Pores (Fissures)	Roots: Abundance and Size	Calcium Carbonate Content	Horizon Boundary: Distinctness and form
1	18	MCL	75YR33	1% HR (vis)	None	None	-	-	Moderate	Good	MF + MVF	-	Clear smooth
2	35	HCL	75YR44	2%>2cm 35% > 2mm 37% HR sieved	None	None	WCSAB	Friable	Moderate	Good	CF + CVF	-	Abrupt wavy
3	45+	C	-	90% Fractured HR (vis)	None	None	-	-	Moderate*[1]	-	FF	-	-

Profile Gleyed From: Not gleyed

Depth to Slowly Permeable Horizon: No SPL

Wetness Class: I

Wetness Grade: 2

Available Water	Wheat:	53 mm
	Potatoes:	54 mm
Moisture Deficit	Wheat:	98 mm
	Potatoes:	89 mm
Moisture Balance	Wheat:	-45 mm
	Potatoes:	-35 mm

Droughtiness Grade: 3b (Calculated to 180 cm)

Final ALC Grade: 3b

Main Limiting Factor(s): Drought

Remarks: 3a depth
*[1] assumed

SITE NAME	PROFILE NO.	SLOPE AND ASPECT	LAND USE		PARENT MATERIAL
Thornbury	Pit 7	2° West	Permanent grass	Av Rainfall: 893 mm ATO: 1491 day °C	Thornbury Beds - Lower Old Red Sandstone
JOB NO.	DATE	GRID REFERENCE	DESCRIBED BY	FC Days: 183 Climatic Grade: 1 Exposure Grade: 1	PSD SAMPLES TAKEN
2/97	6/2/97	ST 6568 9085	PRW/HLJ		SCL S:51; Z:30; C:19

Horizon No.	Lowest Av. Depth (cm)	Texture	Matrix (Ped Face) Colours	Stoniness: Size,Type, and Field Method	*Mottling* Abundance, Contrast, Size and Colour	Mangan Concs	*Structure: Ped* Development Size and Shape	Consistence	Structural Condition	Pores (Fissures)	Roots: Abundance and Size	Calcium Carbonate Content	*Horizon* Boundary: Distinctness and form
1	26	SCL	75YR43	<1% HR (VIS)	None	None	-	-	-	-	MF + VF	-	Clear smooth
2	48	C	05YR54 25YR44 05Y62	0% (VIS)	None	Common	MCSAB*[1]	Firm	Moderate	Poor	CF + VF*[2]	-	Gradual smooth
3	70	C	25YR44 05Y63	0% (VIS)	None	Many	WCSAB	Firm	Poor	Poor	FF + VF	-	Clear smooth
4	83	C	25YR44 059Y71	0% (VIS)	None	Many	WCSAB	Firm	Poor	Poor	FF + VF	-	Clear wavy
5	120+	C	05YR74	0% (VIS)	None	Few	W Massive	Firm	Poor	Poor	VFVF	-	-

Profile Gleyed From: Not gleyed

Depth to Slowly Permeable Horizon: 48 cm

Wetness Class: III/IV

Wetness Grade: 3a/3b

Available Water	Wheat:	131 mm
	Potatoes:	108 mm
Moisture Deficit	Wheat:	98 mm
	Potatoes:	89 mm
Moisture Balance	Wheat:	33 mm
	Potatoes:	19 mm

Droughtiness Grade: 1 (Calculated to 120 cm)

Final ALC Grade: 3a/3b

Main Limiting Factor(s): Wetness

Remarks: Plenty of sphagumm on the surface
*[1] angular and prismatic tendencies
*[2] majority of roots are ex-ped or in one or two large worm channels
3a map unit

SITE NAME	PROFILE NO.	SLOPE AND ASPECT	LAND USE		PARENT MATERIAL
Thornbury	Pit 8 (ASP 57)	0°	Permanent grass	Av Rainfall: 893 mm ATO: 1491 day °C	Keuper Marl
JOB NO.	DATE	GRID REFERENCE	DESCRIBED BY	FC Days: 183 Climatic Grade: 1 Exposure Grade: 1	PSD SAMPLES TAKEN
2/97	6/2/97	ST 6527 9177	PRW/HLJ		None

