M25 junction 10/A3 Wisley interchange TR010030
6.5 Environmental Statement: Appendix 13.3 Soil resources and ALC - Park Barn Farm

Regulation 5(2)(a)
Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended)

M25 junction 10/A3 Wisley interchange

The M25 junction 10/A3 Wisley interchange Development Consent Order 202[x]

6.5 ENVIRONMENTAL STATEMENT:

APPENDIX 13.3 SOIL RESOURCES AND ALC – PARK BARN FARM

Regulation Number:	Regulation 5(2)(a)
Planning Inspectorate Scheme Reference	TR010030
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Author:	M25 junction 10/A3 Wisley interchange project team, Highways England

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Rev 0	June 2019	Development Consent Order application

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Appendix 13.1 Soil Resources and Agricultural Land Classification - Park Barn Farm

13.1 Soil Resources and Agricultural Land Classification - Park Barn Farm

13.1.1 Introduction

13.1.1.1 Soil surveys and land evaluations were undertaken to provide information for a soil resource inventory. The inventory provides for an agricultural land classification (ALC) assessment to be made to determine the distribution and areas of Grades and Subgrades across the agricultural land at Park Barn Farm.

13.1.1.2 The survey area corresponds to three of the potential areas for Land Replacement at Park Barn Farm, areas denoted on Figure 13.1 as 1a, 1b and 1c. Area 1a lies immediately south of the River Wey on low-lying ground in the west, and 1b and 1c rise progressively towards Foxwarren Park in the east. The ALC survey is restricted to grassland; the woodland is not included in this assessment.

13.1.2 Survey Methods

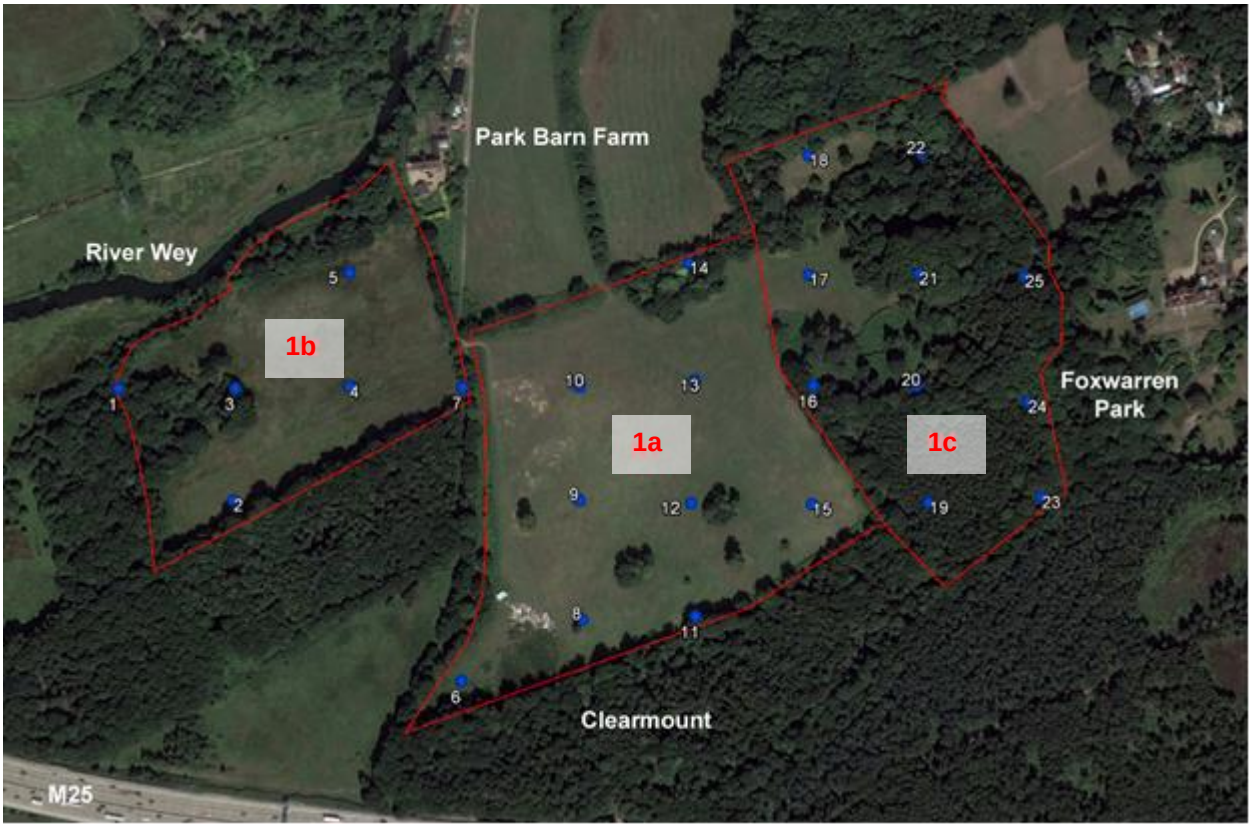
13.1.2.1 Fieldwork, which was undertaken between 7–10 January 2018, consisted of recording soil profiles at 25 observation sites (Figure 13.1) taken by coring with a hand-held auger to 120 cm depth. A network of pre-determined investigation sites was established at a 100-metre interval at the intersects of the Ordnance Survey National Grid to avoid bias in site selection; this represents one observation point per hectare. Sites on pasture and parkland (i.e. agricultural land) are numbered 1–13 and 15, 17 and 18 and produced 16 investigation sites for ALC and are supplemented by those in woodland for an additional ecological study. Each investigation site was located by readings from a Garmin etrex 30 hand-held GPS receiver calibrated to the Ordnance Survey grid reference system.

13.1.2.2 Soil profile properties such as texture, structure, colour and mottling, the presence of carbonate (free lime), drainage status, stones and the presence of a slowly permeable layer (SPL) were recorded in accordance with the Soil Survey Field Handbook (Hodgson 1997) and the MAFF Agricultural Land Classification (1988) criteria and guidelines. Soil texture was determined by hand texturing by an experienced operative, which involved rubbing a moist sample of soil between the thumb and fingers to detect proportions of sand, silt, clay and organic matter. Soil and mottle colours were compared with the Munsell Color Charts. Calcium carbonate content was assessed where necessary by applying weak (10%) hydrochloric acid, observing the effervescence and relating this to the simplified scheme in the Soil Survey Field Handbook.

13.1.2.3 Information gathered on site characteristics, gradient (measured with a Suunto clinometer), flood risk and the climate record completed the data required for an ALC assessment for each observation site.

13.1.2.4 After completing each auger bore the depth to the top of the water table was measured.

Figure 13.1: Plan of the Park Barn Farm survey area and location of the numbered soil investigation sites 1–25. Areas designated 1a, 1b and 1c are potential locations for Replacement Land



13.1.3 Background Information

Geology

13.1.3.1 Geology forms the 'soil parent material' in which soils develop by pedological processes. The 'solid geology' comprises the Bagshot Formation (formerly Bagshot Beds), mapped and described by the British Geological Survey (map symbol BGS in Figure 13.2). It directly underlies the whole of areas 1b and 1c. It consists of variable shallow marine detrital deposits of predominately sands but with seams of clay in places (Table 13.1). Stones are uncommon. This survey found the occurrence of these differing lithological elements to be unpredictable in the landscape without more detailed investigation.

13.1.3.2 Area 1a is mapped as superficial (drift) river terrace deposits, labelled in Figure 13.2 as RTD, using a generic term for variable fluvial sand and gravel deposits of different ages and lying at different elevations in the landscape. Such deposits at Park Barn Farm seem to have formed as Head derived from the Bagshot Formation unslope, with profiles that are mainly sandy, especially on raised areas but with clay seams in places.

13.1.3.3 The strip along the wooded northern edge of area 1a consists of usually clayey riverine alluvium (Figure 13.2, symbol ALV) deposited from channel overflow on the floodplain of the River Wey.

Figure 13.2: Geological map of the Park Barn Farm (PBF) survey area

Table 13.1: Brief description of the geological deposits

Map Symbol	Name	Age	Description
ALV	Alluvium	Holocene (recent)	clayey alluvium deposited on the floodplains of rivers and streams
RTD	River Terrace Deposits (Undifferentiated)	Pleistocene	variable fluvial sand and gravel deposits
BGS	Bagshot Formation	Eocene	shallow marine detrital coarse- to fine-grained sand, frequently micaceous and locally clayey or with some carbonate
CLGB	Claygate Member	Eocene	clay, silt and fine-grained sand
LC	London Clay Formation	Eocene	blue-grey or grey-brown, slightly calcareous, impermeable clay or silty clay, weathered brown and decalcified near the ground surface

Soils

13.1.3.4 A **detailed soil map** of the Soil Survey of England and Wales at 1:25,000 scale covers the Woking district (Fordham 1986). Soils of the survey site are allocated to Ebstree, Wickham and Woking soil types (known as 'soil series'), as shown in an extract from the paper map in Figure 13.3 and briefly described in Table 13.2. **Ebstree series** is defined as 'argillic brown sands', in sandy drift with siliceous stones; **Wickham series** as 'typical stagnogley soils'; and **Woking series** as 'typical sand-rankers', fine sandy material passing to sand or soft sandstone.

13.1.3.5 The local, detailed soil information has been summarised initially as a paper map (Soil Survey of England and Wales 1983) produced at 1:250,000 scale. A digital version of this **National Soil Map** 'NATMAPvector' is published by Cranfield University http://www.landis.org.uk/data/natmap.cfm. The survey area falls into three soil associations, groups of dominant and ancillary soil types (soil series); the dominant soil series gives its name to the association. These soil associations are labelled 571w (area 1a), 643a (area N1 and N4), and 813d (area 1a, northern fringe) in Figure 13.4 and each is described in Table 13.3 along with its composition of soil series.

Figure 13.3: Extract from the published detailed Woking soil map with part of Park Barn Farm survey site indicated

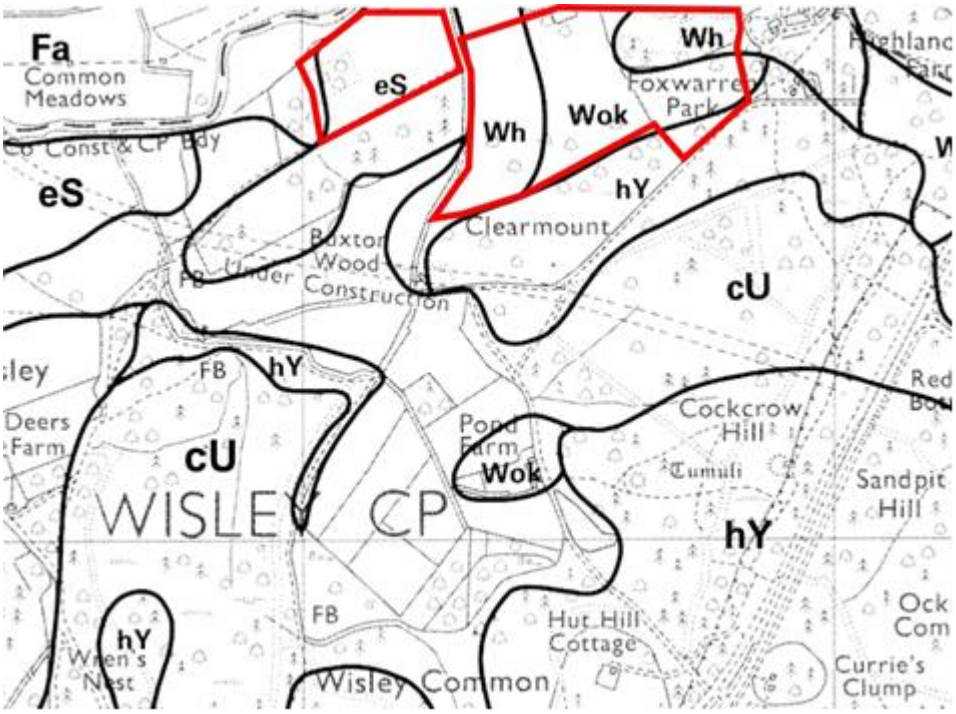


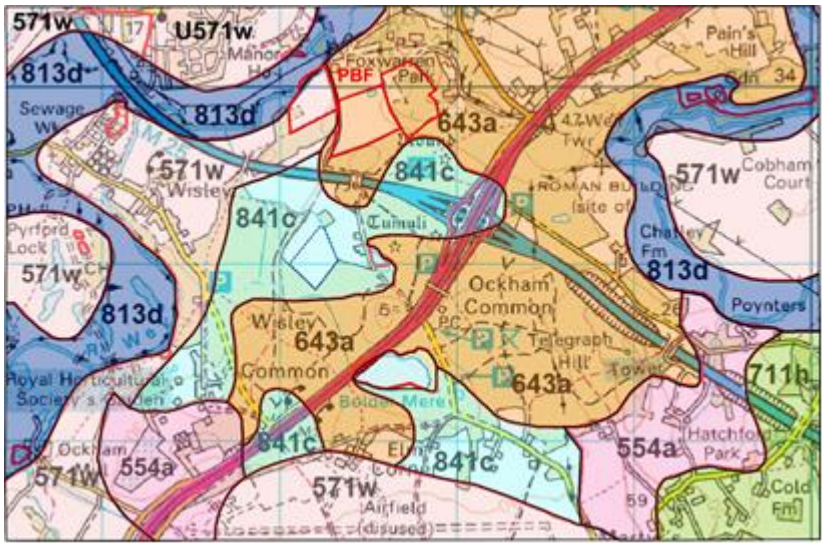
Table 13.2: Brief description of the soil map units of the Woking soil Map (Figure 13.3)

Map symbol	Soil map unit	Topsoil texture and stoniness	Main soil characteristics	Soil water regime
eS	Ebstree	slightly stony loamy sand	Deep, permeable sandy soils with reddish flinty sandy loam below 40 cm depth. Some similar slightly mottled soils (Bentley series) and occasional stoneless soils in places.	well drained, subsoil rarely wet
Wh	Wickham	slightly stony clay loam	Slowly permeable, prominently mottled medium loamy over clayey soils passing to massive stoneless clay at depth.	seasonally waterlogged, topsoil intermittently wet and upper subsoil wet for most of the winter and early spring; most excess water moves laterally through the upper parts of the soil
Wok	Woking	very slightly stony fine sand	Deep permeable stoneless fine sandy soils over loose, weakly bedded sands within 40 cm depth. Some slightly mottled light loamy soils in places.	well drained, subsoil rarely wet

13.1.3.6 Creation of a National Soil Map allows numerous interpretations to be made of practical application to users. **Soil Site Reporter** identifies and describes the properties and capacities of the soil in each soil association, being the most accurate and comprehensive source of soil information at the national level https://www.landis.org.uk/sitereporter.

13.1.3.7 **Soilscapes** (http://www.landis.org.uk/data/nmsoilscapes.cfm) is a simplified soils dataset created from NATMAPvector with the purpose of effectively communicating a general understanding of the variations which occur between soil types, and how soils affect the environment. The Soilscape units coinciding with NATMAP associations are briefly described in Table 13.4.

Figure 13.4: Extract from the digital version of the National Soil Map NATMAPvector, with Park Barn Farm (PBF) situated in soil associations 571W, 643a and 813d



Soils Data © Cranfield University (NSRI) and for the Controller of HMSO 2018

Table 13.3: National Soil Map soil associations mapped on Park Barn Farm

Map Symbol	Soil Association	Ancillary subgroups and soil series	Geology	Soil and Site Characteristics
571w	HUCKLESBROOK	571 Maplestead 554 Ebstree 573 Breamore	River terrace drift	Well drained light loamy and some sandy soils, commonly over gravel. Some similar permeable soils affected by groundwater. Usually on flat land.
643a	HOLIDAYS HILL	631 Shirrell Heath 711 Kings Newton 861 Isleham 643 Rapley	Tertiary and Cretaceous sand, loam and clay	Naturally very acid sandy over clayey and loamy over clayey soils locally with humose or peaty surface horizons, slowly permeable subsoils and slight seasonal waterlogging. Some very acid well drained sandy soils, and some deep sandy soils, affected by groundwater with humose surface horizons.
813d	FLADBURY 3	811 Conway 811 Enborne	Riverine alluvium	Stoneless clayey, medium silty and medium loamy soils affected by groundwater. Flat land. Risk of flooding.

Table 13.4: Summary of Soilscapes units mapped on Park Barn Farm

Unit	NATMAP association	Description	Habitats
6	571w - Hucklesbrook	Freely draining slightly acid loamy soils	Neutral and acid pastures and deciduous woodlands
15	643a - Holidays Hill	Naturally wet very acid sandy and loamy soils	Mixed dry and wet lowland heath communities
20	813d - Fladbury	Loamy and clayey floodplain soils with naturally high groundwater	Wet flood meadows with wet carr woodlands in old river meanders

Text developed by Cranfield University and sponsored by Defra, Copyright © Cranfield University 2018
See: http://www.landis.org.uk/overview/casestudies_conservation.cfm for the use of Soilscapes in Conservation Management

13.2 The Soil Resources

13.2.1 Soil investigation soil profile results

13.2.1.1 Area 1a soil profiles 1–5 and 7 (Figure 13.1) are recorded in Table 13.5. An explanation of the terms and abbreviations are given in Annex 1.

Table 13.5: Soil profile for Area 1a

Sidebar	KEY	AREA 1aAuger Field Records							
Easting	Northing								
	Land use								
	Water table								
	Wetness Class								
	Horizons								
507000	159900	Profile:	1					Altitude	17
	RGR		Profile	Details					
	WT 45 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC IV	From (cm)	To (cm)		%	Type	%	Type	
	Ah1	0	10	MSL	0		0		TS
	Ah2	10	28	MSL	0		0		M
	Bw	28	39	MSL	0		0		M
	Bg1	39	80	MSL	0		0		M
	Bg2	80	110	MSL	0		0		M
	BCg	110	120	MSL	0		0		M
507100	159800	Profile:	2					Altitude	19
	PGR		Profile	Details					
	WT 34 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC III	From (cm)	To (cm)		%	Type	%	Type	
	Ap	0	27	MSL	0		0		TS
	Bg	27	47	MSL	0		0		M
	2BCg	47	83	C	0		0		P
	2Cg1	83	98	C	0		0		P
	2Cg2	98	120	C	0		0		P
507100	159900	Profile:	3					Altitude	17
	DCD/RGR		Profile	Details					

Sidebar	KEY	AREA 1aAuger Field Records							
	WT 32 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC IV	From (cm)	To (cm)		%	Type	%	Type	
	Ah	0	8	MSL	0		0		TS
	Ahg	8	24	MSL	0		0		M
	Bg1	24	90	MSL	0		0		M
	Bg2	90	95	MSL	0		0		M
	2Cg	95	120	C	0		0		P
507200	**159900**	**Profile:**	**4**				**Median**	**Altitude**	**24**
	PGR		Profile	Details					
	WT 110 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC I-II	From (cm)	To (cm)		%	Type	%	Type	
	Ap	0	25	LMS	0		0		TS
	Bw1	25	42	LMS	0		0		M
	Bw2	42	68	MS	0		0		M
	Bw3	68	78	MS	0		0		M
	BC(g)1	78	95	LMS	0		0		M
	BC(g)2	95	120	MS	0		0		M
507200	**160000**	**Profile:**	**5**					**Altitude**	**18**
	PGR		Profile	Details					
	WT 65 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC II	From (cm)	To (cm)		%	Type	%	Type	
	Ap	0	22	LMS	0		0		TS
	Bw	22	35	LMS	0		0		M
	Bg1	35	65	LMS	0		0		M
	Bg2	65	85	LMS	0		0		M
	Bg3	85	98	MS	0		0		M
	BCg	98	120	MS	0		0		M
507300	**159900**	**Profile:**	**7**					**Altitude**	**23**
	PGR		Profile	Details					
	WT >120 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC I	From (cm)	To (cm)		%	Type	%	Type	
	Ap	0	28	LMS	0		0		TS
	Bw1	28	62	MS	0		0		M
	Bw2	62	78	MS	0		0		M
	BC	78	120	FS	0		0		M

13.2.1.2 Soil profile observations show the western end of 1a (sites 1, 2 and 3) to have light loamy profiles of medium sandy loam (MSL) texture, but at site 2 on the southern edge there is a clay (C) upper and lower subsoil, similar to some profiles investigated on the Bagshot Formation in area 1c.

13.2.1.3 Water tables during the survey were high, between 32 and 45 cm depth below the ground surface. Site 1 is on the edge of the narrow Wey floodplain to the north and is affected by groundwater and potentially flooding. Site 2 has surface water supported by a clayey, slowly permeable subsoil. Site 3 is near the edge of grazed deciduous woodland which forms a drainage receiving site; in the centre of the wooded area is boggy ground with the potential of surface water flooding.

13.2.1.4 In the eastern part of area 1a, on slightly higher ground, the soil profiles (4, 5 and 7) are sandy throughout to 120 cm depth. The topsoils are of loamy medium sand (LMS) texture which also extends into the subsoils down to 85 cm (site 5) and 42 cm (site 4). The subsoil of site 7 consists of medium grade sand (MS) passing down to geological parent material of fine sand (FS). The lower subsoils of sites 4 and 5 are mainly medium sands (MS). There is substantial animal burrowing on these sandy soils around 4 and 5 and molehills are widespread.

13.2.1.5 At site 5, just beyond the floodplain, there was a groundwater table at 65 cm depth and the site could potentially be affected by river flooding from the Wey to the north. At site 4 the water table was at 110 cm depth while on the highest ground at site 7 there was no water table within 120 cm depth.

13.2.1.6 All soil profiles are stoneless; no gravel seam was found that would be likely to occur in river terrace deposits.

13.2.1.7 The thin strip of wooded floodplain beside the Wey in the north of area 1a was not examined as part of the ALC survey as being non-agricultural. It is expected to have clayey alluvial soil material over a sandy substrate.

Figure 13.5: View of area 1a from the Public Bridleway at the eastern end – note the molehills visible

13.2.1.8 Area 1c soil profiles for sites 6, 8–13 and 15, 17 and 18 (Figure 13.1) in grass/parkland are recorded in Table 13.6.

13.2.1.9 Soil profile observations show that the broad central section of area 1c (sites 9, 10, 12, 13 and 15) has mainly sandy profiles of mostly loamy medium sand (LMS) texture with some layers of light loamy medium sandy loam (MSL) or sand (MS or FS). Higher ground along the southern edge (sites 6, 8 and 11) can be differentiated by having clay (C) seams within the Bagshot Formation that occur within the subsoils. Sites 8 and 11 have medium sandy loam (MSL) topsoils while site 6 has a sandier loamy medium sand (LMS) topsoil.

13.2.1.10 Shallow water tables at sites 8 and 11 are caused by slowly permeable clayey layers in the subsoil. Surface wetness was encountered on the upper slopes in the south, for example, between sites 11 and 12.

13.2.1.11 Molehills within the parkland exposed sandy topsoils with a few small and medium-sized rounded pebbles but all subsoils appeared to be stone free.

13.2.1.12 Site 14 is located within a wooded surround to an ornamental lake and is, therefore, non-agricultural and not included in this report.

13.2.1.13 The grass/parkland extends into an area of almost one hectare in area 1c where two profiles were examined, sites 17 and 18 on gently to moderately sloping land. Although with no water table in the auger hole following investigation, both profiles displayed colour mottling in the lower subsoil above clayey (C) seams typical of the Bagshot Formation. The profile of site 17 is loamy medium sand (LMS) to 98 cm depth and site 18 is a medium sandy loam (MSL) to 56 cm depth.

Table 13.6: Soil profile details for Areas 1b and 1c

Sidebar	Key	Auger	Field	Records	N1	N4			
Easting	**Northing**								
	Land use								
	Water table								
	Wetness Class								
	Horizons								
507304	159652	Profile:	6					Altitude:	27
	PGR		Profile	Details					
	WT >120 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC III	From (cm)	To (cm)		%	Type	%	Type	
	Ap	0	18	LMS	0		0		TS
	Bw(g)1	18	45	LMS	0		0		M
	Bw(g)2	45	59	HCL	0		0		M
	Bg1	59	78	C	0		0		P
	Bg2	78	108	SCL	0		0		M
	BCg	108	120	MSL	0		0		M
507400	**159700**	**Profile:**	**8**					**Altitude:**	**33**
	PGR		Profile	Details					
	WT 22 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure

Sidebar	Key	Auger	Field	Records	N1	N4			
	WC IV	From (cm)	To (cm)		%	Type	%	Type	
	Ap	0	15	MSL	0		0		TS
	Ahg	15	30	MSL	0		0		M
	2Bg1	30	55	MCL	0		0		P
	2Bg2	55	70	MCL	0		0		P
	BCg	70	105	MSL	0		0		M
	3Cg	105	120	C	0		0		P
507400	**159800**	**Profile:**	**9**					**Altitude:**	**31**
	PGR		Profile	Details					
	WT >120 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC II	From (cm)	To (cm)		%	Type	%	Type	
	Ap	0	26	LMS	0		0		TS
	Bw	26	52	LMS	0		0		M
	Bw(g)	52	80	LMS	0		0		M
	BCg	80	105	LMS	0		0		M
	2BCg	105	115	SCL	0		0		M
	Cg	115	120	MS	0		0		M
507400	**159900**	**Profile:**	**10**					**Altitude:**	**29**
	PGR		Profile	Details					
	WT >120 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC II	From (cm)	To (cm)		%	Type	%	Type	
	Ap	0	25	LMS	0		0		TS
	Bw1	25	50	LMS	0		0		M
	Bw2	50	68	LMS	0		0		M
	BCg1	68	88	MSL	0		0		M
	BC(g)	88	104	LMS	0		0		M
	BCg2	104	120	LMS	0		0		M
507500	**159700**	**11**					**Altitude:**		**29**
	PGR	Profile		Details					
	WT ? cm	Depth		Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC IV	To (cm)			%	Type	%	Type	
	Apg	28		MSL	0		0		TS
	Bg1	38		C	0		0		P
	Bg2	98		C	0		0		P
	2BCg	115		SCL	0		0		P
	3Cu	120		FS	0		0		M
507500	**159800**	**12**					**Altitude:**		**27**
	PGR	Profile		Details					
	WT 46 cm	Depth		Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC II	To (cm)			%	Type	%	Type	
	Ap	27		MSL	0		0		TS
	Ah	35		MSL	0		0		M
	Eb	68		LMS	0		0		M
	Bh	80		LMS	0		0		M
	Bs	90		LMS	0		0		M
	BC	98		MS	0		0		M
	Cu	120		MS	0		0		M
507500	**159900**	**13**					**Altitude:**		**29**

Sidebar	Key	Auger	Field	Records		N1	N4			
	PGR	Profile		Details						
	WT 88 cm	Depth		Texture	Stone1	Stone1	Stone2	Stone2		Structure
	WC I	To (cm)			%	Type	%	Type		
	Ap	20		MSL	0		0			TS
	Bw1	32		LMS	0		0			M
	Bw2	50		LMS	0		0			M
	Bw3	73		LMS	0		0			M
	BC1	89		MSL	0		0			M
	BC2	105		MS	0		0			M
	BC3	120		LMS	0		0			M
507600	**159800**	**15**						**Altitude:**		**38**
	PGR	Profile		Details						
	WT >120 cm	Depth		Texture	Stone1	Stone1	Stone2	Stone2		Structure
	WC II-I	To (cm)			%	Type	%	Type		
	Ap	25		LMS	0		0			TS
	Eb/Bw	36		LMS	0		0			M
	Bf	48		MSL	0		0			M
	BC	60		LMS	0		0			M
	BC(g)	85		LMS	0		0			M
	Cu	120		FS	0		0			M
507600	**160000**	**17**						**Altitude:**		**27**
	PGR	Profile		Details						
	WT >120 cm	Depth		Texture	Stone1	Stone1	Stone2	Stone2		Structure
	WC II	To (cm)			%	Type	%	Type		
	Ap	20		LMS	0		0			TS
	Bw	50		LMS	0		0			M
	Bg	98		LMS	0		0			M
	2BCg	120		SC	0		0			P
507600	**160100**	**18**						**Altitude:**		**27**
	PGR	Profile		Details						
	WT >120 cm	Depth		Texture	Stone1	Stone1	Stone2	Stone2		Structure
	WC II	To (cm)			%	Type	%	Type		
	Ah1	25		MSL	0		0			TS
	Ah2	45		MSL	0		0			M
	Bw	56		MSL	0		0			M
	Bg	69		MCL	0		0			M
	Cu1	83		FS	0		0			M
	BCg	93		C	0		0			P
	Cu2	120		FS	0		0			M

Figure 13.6: View of area 1c from near site 10 towards site 15 in area 1b in the south east

13.3 The Agricultural Land Classification (ALC)

13.3.1 Introduction

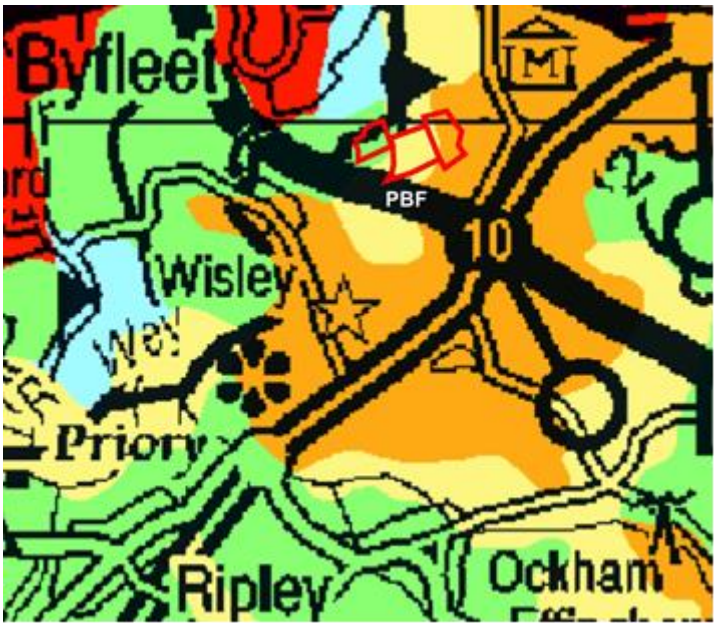
13.3.1.1 The assessment has been made in accordance with the revised guidelines and criteria (MAFF 1988, Natural England 2012) for ALC. The scheme provides a framework for classifying land according to the extent to which its physical or chemical characteristics impose long-term limitations on agricultural use. It allows the relative potential of land for agricultural use to be assessed and compared. The principal physical factors influencing agricultural production are climate, site and soil. These factors together with interactions between them form the basis for classifying land into one of five grades (Annex 2).

13.3.1.2 The grading does not necessarily reflect the current economic value of land, land use, range of crops, suitability for specific crops or level of yield. Likewise, the size, structure and location of farms, the standard of fixed equipment and the accessibility of land do not affect grading although they may influence land-use decisions.

13.3.1.3 A Provisional ALC for England at 1:250,000 scale is available from the Natural England (2010) website. It has been digitised from the published 1:250,000 maps, which were in turn compiled from the published 1 inch to 1 mile (1:63,360-scale) maps. Having been compiled on pre-MAFF 1988 criteria and where Grade 3 was not divided into Subgrades 3a and 3b, these maps are no longer considered to show the accurate Grade of the land and should not be enlarged to a better scale than 1:250,000 for this purpose.

13.3.1.4 The Provisional ALC map indicates Grade 3 (undivided) for the 1a area, and Grade 4 for the 1b and 1c parkland as shown in Figure 13.7.

Figure 13.7: The Provisional ALC map – grading key: blue Grade 2, green Grade 3 (undivided), yellow Grade 4, orange non-agricultural, red urban



13.3.1.5 In this survey, each soil investigation site has been assessed separately on its merits using the principle of most limiting factor to obtain the overall grade. These assessments have been combined to form a detailed classification for the surveyed area. This detailed re-assessment supersedes the 'Provisional' version.

13.4 Investigation Results

13.4.1 Climatic Limitations

13.4.1.1 Climatic details for the land are provided as Agricultural Climatic Data below. Average annual rainfall for the area is calculated at 676 mm. There is a winter field capacity period, when the soil is fully recharged with water and susceptible to trafficking and structure damage, of 141 Field Capacity Days (FCD). During the growing season a large moisture deficit (MDM) builds up, the mean maximum deficit for wheat being 116 mm, and for potatoes of 112 mm. Climatic conditions are not limiting with all sites able to qualify as Grade 1.

13.4.2 Site limitations

13.4.2.1 Slopes of up to 7° are not limiting. Gradient is limiting to subgrade 3b for strongly sloping land up to 11° and to grade 4 for moderately steeply sloping land up to 18°. This limits the steepest grassed areas within the parkland to subgrade 3b at site 18.

13.4.2.2 Microrelief and Pattern are not considered limiting.

13.4.2.3 Flooding by the River Wey as the channel capacity is exceeded has been recorded in 1968 and 2002-03 affecting the land use and hence land quality of the floodplain (Figure 13.8). The Environment Agency has published maps of flood risk from rivers and the sea, and from surface flooding. Figure 13.9 shows the extent of the ‘High’ risk zone of flooding from rivers occupying the floodplain in area 1a, affecting investigation sites 1 and 3. For a further slight distance south of the floodplain there is land that is considered at 'Low' risk, occupied by investigation site 5. ‘High’ means greater than or equal to 1 in 30 (3.3%) chance in any given year, and ‘Low’ means less than 1 in 100 (1%) but greater than or equal to 1 in 1,000 (0.1%) chance in any given year.

Figure 13.8: Flooding extents of the River Wey and from surface water recorded in 1968 and 2002-03

Source: Environment Agency https://data.gov.uk/dataset/recorded-flood-outlines1
File ... Recorded_Flood_Outlines_v201502.shp

Table 13.7: Wisley Common ALC Computer-generated Agricultural Climate Data

Grid Ref	ALT m	AAR mm	LAAR mm/m	ASR mm	LASR mm/m	AT0	ATS	MDM WHT	MDM POT	FCD	BEST GRADE
TQ 0750 5990	28	676	0.7	326	0.34	1489	2477	116	112	141	1 Park Barn Fm

KEY

ALT	Altitude in metres
AAR	Average annual rainfall in mm
LAAR	Lapse rate for average annual rainfall in mm/metre
ASR	Average summer rainfall (April to September) in mm
LASR	Lapse rate for summer rainfall in mm/metre
AT0	Accumulated temperature above 0° C (January to June)
ATS	Accumulated temperature above 0° C (April to September)
MDM WHT	Moisture deficit for winter wheat in mm (from regressions on ATS and ASR)
MDM POT	Moisture deficit for potatoes in mm (from regressions on ATS and ASR)
FCD	Median duration of field capacity in days, when the soil moisture deficit is zero

The BEST GRADE gives the overall climatic assessment in terms of most limiting ALC Grade for the site.
FCD data are used in calculations for soil wetness.
MDM figures are used in assessments for droughtiness.

Determination of Wetness Class (WC)

using depth to gleying (distinct mottling) and to a slowly permeable layer at least 15 cm thick (SPL) for 141 Field Capacity Days (FCD) where gleying starts within 40 cm depth, and where gleying starts between 40-70 cm depth, and where SPL within 80 cm depth where SPL within 80 cm depth

SPL within 38 cm depth	= WC IV		
SPL between 38-66 cm depth	= WC III	SPL within 48 cm depth	= WC III
SPL deeper than 66 cm	= WC II	SPL deeper than 48 cm	= WC II

Grade according to soil wetness – mineral soils

Wetness Class	Texture[1] of the top 25 cm	Grade for 126-150 Field Capacity Days
I	S[2] LS[3] SL SZL	1
	ZL MZCL MCL SCL	1
	HZCL HCL	2
	SC ZC C	3a(2)
II	S[2] LS[3] SL SZL	1
	ZL MZCL MCL SCL	2
	HZCL HCL	3a(2)
	SC ZC C	3b(3a)
III	S[2] LS SL SZL	2
	ZL MZCL MCL SCL	3a(2)
	HZCL HCL	3b(3a)
	SC ZC C	3b(3a)
IV	S[2] LS SL SZL	3a
	ZL MZCL MCL SCL	3b
	HZCL HCL	3b
	SC ZC C	3b
V	S LS SL SZL	4
	ZL MZCL MCL SCL	4
	HZCL HCL	4
	SC ZC C	4

[1] For naturally calcareous soils with more than 1% $CaCO_3$ and between 18% and 50% clay in the top 25 cm, the grade, where different from that of other soils, is shown *in brackets;*
[2] Sand is not eligible for Grades 1, 2 or 3a;
[3] Loamy sand is not eligible for Grade 1

Figure 13.9: EA-determined risk from river flooding (left) and surface flooding (right)
Note: Dark, medium and light blue indicate High, Medium and Low Risk, white Very Low, respectively

13.4.2.4 The extent, duration, frequency and timing of flooding can be difficult to establish precisely. The overall effect of flooding depends on a range of circumstances. The after-effects of inundation depend in part on soil type and will generally be more serious on impermeable soils, which remain saturated for longer periods than permeable soils. The time of year at which flooding occurs is particularly significant. Floods which occur in summer are generally more damaging than winter floods because root systems are active and more likely to be affected by waterlogging.

13.4.2.5 The guidelines given by MAFF (1988, Tables 2 and 3) take account of frequency, duration and timing of flooding and apply to soils of good or moderate permeability. Further downgrading may be justified where flooding affects soils of low permeability. The year is divided into two parts, with a long 'summer' period which includes the spring sowing and late autumn harvesting seasons. When grading land, the flood limitation is assessed separately for the summer and winter seasons and, applying the 'most limiting factor' principle, either assessment can determine the grade. Information on flooding at a local scale is often fragmentary and the assessment may have to be based on local knowledge, together with any information or advice which can be obtained from official statistics. Most weight should be given to the predicted long-term risk, or the return periods used in the design of flood protection schemes, rather than to the average incidence of flooding in recent years, which may have been influenced by atypical climatic conditions.

13.4.2.6 In considering the factors in the guidelines, area 1a land in the **'High Risk' category** has been graded as Subgrade 3b, and in the **'Low Risk' category** as Subgrade 3a. The small, localised surface-water ponding in area N1 has not been considered as a limitation.

13.4.3 Soil limitations

13.4.3.1 At observations sites 4–7, 9, 10, 15 and 17 there is a direct limitation **from topsoil texture** to no higher than Grade 2, where the topsoil is loamy medium sand (LMS) (Table 13.7). There is no limitation from **soil depth** or **topsoil stone content. Chemical conditions** are not directly limiting anywhere in the survey site.

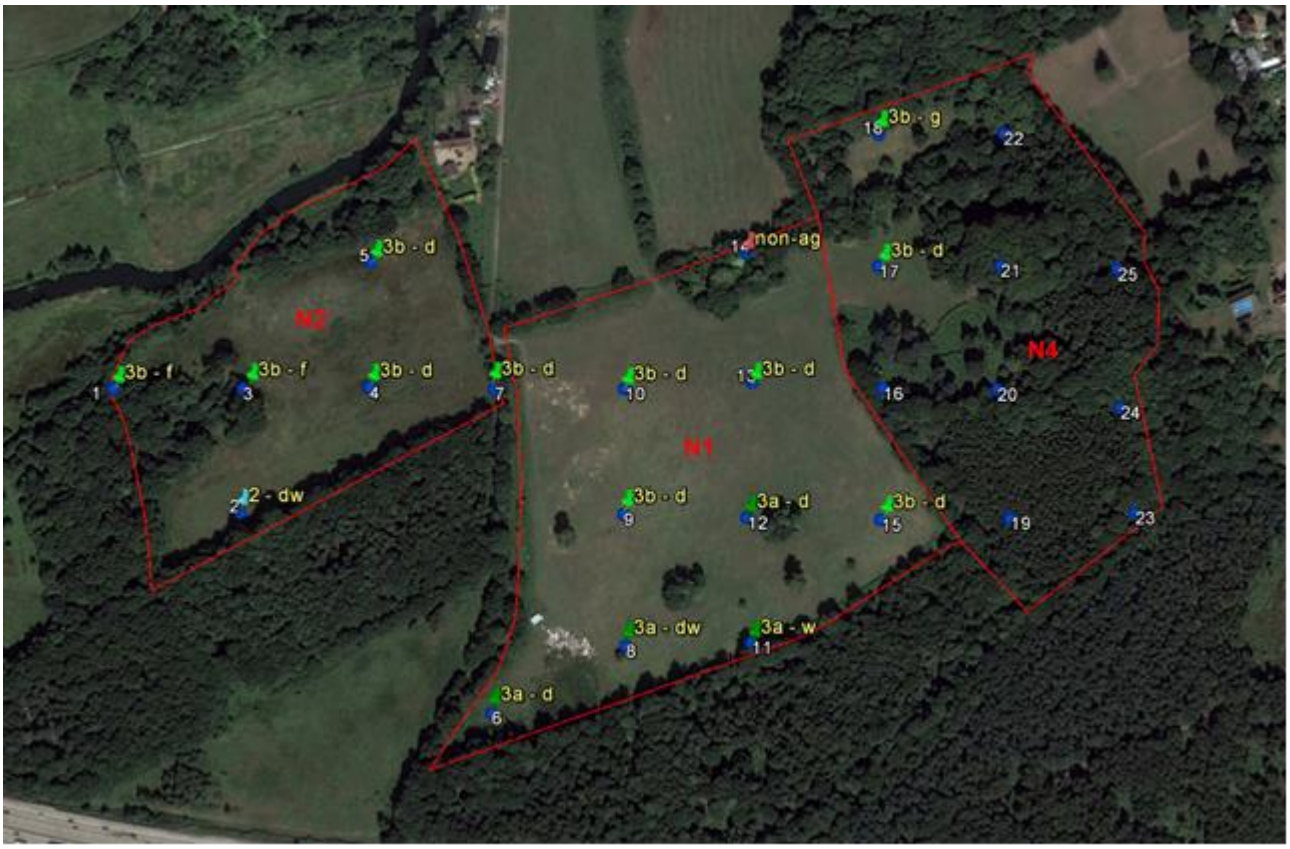
13.4.3.2 However, many observation sites are affected to variable degrees by **'soil and interactive limitations'**, including soil (subsoil) texture and structure, soil wetness and soil droughtiness.

13.4.3.3 Soil texture and structure: these features have a major influence on water retention and movement in a soil, and on workability, trafficability and suitability as a growing medium. They are significant parameters in the assessment of wetness and droughtiness; texture (as explained in Annex 1, soil texture and abbreviations) and structure, categorised as 'topsoil', 'good', 'moderate' or 'poor' (MAFF 1988, Figures 9–11).

13.4.3.4 **Soil wetness and texture:** A soil wetness limitation exists where the soil water regime adversely affects plant growth or imposes restrictions on cultivations. Permeable soils are affected by wetness where there is a ground-water table that cannot be removed by normal field drainage improvements. In less permeable soils the degree of waterlogging depends partly on the depth at which the soil becomes slowly permeable, and responsible for maintaining a perched water table. This is defined as having a lateral hydraulic conductivity of less than 10 cm a day, but in the field by observations on soil colour (denoting the natural water regime observed by gleying) and soil structure.

13.4.3.5 The soil wetness assessment has taken into account the local climate (as the number of Field Capacity Days, the soil wetness class (Annex 1), and the texture of the topsoil (Annex 1), according to the MAFF guidelines. For each observation site the allocated **Wetness Class (WC)** is given in the Table 13.7 data summary. To assess the wetness class the guidelines distinguish soils with different 'gleying' features (evident as distinct colour mottles). Wetness Class determination for soil types is based on the climatic parameter of Field Capacity Days (FCDs) and the depth to a Slowly Permeable Layer (SPL) thicker than 15 cm (MAFF 1988, Figure 13.7, Tables 13.12 & 13.13), as indicated for Park Barn Farm in the Agricultural Climate Data section above. Where these requirements are not met the soil is Wetness Class I.

Figure 13.10: Agricultural Land Classification overall grade allocated to each soil investigation site



The suffix indicates the determining limitation(s) – d drought; w wetness and texture; f flooding, g gradient

13.4.3.6 **Droughtiness:** To achieve full yield potential, a crop requires an adequate supply of soil moisture throughout the growing season. Droughtiness becomes a limitation in areas of low rainfall and where the soil has only small reserves available to plants. The ALC system uses calculations for two reference crops, winter wheat and maincrop potatoes, assuming a full crop rooting depth (120 cm for wheat and 70 cm for potatoes) for the two crop models. Assessments were calculated layer by layer for the soil investigation sites using crop-adjusted available water capacity (AP) and moisture deficit (MDM) (from the Agricultural Climate Data), based on the actual soil profile characteristics (texture, structure and stone content), as recorded in the field and summarised in Tables 13.5 and 13.6. Droughtiness, particularly for the potato reference crop, is considered one of the main limitations at 11 of the 16 investigation sites because of the sandy nature of the soil profiles. The limitations for each site for the two reference crops are given in Table 13.8?.

Table 13.8: Site, soil characteristics and ALC limitations - summary

Site location					Soil characteristics			ALC Grade/Subgrade limitations						
Easting	Northing	Bore	Slope °	Land use	Topsoil texture	SPL depth (cm)	WC	Wetness + Texture	Gradient	Stones	Drought wheat	Drought potatoes	Flooding	Overall Grade
507000	159900	1	0	RGR	mSL		IV	3a	1	1	1	2	3b	**3b**
507100	159800	2	<1	PGR	mSL	47	III	2	1	1	2	2	1	**2**
507100	159900	3	1	DCD/RGR	mSL	95	IV	3a	1	1	2	2	3b	**3b**
507200	159900	4	1	PGR	LmS		I	2	1	1	3b	3b	1	**3b**
507200	160000	5	1	PGR	LmS		II	2	1	1	3b	3b	3a	**3b**
507304	159652	6	3	PGR	LmS	45	III	2	1	1	2	3a	1	**3a**
507300	159900	7	1.5	PGR	LmS		I	2	1	1	3a	3b	1	**3b**
507400	159700	8	3	PGR	mSL	30	IV	3a	1	1	2	3a	1	**3a**
507400	159800	9	1.5	PGR	LmS		II	2	1	1	3a	3b	1	**3b**
507400	159900	10	2	PGR	LmS		II	2	1	1	3a	3b	1	**3b**
507500	159700	11	2	PGR	mSL	28	IV	3a	1	1	2	2	1	**3a**
507500	159800	12	2	PGR	mSL		II	1	1	1	3a	3a	1	**3a**
507500	159900	13	2	PGR	mSL		I	1	1	1	3a	3b	1	**3b**
507600	159800	15	3.5	PGR	LmS		II	2	1	1	2	3b	1	**3b**
507600	160000	17	5	PGR	LmS	98	II	2	1	1	3a	3b	1	**3b**
507600	160100	18	7.5	PGR	mSL		II	1	3b	1	1	2	1	**3b**

13.4.4 Conclusions

13.4.4.1 Each observation site has been assessed for its grade according to all of the possible limitations, and an overall grade has been allocated to each one based on the **'most limiting factor'** principle. These allocations are given in Table 13.7 and the distribution is mapped in Figure 13.10.

13.4.4.2 Rather than delimiting ALC 'zones', because of the variability of the soil profiles that gives an unpredictable distribution (see para 4.2.6) and hence main limitation, Figure 13.10 provides overall grades indicated at the survey points 100 metres apart.

13.4.4.3 Of the total 23.16 ha the division into the Grades and Subgrades is given in Table 13.9 by each area:

Table 13.9: ALC Grades and subgrades for the potential Land Replacement Areas at Park Barn Farm

Grade	ha	%
1	0.00	0.0
2	0.23	3.9
3a	0.00	0.0
3b	5.66	96.1
4	0.00	0.0
non-ag	0.00	0.0
Total	5.89	100.0

Grade	ha	%
1	0.00	0.0
2	0.00	0.0
3a	2.85	30.8
3b	6.13	66.1
4	0.00	0.0
non-ag	0.29	3.1
Total	9.27	100.0

Grade	ha	%
1	0.00	0.0
2	0.00	0.0
3a	0.00	0.0
3b	0.93	11.6
4	0.00	0.0
non-ag	7.07	88.4
Total	8.00	100.0

13.4.4.4 **Best and most versatile land (BMV)** is defined as Grades 1, 2 and 3a and this comprises 3.08 ha or 13.3% of the agricultural land of potential Land Replacement areas 1a, 1b and 1c.

13.5 References

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Appendices

Appendix A. Key to Tables 4 and 5 and other abbreviations

Stone Types:	Stone type 1, HR = hard rocks, flint, quartzite, quartz; Stone type 2 = soft rocks
Structure:	TS = topsoil; G = good structure; M = moderate structure; P = poor structure
MD	Climatic **Moisture Deficit** in mm for the crop at that site
AP	Crop-adjusted **Available Water Content** in mm for the soil profile
MB	**Moisture Balance** (AP–MD) in mm for the crop in the soil profile at that site
ALC	The Agricultural Land Classification **Grade** or **Subgrade** based on the Droughtiness calculation for the winter wheat and potato crop – the lower Grade/Subgrade defines the limitation for Droughtiness

For an explanation of the calculation of Available Water (AP) and climatic Moisture Deficit (MD) data see MAFF 1988, Appendix 4 and 1, respectively. For an explanation of Droughtiness see MAFF 1988, p.19–21.

Series refers to the named Soil Type in the National Soil Classification of the National Soil Resources Institute (NSRI) of Cranfield University, formerly the Soil Survey of England and Wales (SSEW).

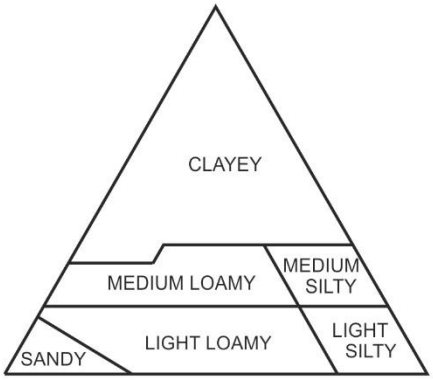
For an explanation of **Horizons** see the Soil Survey Field Handbook, Hodgson 1997, p.83–97.

Texture Classification and Abbreviations

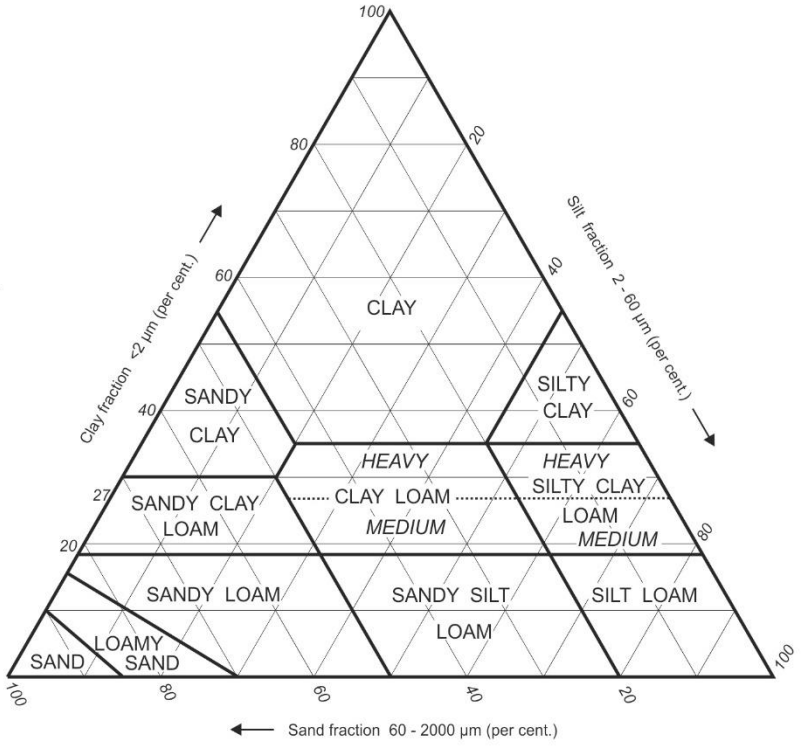
ALC 'Texture' & Stone Type	Code
Silt loam	ZL
Fine sandy silt loam	FSZL
Medium sandy silt loam	MSZL
Coarse sandy silt loam	CSZL
Fine sandy loam	FSL
Medium sandy loam	MSL
Coarse sandy loam	CSL
Loamy fine sand	LFS
Loamy medium sand	LMS
Loamy coarse sand	LCS
Fine sand	FS
Medium sand	MS
Coarse sand	CS
Marine light silts	MZ
Organic sands	OS
Organic loams	OL
Organic clays	OC
Peaty sands	PS
Peaty loams	PL
Sandy peats	SP
Loamy peats	LP
Humified Peats	HP
Fibrous & semi-fibrous peats	FSP
Hard rocks	HR
Soft, medium/coarse sandstone	MSS
Weathered igneous/metamorphic	WIM
Oolitic/dolomitic limestones	ODL

ALC 'Texture' & Stone Type	Code
Soft, fine sandstone	FSS
Soft, argillaceous/silty	MST
Chalk or chalk stones	CH
Gravel (hard stones)	GRH
Gravel (soft stones)	GRS

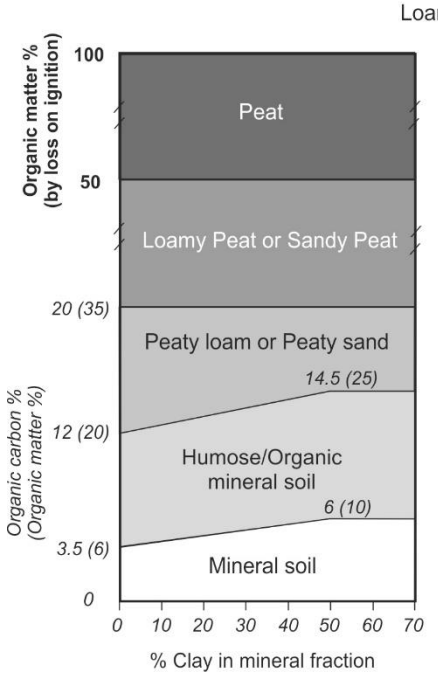
SUBGROUPS



PARTICLE-SIZE CLASSES mineral soils, with limiting percentages of sand, silt and clay fractions



ORGANIC MATTER STATUS



Texture abbreviations

C	clay	S	sand
HCL	heavy clay loam	LS	loamy sand
MCL	medium clay loam	SL	sandy loam
ZC	silty clay	SCL	sandy clay loam
HZCL	heavy silty clay loam	SC	sandy clay
MZCL	medium silty clay loam	SZL	sandy silt loam
ZL	silt loam		
F	fine grade sand	M	medium grade sand
C	coarse grade sand		
HP	humified peat	MP	mesic (semi-fibrous) peat
FP	fibrous peat		
LP	loamy peat	PL	peaty loam
SP	sandy peat	PS	peaty sand
h/O	humose/organic (mineral soil)		

Definition of Soil Wetness Classes

Wetness Class	Descriptive Terms	Duration of Waterlogging [1].
Class I	*Rarely wet* Well Drained	The soil profile is not wet within 70 cm depth for more than 30 days in most years [2].
Class II	*Seldom wet* Slight seasonal waterlogging	The soil profile is wet within 70 cm depth for 30-90 days in most years.
Class III	*Occasionally wet* Seasonally waterlogged	The soil profile is wet within 70 cm for 90-180 days in most years.
Class IV	*Commonly wet* Waterlogged for long periods in winter	The soil profile is wet within 70 cm depth for more than 180 days, but not wet within 40 cm depth for more than 180 days in most years.
Class V	*Usually wet* Severely waterlogged	The soil profile is wet within 40 cm depth for more than 180 days, and is usually wet within 70 cm for more than 335 days in most years.
Class VI	*Permanently wet* Permanently waterlogged	The soil profile is wet within 40 cm depth for more than 335 days in most years.

Notes:

1) The number of days specified is not necessarily a continuous period.
2) “In most years” is defined as more than 10 out of 20 years.

Sources:
Soil Survey Field Handbook – J.M. Hodgson, Soil Survey and Land Research Centre, 1997
Revised Guidelines and Criteria for Grading the Quality of Agricultural Land- MAFF, 1988.

Data on the duration of waterlogging at a given site are rarely available. Wetness classes are, therefore, assigned in field survey by assessing soil texture, structure and gley morphology (*i.e.* colour mottling) in conjunction with climatic data.

Appendix B. The Agricultural Land Classification System

B.1.1 The Agricultural Land Classification of England and Wales (MAFF, 1988) provides a framework for classifying land according to the extent to which its physical or chemical characteristics impose long-term limitations on agricultural use. The limitations can operate in one or more of four principle ways: they may affect the range of crops which can be grown, the level of yield, the consistency of yield and the cost of obtaining it. The classification gives considerable weight to the flexibility of cropping, whether actual or potential, but the ability of some land to produce consistently high yields of a somewhat narrower range of crops is also taken into account.

B.1.2 The principal factors influencing agricultural production are climate, site and soils. The main climatic factors which are taken into account are temperature and rainfall, although account is also taken of exposure, aspect and frost risk. The site factors used in the classification system are gradient, microrelief and flood risk. Soil characteristics of particular importance are texture, structure, depth and stoniness. In some situations where chemical properties may influence the long-term potential of the land, these are taken into account.

B.1.3 These factors result in varying degrees of constraint on agricultural production. They can act either separately or in combination, the most important interactive limitations being soil wetness and droughtiness. The grade or subgrade of the land is determined by the most limiting factor present. Five grades of land are recognised ranging from Grade 1 – land of excellent quality, to Grade 5 – land of very poor quality. Grade 3, which constitutes about half the agricultural land in England and Wales is divided into two subgrades designated 3a and 3b.

B.1.4 Details of the ALC system are contained in the Revised Guidelines and Criteria for grading agricultural land in England and Wales (MAFF, 1988). Descriptions of the grades and subgrades are shown below.

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 includes 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 or horticultural crops can usually be grown but on some land of this 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 land.

Grade 3: Good to Moderate Quality Land

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

Grades 1, 2 and Subgrade 3a are together termed ‘Best and Most Versatile’ (BMV) land.

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