READING AGRICULTURAL CONSULTANTS

June 2018

Barratt & David Wilson Homes South Wales

Agricultural Land Classification and Soil Resources

at

Land at Bayfields, Chepstow, Monmouthshire

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1 Introduction

1.1 Reading Agricultural Consultants Ltd (RAC) is instructed by Barratt & David Wilson Homes South Wales to investigate the Agricultural Land Classification (ALC) and soil resources of land at Bayfields, west of Chepstow, by means of a detailed survey of soil and site characteristics.

1.2 Guidance for assessing the quality of agricultural land in England and Wales is set out in the Ministry of Agriculture, Fisheries and Food (MAFF) revised guidelines and criteria for grading the quality of agricultural land (1988)[1].

1.3 Agricultural land in England and Wales is graded between 1 and 5, depending on the extent to which physical or chemical characteristics impose long-term limitations on agricultural use. The principal physical factors influencing grading are climate, site and soil which, together with interactions between them, form the basis for classifying land into one of the five grades.

1.4 Grade 1 land is excellent quality agricultural land with very minor or no limitations to agricultural use, and Grade 5 is very poor quality land, with severe limitations due to adverse soil, relief, climate or a combination of these. Grade 3 land is subdivided into Subgrade 3a (good quality land) and Subgrade 3b (moderate quality land). Land which is classified as Grades 1, 2 and 3a in the ALC system is defined as best and most versatile agricultural land.

1.5 A definitive ALC grading should be obtained by undertaking a detailed survey according to the published guidelines, at an observation density of one boring per hectare. This survey follows the detailed methodology set out in the established guidelines.

2 Site and climatic conditions

General features, land form and drainage

2.1 The survey area comprises 11.9ha in total, predominantly of agricultural grassland which was used for grazing sheep at the time of survey. Non-agricultural land comprises an area of hardstanding in the north of the site. The site is bounded to the north-east, east and south by

[1] **MAFF (1988).** *Agricultural Land Classification of England and Wales. Revised guidelines and criteria for grading the quality of agricultural land*. MAFF Publications.

the settlement of Chepstow, to the north-west by the B4235 and Bishop's Barnets Wood, and to the west by other agricultural land.

2.2 Topography across the survey area slopes generally downward from a hilltop in the south-east, to the north and west. There is a short downward slope in the northernmost field of the site, toward the B4235. Elevation varies from around 95m above Ordnance Datum (AOD) in the south-east to 75m AOD in the north, with much of the central site area relatively level at around 88m AOD.

Agro-climatic conditions

2.3 Agro-climatic data for the site have been interpolated from the Meteorological Office's standard 5km grid point data set at a representative altitude of 90m AOD, and are given in Table 1. The site is wet and moderately warm, with moderate to moderately small moisture deficits. The number of Field Capacity Days is relatively high and is unfavourable for providing opportunities for agricultural field work.

Table 1: Local agro-climatic conditions

Parameter	Value
Average Annual Rainfall	1,010mm
Accumulated Temperatures >0°C	1,439 day°
Field Capacity Days	209 days
Average Moisture Deficit, wheat	79mm
Average Moisture Deficit, potatoes	65mm

Soil parent material and soil type

2.4 The underlying geology mapped by the British Geological Survey[2] is complex. In the west of the site the bedrock comprises ooidal limestones of the Hunts Bay Oolite Subgroup. In the south-east, north and in a central band aligned north to south, the bedrock includes packstones and mudstones of the Black Rock Limestone Subgroup. The Avon Group, comprising interbedded mudstones and packstones, is mapped in the north-east of the site, and the Cromhall Sandstone Formation, comprising quartzitic sandstone which may be brown, grey or red and may also include limestones, mudstones and siltstones, is mapped in the north-west.

[2] **British Geological Survey (2018).** *Geology of Britain viewer*, http://mapapps.bgs.ac.uk/geologyofbritain/home.html

2.5 The Soil Survey of England and Wales soil association mapping[3] (1:250,000 scale) shows the East Keswick 3 association across the site, bordering on the Waltham association to the north. Soils of both associations develop on level to gently sloping land and are characterised by profiles of clay loam of variable depth over limestone. Profiles are well drained and are commonly assessed as Wetness Class (WC) I[4]. The main Waltham soils tend to be shallower and may be slightly droughty.

3 Agricultural land quality

Soil survey methods

3.1 Eleven soil profiles were examined using an Edelman (Dutch) auger at an observation density of approximately one per hectare in accordance with the established recommendations for ALC surveys. One observation pit was also excavated to examine subsoil structures. The locations of observations are indicated on Figure RAC8073-1. At each observation point the following characteristics were assessed for each soil horizon up to a maximum of 120cm or any impenetrable layer:

- soil texture;
- significant stoniness;
- colour (including localised mottling);
- consistency;
- structural condition;
- free carbonate; and
- depth.

3.2 Two topsoil samples were submitted for laboratory determination of particle size distribution, pH, organic matter content and nutrient contents (P, K, Mg). Results are presented in Appendix 1.

[3] **Soil Survey of England and Wales (1984).** *Soils of Wales* (1:250,000), Sheet 2

[4] **Rudeforth et al (1984).** *Soils and their Use in Wales,* Soil Survey of England and Wales, Bulletin No.11

3.3 Soil Wetness Class (WC) was inferred from the matrix colour, presence or absence of, and depth to, greyish and ochreous gley mottling, and slowly permeable subsoil layers at least 15cm thick, in relation to the number of Field Capacity Days at the location.

3.4 Soil droughtiness was investigated by the calculation of moisture balance equations (given in Appendix 2). Crop-adjusted Available Profile Water (AP) is estimated from texture, stoniness and depth, and then compared to a calculated moisture deficit (MD) for the standard crops wheat and potatoes. The MD is a function of potential evapotranspiration and rainfall. Grading of the land can be affected if the AP is insufficient to balance the MD and droughtiness occurs.

Agricultural land classification and site limitations

3.5 Assessment of land quality has been carried out according to the MAFF revised ALC guidelines (1988)[1]. Soil profiles have been described according to Hodgson (1997)[5] which is the recognised source for describing soil profiles and characteristics according to the revised ALC guidelines.

3.6 There are two soil types present at the site. The predominant soil type includes organic heavy silty clay loam topsoil of 26cm average depth. The topsoil is mostly brown (7.5YR4/3 or 10YR4/3 in the Munsell soil colour charts[6]) and has a fine subangular to crumb structure. In the south and east, across the higher ground and sloping ground, the topsoil stone content is relatively high, at up to around 30% by volume, and includes large stones greater than 6cm in diameter. Across the lower ground in the west, this soil type is only slightly stony in the topsoil, up to around 5% by volume.

3.7 Upper subsoil is of medium or occasionally heavy silty clay loam which is mostly brown (7.5YR4/3 or 4/4). In the south-east of the site, the stone content is high at around 40% and often impenetrable to narrow gouge auger. The upper subsoil was friable at the time of survey, with a fine angular blocky structure. Although often mottled, the upper subsoil is permeable and contains many grass roots. The pit excavated within this soil type showed the upper subsoil to continue to a depth of at least 60cm.

3.8 In the west of the site, lower subsoil was observed to depth and comprises brown (7.5YR4/4 or 5/3) medium or heavy silty clay loam. One lower subsoil is gleyed, however all profiles of this soil type are assessed as WC I.

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[5] **Hodgson, J. M. (Ed.) (1997).** *Soil survey field handbook.* Soil Survey Technical Monograph No. 5, Silsoe.

[6] **Munsell Color (2009).** *Munsell Soil Color Book*. Grand Rapids, MI, USA

3.9 Profiles in the west of the site are limited by workability to Subgrade 3a due to the heavy topsoil texture. Profiles in the south-east of the site are affected most severely by topsoil stone content or by gradient, which is measured at 7-8°, and are limited to Subgrade 3b.

3.10 The second soil type present at the site comprises brown or dark greyish brown (7.5YR4/3, 10YR3/2, 4/2 or 4/3) silty clay loam or clay loam with a medium angular blocky structure. The average depth is 30cm and the stone content is slight (up to 5%).

3.11 Subsoil horizons are of heavy clay loam or silty clay. The colour is variable, ranging from reddish brown and dark grey (5YR4/4 and 10YR4/1) in the north to light olive brown (2.5Y5/3) in the north-east. Stone content is slight to moderate (up to 15% by volume). The subsoil is gleyed with impeded drainage, and the profiles are assessed mostly as WC IV. Combined with medium topsoil textures and 209 FCDs, all profiles of this second soil type are assessed as Subgrade 3b.

3.12 The vegetation of the field parcel in which Observation 11 was made includes reeds, and the soil was found to become malodorous at around 40cm depth. The field parcel is not considered most suitable for arable crops and is therefore assessed as Grade 4.

3.13 The areas of each ALC grade of land on the site are given in Table 2 and are shown in Figure RAC8073-2. Photographs taken at the site are given in Appendix 3.

Table 2: Agricultural land classification

Grade	Description	Area (ha)	% of agri land
3a	Good quality	3.3	28
3b	Moderate quality	7.7	66
4	Poor quality	0.6	6
	Total Agricultural	11.6	100
	Non-Agricultural	0.3	-

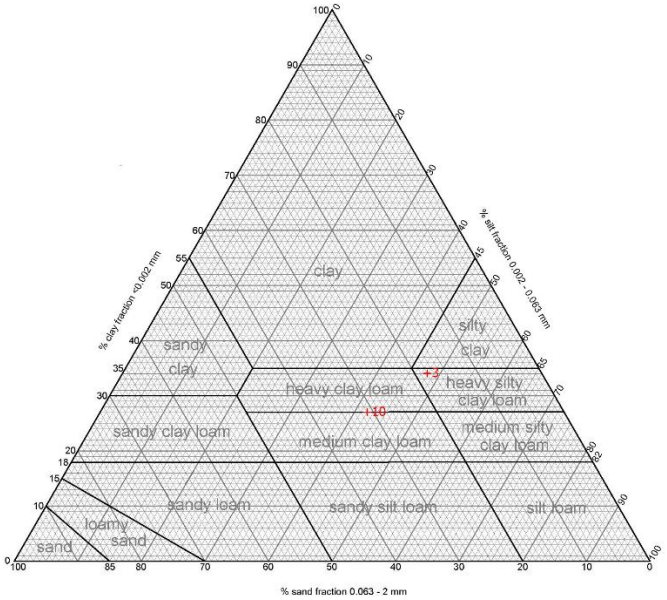
Appendix 1: Laboratory Data

Determinand	Site 3	Site 10	Units
Sand 2.00-0.063 mm	18	31	% w/w
Silt 0.063-0.002 mm	48	42	% w/w
Clay <0.002 mm	34	27	% w/w
Organic Matter	10.5	5.4	% w/w
Texture	Organic Heavy Silty Clay Loam	Heavy Clay Loam	

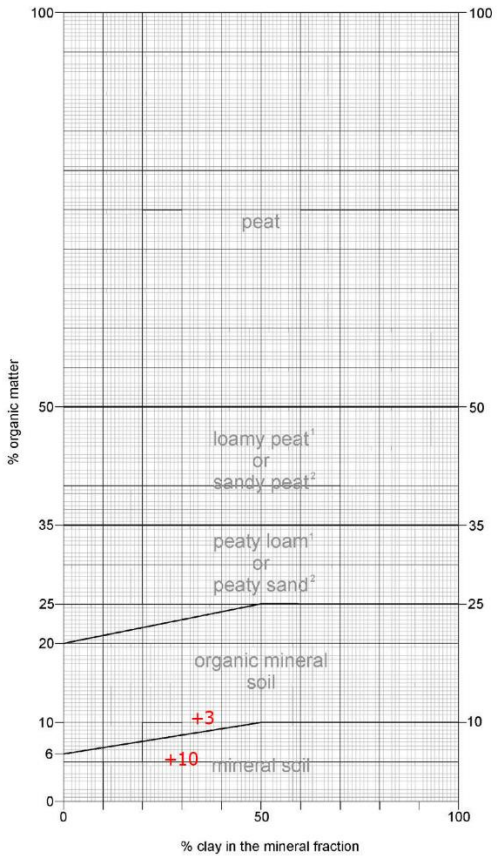
Determinand	Site 3	Site 10	Units
Soil pH	7.5	6.5	
Phosphorus (P)	85.4	13.0	Mg/l (av)
Potassium (K)	532	103	Mg/l (av)
Magnesium (Mg)	557	316	Mg/l (av)

Determinand	Site 3	Site 10	Units
Phosphorus (P)	5	1	ADAS Index
Potassium (K)	4	1	ADAS Index
Magnesium (Mg)	6	5	ADAS Index

Soil Texture by Particle Size Analysis



Organic Matter Class



[1] Less than 50% sand in the mineral fraction

[2] 50% sand or more in the mineral fraction

Appendix 2: Soil Profile Summaries and Droughtiness Calculations

Wetness / workability limitations are determined according to the methodology given in Appendix 3 of the ALC guidelines, MAFF 1988

Droughtiness calculations are made according to the methodology given in Appendix 4 of the ALC guidelines, MAFF 1988.

Grades are shown for drought, wetness and any other soil or site factors which are relevant. The overall Grade is set by the most limiting factor and shown on the right.

Stone types		
%	TAv	Eav
hard	1	0.5
chalk	10	7

Climate Data	
MDwheat	79
MDpotato	65
FCD	209

Wetness Class Guidelines	*II*	*III*	*IV*
SPL within 80cm, gleying within 40cm		>56cm	<56cm
SPL within 80cm, gleying at 40-70cm	>76cm	<76cm	
No SPL but gleying within 40cm	coarse subsoil	*II*	other cases *III*

hard flint & pebble

Maximum depth of auger penetration is underlined

Site No.		Depth cm		Texture	$CaCO_3$	Colour	Mottle colour	abund-ance	stone% hard	stone% chalk	Struct-ure	APwheat mm	AP potato mm	Gley	SPL	WC	Wetness grade WE	Final Grade	Limiting Factor(s)
1	T	0	28	mZCL		10YR3/2			0			53	53	n	n	*IV*	3b	**3b**	WE
		28	70	ZC		2.5Y5/3	Fe	com	15		poor	35	43	y	y				
		70	120	ZC		2.5Y5/3	Fe	com	15		poor	30	0	y	y				
											Total	**118**	**97**						
											MD	39	32						
											Droughtiness grade (DR)	1	1						
2	T	0	28	mCL		10YR4/3			5		-	48	48	n	n	*I*	2	**2**	WE
		28	75	hZCL		7.5YR5/4	och	few	2			61	70	n	n				
		75	120	C		5YR5/4	och	com	1		poor	31	0	y	y				
											Total	**140**	**118**						
											MD	61	53						
											Droughtiness grade (DR)	1	1						
3	T	0	25	ohZCL		10YR3/2			30		-	50	50	n	n	*I*	3a	**3b**	ST
		25	60	mZCL		7.5YR4/3			40			33	37	n	n				
		60	120	mZCL		7.5YR4/3			40			37	11	n	n				
											Total	**120**	**97**						
											MD	41	32						

TS Stone	>15% >2cm	>10% >6cm

								Droughtiness grade (DR)		1	1							
4	T	0	28	ohZCL	10YR3/2			5	-	75	75	n	n	*I*	3a	**3a**	WE	
		28	35	mZCL	7.5YR4/3	Fe	com	40		7	7	n	n					
		35	120	mZCL	7.5YR4/3	Fe	com	40		59	37	n	n					
									Total	**141**	**119**							
									MD	62	54							
								Droughtiness grade (DR)		1	1							
5	T	0	15	ohZCL	10YR3/3			5	-	42	42	n	n	*I*	3a	**3b**	GR ST	
		15	35	mZCL	7.5YR4/3	Fe	com	30		24	24	n	n					
		35	60	mZCL	7.5YR4/3	Fe	com	40		22	27	n	n					
		60	120	mZCL	7.5YR4/3	Fe	com	40		37	11	n	n					
									Total	**125**	**103**			GR		7-8°		
									MD	46	38							
								Droughtiness grade (DR)		1	1							
6	T	0	15	ohZCL	10YR3/3			5	-	42	42	n	n	*I*	3a	**3b**	GR ST	
		15	35	mZCL	7.5YR4/3	Fe	com	30		24	24	n	n					
		35	60	mZCL	7.5YR4/3	Fe	com	40		22	27	n	n					
		60	120	mZCL	7.5YR4/3	Fe	com	40		37	11	n	n					
									Total	**125**	**103**			GR		7-8°		
									MD	46	38							
								Droughtiness grade (DR)		1	1							
7	T	0	25	hZCL	7.5YR4/3			1	-	47	47	n	n	*I*	3a	**3a**	WE	
		25	120	hZCL	7.5YR4/4	Fe	com	1		111	76	n	n					
									Total	**158**	**123**							
									MD	79	58							
								Droughtiness grade (DR)		1	1							
8	T	0	28	hZCL	10YR4/3			5	-	51	51	n	n	*I*	3a	**3a**	WE	
		28	60	mZCL	7.5YR4/4			2		47	53	n	n					
		60	120	mZCL	7.5YR5/3	Fe	com	1		59	17	y	n					
									Total	**157**	**121**							
									MD	78	56							
								Droughtiness grade (DR)		1	1							

9	T	0	30	mCL		10YR4/3			2	-	53	53	n	n	*IV*	3b	**3b**	WE
		30	50	hCL		5YR5/4	Fe	com	15		28	28	y	n				
		50	75	hCL		5YR5/4	Fe	com	15	poor	15	21	y	y				
		75	120	hCL		5YR5/4	Fe	com	15	poor	27	0	y	y				
										Total	**123**	**101**						
										MD	44	36						
									Droughtiness grade (DR)		1	1						
10	T	0	25	CL		7.5YR4/3			2	-	44	44	n	n	*III-IV*	3b/4	**3b**	WE
		25	80	ZC		5YR4/4	Fe	com	2	poor	50	53	y	y				
		80	120	hCL	y	5YR6/3	Fe	com	2		39	0	y	n				
										Total	**133**	**97**			Topsoil border m-hCL			
										MD	54	32						
									Droughtiness grade (DR)		1	1						
11	T	0	35	hZCL		10YR4/2			5	-	63	63	n	n	*IV*	4	**4**	WE
		35	40	hCL		10YR4/1+N3	Fe	com	10	poor	5	5	y	y				
		40	120	hCL		10YR4/1+N3	Fe	com	20	poor	70	39	y	y				
										Total	**138**	**108**						
										MD	59	43						
									Droughtiness grade (DR)		1	1						

Appendix 3: Site Photographs

Pit 1

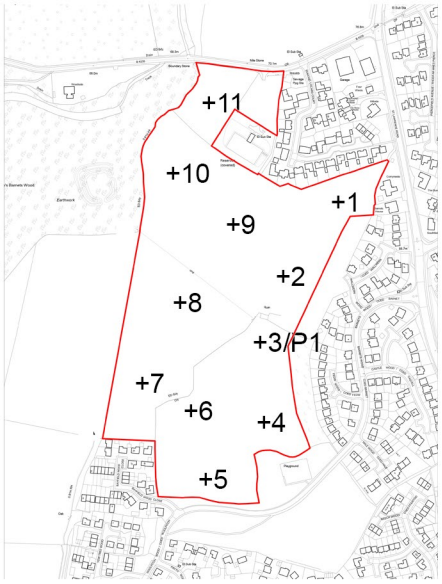
Topsoil Stone

Slowly permeable lower subsoil

Slowly permeable subsoil, better drained at depth

Grey malodorous subsoil at Ob 11

Reeds in northern parcel



Survey Area

.1 Auger Observation

.P1 Pit Observation

N

Scale 1:10,000@A4 June/2018

Figure	RAC8073-1: Observations
Site:	Land at Bayfields, Chepstow
Client:	Barratt and David Wilson Homes South Wales

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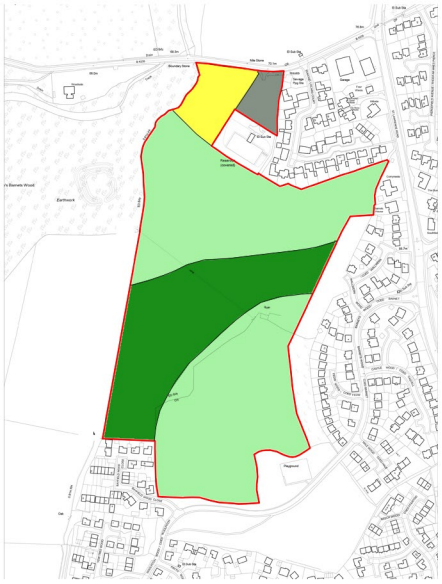

Grade 1 - excellent quality
Grade 2 - very good quality
Subgrade 3a - good quality
Best and most versatile land
Subgrade 3b - moderate quality
Grade 4 - poor quality
Grade 5 - very poor quality
Not Present

N

Scale 1:10,000@A4 June/2018

Figure	RAC8073-2: Agricultural Land Classification
Site:	Land at Bayfields, Chepstow
Client:	Barratt and David Wilson Homes South Wales

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