Horizon No.	Lowest Av. Depth (cm)	Texture	Matrix (Ped Face) Colours	Stoniness: Size,Type, and Field Method	Mottling Abundance, Contrast, Size and Colour	Mangan Concs	Structure: Ped Development Size and Shape	Consistence	Structural Condition	Pores (Fissures)	Roots: Abundance and Size	Calcium Carbonate Content	Horizon Boundary: Distinctness and form
1	20	MCL	7.5YR43	None (vis)	None	None	-	Friable	Moderate	Good	MF + MVF	-	Clear smooth
2	35	C	7.5YR44	<1% (Sandstone) MSST (vis)	None	Few	MCSAB (weakly prismatic)	Friable	Moderate	Good	MF + MVF	-	Clear wavy
3	75	C	2.5YR43	None (vis)	None	Common	MCAB	Firm	Moderate	Poor	FF + FVF	-	Clear smooth
4	90	C	5GY61	3% MSST (vis)	None	Common	MMSAB	Firm	Good	Poor	FF + FVF	-	-

Profile Gleyed From: Not gleyed

Depth to Slowly Permeable Horizon: 35 (to 75) cm

Wetness Class: III

Wetness Grade: 3a

Available Water Wheat: 170 mm

Potatoes: 116 mm

Moisture Deficit Wheat: 98 mm

Potatoes: 89mm

Moisture Balance Wheat: 72 mm

Potatoes: 27 mm

Droughtiness Grade: 1 (Calculated to 120 cm)

Final ALC Grade: 3a

Main Limiting Factor(s): Wetness

Remarks: Weathering soft sandstone fragments in horizon 4

SITE NAME	PROFILE NO.	SLOPE AND ASPECT	LAND USE		PARENT MATERIAL
Thornbury	Pit 9 (ASP 210-211)	4° North West	Ploughed	Av Rainfall: 893 mm ATO: 1491 day °C	Dolomitic Conglomerate
JOB NO.	DATE	GRID REFERENCE	DESCRIBED BY	FC Days: 183 Climatic Grade: 1 Exposure Grade: 1	PSD SAMPLES TAKEN
2/97	6/2/97	ST 6583 8992	HLJ/PRW		MSL S:61; Z:23; C:16

Horizon No.	Lowest Av. Depth (cm)	Texture	Matrix (Ped Face) Colours	Stoniness: Size,Type, and Field Method	Mottling Abundance, Contrast, Size and Colour	Mangan Concs	Structure: Ped Development Size and Shape	Consistence	Structural Condition	Pores (Fissures)	Roots: Abundance and Size	Calcium Carbonate Content	Horizon Boundary: Distinctness and form
1	30	MSL	7.5YR43	1% HR (VIS)	None	None	-	-	-	-	CF + VF	-	Clear smooth
2	48	SCL	7.5YR44	2% HR (VIS)	None	None	WCSAB	Friable	Moderate	Poor *[1]	CF + VF	-	Clear smooth
3	60 - 90	C	0.5YR44 *[5]	2% HR (VIS)	None	None	WCSAB	Firm	Moderate	Poor	CF+VF (ex-ped)	-	Clear irregular
4	90+	C	0.5YR44	85% HR (VIS)*[2]	None	None	-	-	Moderate *[3]	Good*[4]	FF + VF	-	-

Profile Gleyed From: Not gleyed

Depth to Slowly Permeable Horizon: 48 to 60-90

Wetness Class: III

Wetness Grade: 3a

Available Water Wheat: 107 mm

Potatoes: 112 mm

Moisture Deficit Wheat: 98 mm

Potatoes: 89 mm

Moisture Balance Wheat: 9 mm

Potatoes: 23 mm

Droughtiness Grade: 2 (Calculated to 120 cm)

Final ALC Grade: 3a

Main Limiting Factor(s): Wetness

Remarks:

*[1] bordeline
*[2] limestone
*[3] assumed
*[4] assumed due to stones
*[5] extensive, silky black substance on the ped exteriors and in fissures of H3 - organic? Calculate H3 to 75 cm

SITE NAME	PROFILE NO.	SLOPE AND ASPECT	LAND USE		PARENT MATERIAL
Thornbury	Pit 10 (ASP 156)	3° South East	Fallow	Av Rainfall: 893 mm ATO: 1491 day °C	Thornbury Reds - Lower Old Red Sandstone
JOB NO.	DATE	GRID REFERENCE	DESCRIBED BY	FC Days: 183 Climatic Grade: 1 Exposure Grade: 1	PSD SAMPLES TAKEN
2/97	3/397	ST 6596 9084	HLJ		MCL S:36; Z:41; C:23

Horizon No.	Lowest Av. Depth (cm)	Texture	Matrix (Ped Face) Colours	Stoniness: Size,Type, and Field Method	Mottling Abundance, Contrast, Size and Colour	Mangan Concs	Structure: Ped Development Size and Shape	Consistence	Structural Condition	Pores (Fissures)	Roots: Abundance and Size	Calcium Carbonate Content	Horizon Boundary: Distinctness and form
1	24	MCL	7.5YR43	<1% HR (VIS)	None	None	-	-	-	-	FF + VF	-	Clear smooth
2 *[2]	32	C	7.5YR54	<1% HR (VIS)	CFFO (75YR56)	Common	-	-	Moderate (assumed)	-	-	-	Gradual wavy
3	57	C	2.5YR44 (05YR53, 54)	None (VIS)	None	Few	MCAB	Firm *[2]	Moderate	Poor	VFF + FVF*[3]	-	Gradual smooth
4 *[6]	100+	C	2.5YR44, 46	None (VIS)	None	None	WCA+SAB*[4] or massive breaking down?	Firm *[5]	Moderate	Poor	VFVF	-	-

Profile Gleyed From: Not gleyed

Depth to Slowly Permeable Horizon: 32 - 100+ cm

Wetness Class: IV

Wetness Grade: 3b

Available Water	Wheat:	141 mm
	Potatoes:	117 mm
Moisture Deficit	Wheat:	98 mm
	Potatoes:	89 mm
Moisture Balance	Wheat:	43 mm
	Potatoes:	28 mm

Droughtiness Grade: 1 (Calculated to 120 cm)

Final ALC Grade: 3b

Main Limiting Factor(s): Wetness

Remarks:

*[1] an intermittent transition horizon of 6-10cm
*[2] plastic
*[3] larger ones are ex-ped
*[4] breaking to WMAB
*[5] brittle feel
*[6] very crumbly and more orange (2.5YR48) in the auger

SITE NAME	PROFILE NO.	SLOPE AND ASPECT	LAND USE		PARENT MATERIAL
Thornbury	Pit 11 (ASP 230)	3° North West	Permanent Grass	Av Rainfall: 837 mm ATO: 1491 day °C FC Days: 183 Climatic Grade: 1 Exposure Grade: 1	Keuper Marl
JOB NO.	DATE	GRID REFERENCE	DESCRIBED BY		PSD SAMPLES TAKEN
2/97	3/397	ST 6527 8942	HLJ		None

Horizon No.	Lowest Av. Depth (cm)	Texture	Matrix (Ped Face) Colours	Stoniness: Size,Type, and Field Method	Mottling Abundance, Contrast, Size and Colour	Mangan Concs	Structure: Ped Development Size and Shape	Consistence	Structural Condition	Pores (Fissures)	Roots: Abundance and Size	Calcium Carbonate Content	Horizon Boundary: Distinctness and form
1	29	MCL	10YR43	1% HR (VIS)	None	None	-	-	-	Good	CF + VF	-	Clear smooth
2	57	MCL	10YR44	1% HR (VIS)	None	None	MMSAB	Friable	Moderate	Good	CF + VF	-	Clear smooth
3	90+	C	25YR44	0% (VIS)	None	Few	MMAB	Firm	Moderate	Good	FF + VF	-	-

Profile Gleyed From: Not gleyed

Depth to Slowly Permeable Horizon: No SPL

Wetness Class: I

Wetness Grade: 2

Available Water	Wheat:	142 mm
	Potatoes:	117 mm
Moisture Deficit	Wheat:	98 mm
	Potatoes:	89 mm
Moisture Balance	Wheat:	44 mm
	Potatoes:	28 mm

Droughtiness Grade: 1 (Calculated to 120 cm)

Final ALC Grade: 2

Main Limiting Factor(s): Workability

Remarks: