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Hardwick, Plymouth

Agricultural Land Classification

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Resource Planning Team
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FRCA Western Region

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HARDWICK, PLYMOUTH

AGRICULTURAL LAND CLASSIFICATION SURVEY

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INTRODUCTION

1. This report presents the findings of a semi-detailed Agricultural Land Classification (ALC) survey of 135 ha of land at Hardwick, Plymouth. Field survey was based on 44 auger borings and 3 soil profile pits, and was completed in November 1998. During the survey 6 samples were analysed for particle size distribution (PSD).

2. The survey was conducted by the Resource Planning Team of FRCA Western Region on behalf of MAFF in its statutory role in the preparation of the Plymouth Structure 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 mainly Grade 3 with Grade 4 on the steep slopes and two areas of Grade 2 one south of Plympton Castle and one north of the A38 by High Park. The site had been surveyed previously (ADAS 1975) but to guidelines for ALC classification which have now been superseded whereas the current survey uses the Revised Guidelines and Criteria for Grading the Quality of Agricultural Land (MAFF, 1988) and supersedes any previous ALC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. Neighbouring land at Hardwick Farm (ADAS 1993) was surveyed in 1993 to the revised guidelines and found mainly Subgrade 3b limited by restricted workability.

5. At the time of survey land cover was permanent pasture and ley pasture. An area of 13 ha of agricultural land within the survey area was not surveyed because access to the land was not possible.

SUMMARY

6. The distribution of ALC grades is shown on the accompanying 1: 15 000 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 Table 1.

Table 1: Distribution of ALC grades: Hardwick

Grade	Area (ha)	% Surveyed Area (69 ha)
3b	54	79
4	5	8
5	9	13
Agricultural land not surveyed	13	
Other land	53	
Total site area	135	

7. This shows that none of the area was found to be best and most versatile. 79 % of the area surveyed was found to be Subgrade 3b limited by restricted workability, wetness and gradient and the remainder was found to be Grades 4 and 5 limited mainly by gradient.

CLIMATE

8. 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.

9. 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 an overall climatic limitation which limits the land to Grade 2 except for an area of lower ground below around 45 m at the centre of the site.

10. 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. A critical boundary of 225 FCD was found at around the 30 m contour so that only a small area at the centre of the site falls below 225 FCDays.

Table 2: Climatic Interpolations: Hardwick

Grid Reference		SX 538 553	SX 542 554
Altitude (m)		60	35
Accumulated Temperature (day °C)		1557	1585
Average Annual Rainfall (mm)		1185	1140
Overall Climatic Grade		2	1
Field Capacity Days		232	225
Moisture deficit (mm):	Wheat	87	93
	Potatoes	75	83

RELIEF

11. Altitude ranges from 15 metres just South of Plympton Castle to 114 metres in the centre of Hardwick Wood with mainly gentle and moderate slopes which are not limiting but with steep slopes limiting the land to Grade 5 along the north edge of the site.

GEOLOGY AND SOILS

12. The underlying geology of the site is shown on the published geology map (IGS, 1974) as mainly Upper Devonian Slate with substantial areas of igneous schalsteins tuffs etc. at the centre of Hardwick Wood and running in a thick band to the north of Ridge Road. Drift alluvium is mapped along the Long Brook. The current survey found parent materials to be derived from slate material although this was variable in stone content and depth to bedrock.

13. Soils were mapped by the Soil Survey of England and Wales at a reconnaissance scale of 1:250 000 (SSEW 1983) as mainly Denbigh 2 association across the majority of the site. This is described as comprising well drained fine loamy soils over slate or slate rubble, with some fine loamy soils variably affected by groundwater. This was mainly borne out by the current survey which frequently found shallow soils over rock but also several profiles with slowly permeable subsoils and evidence of seasonal waterlogging.

AGRICULTURAL LAND CLASSIFICATION

14. The distribution of ALC grades found by the current survey is shown on the accompanying 1: 15000 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.

Subgrade 3b

15. Most of the area shown as Subgrade 3b lies above the 225 FCDay boundary and was found to be mainly limited by restricted workability with heavy clay loam topsoil at Wetness Class I (see Appendix II). This is illustrated by Pit 1 although this was particularly shallow and also identified limitations due to restricted soil depth and droughtiness.

16. Other observation points within the area shown as Subgrade 3b were found to be limited primarily by gradient with slopes of 8 to 11 degrees, although the soil profile at these points may have been similar to those described above.

17. The small area at the centre of the site with less than 225 FCDays had been shown on the published Regional ALC map and in the 1975 survey as Grade 2, but the current survey shows it as Subgrade 3b as the majority of the borings within this area found heavy clay loam topsoil at Wetness Class III with a slowly permeable layer starting in the lower subsoil. This is illustrated by Pit 2. Only two borings at ASP 23 and 31 found Subgrade 3a with heavy clay loam at Wetness Class I and below the 225 FCDay boundary.

Grade 4

18. The area shown as Grade 4 was found to be limited by gradient and wetness, with that part of the area limited by wetness lying above the 225 FCDay boundary and having heavy clay loam topsoil at Wetness Class III with a slowly permeable layer in the upper subsoil. These conditions are illustrated by Pit 3.

Grade 5

19. The area shown as Grade 5 was found to be limited by gradient, with slopes of over 18 degrees.

Other Land

20. Other land which was not surveyed included playing fields, residential areas, common land and farm buildings.

Agricultural Land not surveyed

21. The areas of agricultural land which were not surveyed are both surrounded by land shown as Subgrade 3b and it is considered that this would be the most likely classification for these areas if they were to be surveyed.

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FRCA Bristol
2 February 1999

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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 (eg 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 (Ed) (1997) Soil Survey Field Handbook. Soil Survey Technical Monograph No 5, Silsoe.

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, 1997).

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

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

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		

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.

MREL:	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, an '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	**WA:** Weakly developed Adherent	**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%			

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, 1997) for details.

SITE NAME	PROFILE NO.	SLOPE AND ASPECT	LAND USE		PARENT MATERIAL
Hardwick, Plymouth	Pit 1 (Asp 52)	0°	PGR	Av Rainfall: 1251mm ATO: 1523 day °C	Igneous schalsteins tuffs etc
JOB NO.	DATE	GRID REFERENCE	DESCRIBED BY	FC Days: 241 Climatic Grade: 2 Exposure Grade: 1	PSD SAMPLES TAKEN
56.98	2/12/98	SX 5465 5513	GMN/PRW		Topsoil 0-22 cm: HCL/C (S38:Z28:C34%)

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	22	HCL	7.5YR42	2% > 2cm (s) 4% < 2 cm (s+d) 6% HR	None	None	-	-	M	G	MF,VF	-	Abrupt Smooth
2	45	HCL	10YR43	45% > 2 cm (s) 25%< 2 cm (s+d) 70% HR	None	None	Too stony	-	M	G	FF none observed below 40 cm	-	-

Profile Gleyed From: Not gleyed

Slowly Permeable Horizon From: No SPL

Wetness Class: I

Wetness Grade: 3b

Available Water Wheat: 50 mm

Potatoes: 50 mm

Moisture Deficit Wheat: 80 mm

Potatoes: 65 mm

Moisture Balance Wheat: -30 mm

Potatoes: -15 mm

Droughtiness Grade: 3b (Calculated to 45 cm)

Final ALC Grade: 3b

Main Limiting Factor(s): Soil Depth, Workability, Droughtimess

Remarks: Roots visible below 35 cm therefore AP calculated to 4 cm.

SITE NAME	PROFILE NO.	SLOPE AND ASPECT	LAND USE		Asp value	Site Value	PARENT MATERIAL
Hardwick, Plymouth	Pit 2 (Asp 33)	7° N	PGR	Av Rainfall:	1131	1185mm	Upper Devonian Slate
				ATO:	1591	1557day°C	
JOB NO.	DATE	GRID REFERENCE	DESCRIBED BY	FC Days:	224	232	PSD SAMPLES TAKEN
56.98	2/12/98	SX 54385545	GMN	Climatic Grade:	1	2	None
				Exposure Grade:	1	1	

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	HCL	10YR43	5%HR (vis)	None	None	-	-	M	G	MF,VF	-	Clear Smooth
2	50	C	10YR53	8% HR (vis)	None	None	WKM+CSAB	FR	Good	G	C F,VF	-	Clear Smooth
3	65	C	10YR63 (10YR64)	25%HR (vis)	COM 7.5YR56	Few	WDCSAB	FM	Poor	G	FF,VF	-	Clear Smooth
4	85+	C	10YR63 (10YR64)	25%HR (vis)	COM 7.5YR56	Few	WKCSAB	FM	Poor	P	FF,VF	-	

Profile Gleyed From: 50 cm

Slowly Permeable Horizon From: 65 cm

Wetness Class: III

Wetness Grade: 3b

Available Water Wheat: 110 mm

Potatoes: 111 mm

Moisture Deficit Wheat: 94 mm

Potatoes: 84 mm

Moisture Balance Wheat: +16 mm

Potatoes: +27 mm

Droughtiness Grade: 2 (Calculated to 85 cm)

Final ALC Grade: 3b

Main Limiting Factor(s): We

Remarks: Less than 225 FCD

SITE NAME	PROFILE NO.	SLOPE AND ASPECT	LAND USE		PARENT MATERIAL
Hardwick, Plymouth	Pit 3 (Asp 38)	4° NE	PGR	Av Rainfall: 1193 mm ATO: 1551 day °C FC Days: 233 Climatic Grade: 2 Exposure Grade: 1	Upper Devonian Slate
JOB NO.	DATE	GRID REFERENCE	DESCRIBED BY		PSD SAMPLES TAKEN
56/98	3/12/98	SX 5368 5529	PRW/GMN		Topsoil 0-25 cm : HCL (S25:Z36: C39%)

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	33	HCL	10YR44	5% HR (vis)	None	None	-	-	-	-	MF,VF	-	
2	49	HCL	10YR53	10% HR (vis)	FDFO 10YR56	None	WKMSAB	FR	G	G	CF,VF	-	Clear Smooth
3	80+	C	5Y72 (10YR63)	20% HR (vis)	MDO 7.5YR58	Common	WKCSAB	FM	FM	P	FF	-	Abrupt Smooth

Profile Gleyed From: 49 cm

Slowly Permeable Horizon From: 49 cm

Wetness Class: III

Wetness Grade: 4

Available Water Wheat: 105 mm

Potatoes: 109 mm

Moisture Deficit Wheat: 86 mm

Potatoes: 74 mm

Moisture Balance Wheat: + 19mm

Potatoes: +34 mm

Droughtiness Grade: 2 (Calculated to 80 cm)

Final ALC Grade: 4

Main Limiting Factor(s): We

Remarks: