M25 junction 10/A3 Wisley interchange TR010030
6.5 Environmental Statement: Appendix 13.4 Soil resources and ALC - Nutberry 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 13.4 SOIL RESOURCES AND ALC – NUTBERRY FARM

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Appendix 13.4 Soil Resources and Agricultural Land Classification - Nutberry Farm

13.4 Soils Resources and Agricultural Land Classification - Nutberry Farm

13.4.1 Introduction

13.4.1.1 A soil survey and land evaluation were undertaken to provide information for a soil resource inventory, from which an agricultural land classification (ALC) assessment has been made to determine the distribution and areas of Grades and Subgrades across the specified agricultural land at Nutberry Fruit Farm.

13.4.1.2 The survey area corresponds to a potential area 8 for Temporary Land Replacement at Nutberry Farm, denoted on Figure 1, occupying 9.62 ha. The area lies between the roundabout of classification B roads and the A3 flyover.

13.4.1.3 The land lies at between 31 to 20 metres above sea level, with a broad ridge extending from the south east towards the north west.

13.4.1.4 The land is largely down to grass with dense stands of brambles and mown brambles in places, some deciduous trees and extensive signs of trafficking with resultant surface compaction. Construction materials were being stored at the southern edge of the site during the visit.

13.4.2 Survey Methods

13.4.2.1 Fieldwork, which was undertaken on 13 February 2018, consisted of recording soil profiles at 11 investigation sites (Figure 1) taken by coring with a hand-held auger to 120 cm depth. The network of pre-determined 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 3 and 10 fell just outside of the survey boundary and were moved by a few metres to within the boundary; site 4 was moved to avoid a construction site waste dump. Each investigation site was located by readings from a Garmin etrex 30 hand-held GPS receiver calibrated to the Ordnance Survey grid reference system.

13.4.2.2 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, 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.

13.4.2.3 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.

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

Figure 13.1: Plan of the Nutberry Farm survey area and location of the numbered soil investigation sites 1–11

13.4.3 Background Information

Geology

13.4.3.1 Geology forms the 'soil parent material' in which soils develop by pedological processes. The 'solid geology' of higher land in the south comprises the Bagshot Formation (formerly Bagshot Beds), mapped and described by the British Geological Survey (map symbol BGS in Figure 13.2). It consists of variable shallow marine detrital deposits of predominately sands but with seams of clay in places (Table 13.1). Stones are uncommon.

13.4.3.2 The remainder of the survey area on gently sloping land is mapped as London Clay (LC), an impermeable marine clay deposit.

13.4.3.3 Superficial (drift) river terrace deposits, labelled in Figure 13.2 as the low-level Kempton Park Gravel Member (KPG) are mapped on land immediately to the west and east of the survey site; these are variable fluvial sand and gravel deposits.

13.4.3.4 A thin strip of land along the low-lying northern edge is mapped as riverine alluvium (Figure 13.2, symbol ALV), deposited in a narrow valley of a stream flowing north-westwards towards a tributary of the River Wey.

Figure 13.2: Geological map of the Nutberry Fruit Farm (NPF) survey area

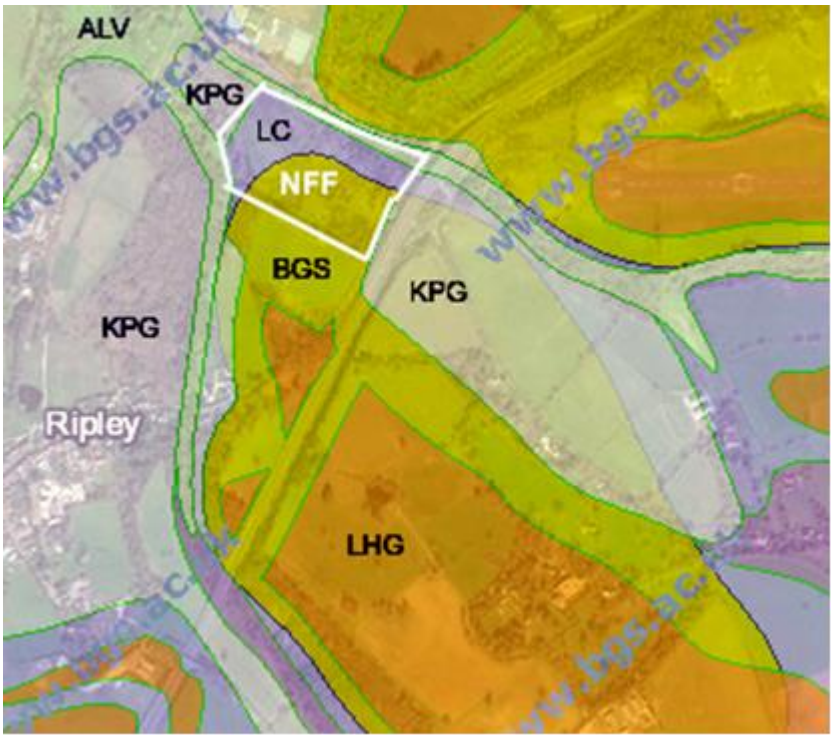


Table 13.1: Brief description of geological deposits

Map Symbol	Name	Age	Description
ALV	Alluvium	Holocene (recent)	clayey alluvium deposited on the floodplains of rivers and streams
KPG	Kempton Park Gravel Member	Pleistocene	variable fluvial sand and gravel river terrace deposits
LHG	Lynch Hill Gravel Member	Pleistocene	variable fluvial sand and gravel river terrace deposits
BGS	Bagshot Formation	Eocene	shallow marine detrital coarse- to fine-grained sand, frequently micaceous and locally clayey or with some carbonate
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

13.4.3.5 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 Arrow soil type (known as 'soil series'), as shown in an extract from the paper map in Figure 13.3. Arrow soil series is defined as 'gleyic brown earths', in light loamy drift with siliceous stones. This mapping implies that practically the whole site is covered in soil developed in superficial deposits of river terraces.

13.4.3.6 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.

13.4.3.7 The survey area falls into a single soil association, a group with, nationally, a dominant and ancillary soil series; the dominant soil series, Hucklesbrook, gives its name to the association. This soil association is labelled 571w in Figure 13.4 and is described in Table 13.2 along with the composition of its component soil types.

Figure 13.3: Extract from the published detailed Woking soil map with Nutberry Farm survey site carrying Arrow soil series (aO)

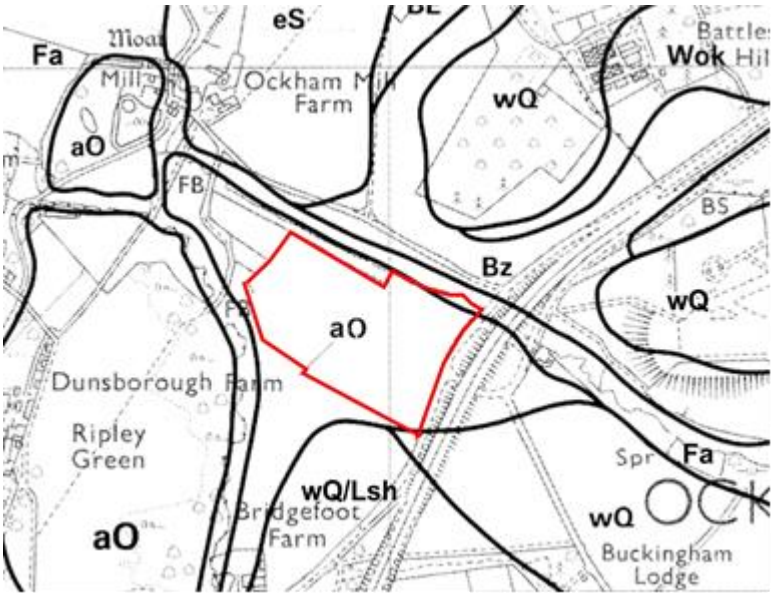
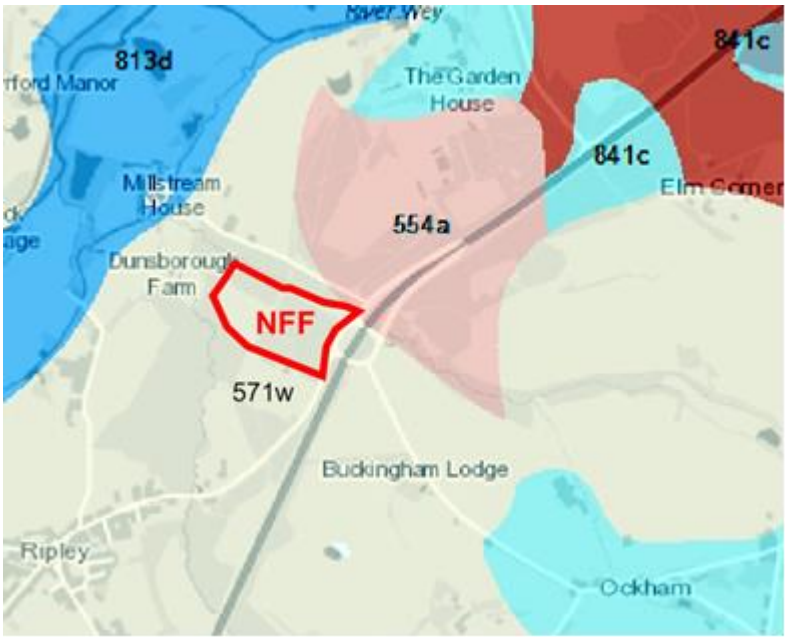


Figure 13.4: Extract from the digital version of the National Soil Map NATMAPvector, with Nutberry Farm (NFF) in soil association 517w



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

Table 13.2: National Soil Map soil associations mapped on Nutberry 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.

13.4.3.8 Hucklesbrook soil series is defined as 'typical argillic brown earths', in light loamy material over non-calcareous gravel.

13.4.3.9 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.

13.4.3.10 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 unit coinciding with NATMAP association 571w is briefly described in Table 13.3.

Table 13.3: Summary of the Soilscapes map unit mapped on Pond farm

Unit	NATMAP association	Description	Habitats
13	571 w – Hucklesbrook	Well drained light loamy and some sandy soils, commonly over gravel	Neutral and acid pastures and deciduous woodlands

13.5 The Soil Resources

13.5.1 Soil investigation soil profile results

13.5.1.1 Nutberry Farm soil profiles 1–11 (Figure 13.1) are recorded in Table 13.4. An explanation of the terms and abbreviations is given in Annex 1.

Table 13.4: Soil profile details for the survey area, Nutberry Farm

Sidebar	KEY								
Easting	Northing			soil	soil				
	Land use			subgroup	series				
	Water table								
	Wetness Class								
	Horizons	Auger Field Records							
505800	157500	Profile:	1	5.41	wQ Wick			Altitude:	20
	PGR		Profile	Details					
	WT >120 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC I	From (cm)	To (cm)		%	Type	%	Type	
	Ap	0	15	MSL	7	HR	0		TS
	Bw1	15	30	MSL	7	HR	0		M
	Bw2	30	45	LMS	20	HR	0		M
	Bcu	45	60	MS	20	HR	0		M
	Cu	60	120	MS	20	HR	0		M
505800	157600	Profile:	2	5.41	wQ Wick			Altitude:	22
	PGR		Profile	Details					
	WT >120 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC I	From (cm)	To (cm)		%	Type	%	Type	
	Ap	0	26	MSL	3	HR	0		TS
	Bw1	26	40	MSL	5	HR	0		M
	Bw2	40	50	LMS	5	HR	0		M
	BC	50	60	MS	20	HR	0		M
	Cu	60	120	MS	20	HR	0		M
505801	576688	Profile:	3	5.41	wQ Wick			Altitude:	20
	PGR		Profile	Details					
	WT >120 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC I	From (cm)	To (cm)		%	Type	%	Type	

Sidebar	KEY								
Easting	Northing			soil	soil				
	Ap	0	25	MSL	5	HR	0		TS
	Bw1	25	39	MSL	5	HR	0		M
	Bw2	39	60	LMS	5	HR	0		M
	BC	60	80	LMS	10	HR	0		M
	Cu	80	120	MS	20	HR	0		M
505900	**157412**	**Profile:**	**4**	**5.72**	**Lsh Loshes**			**Altitude:**	**20**
	BRA		Profile	Details					
	WT >120 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC I	From (cm)	To (cm)		%	Type	%	Type	
	Ap	0	22	MSL	3	HR	0		TS
	Bw1	22	39	MSL	3	HR	0		M
	Bw2	39	64	LMS	3	HR	0		M
	2BCg1	64	78	HCL	0		0		M
	2BCg2	78	115	HCL	0		0		P
	2Cg	115	120	MCL	0		0		M
505900	**157500**	**Profile:**	**5**	**5.41**	**wQ Wick**			**Altitude:**	**25**
	PGR/REC		Profile	Details					
	WT >120 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC I	From (cm)	To (cm)		%	Type	%	Type	
	Ahg1	0	20	MSL	3	HR	0		TS
	Ahg2	20	38	MSL	3	HR	0		M
	Bg	38	70	LMS	3	HR	0		M
	2Cg1	70	95	MS	3	HR	0		M
	2Cg2	95	120	MS	0		0		M
505900	**157600**	**Profile:**	**6**	**5.43**	**aO Arrow**			**Altitude:**	**22**
	PGR		Profile	Details					
	WT 88 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC II	From (cm)	To (cm)		%	Type	%	Type	
	Ap	0	23	MSL	0		0		TS
	Bw	23	39	MSL	0		0		M
	Bg	39	58	MSL	0		0		M
	Bw(g)	58	75	LMS	0		0		M
	BCg	75	85	MSL	5	HR	0		M
	BC	85	120	LMS	5	HR	0		M
506600	**157400**	**Profile:**	**7**	**5.72**	**Lsh Loshes**			**Altitude:**	**26**
	ORC		Profile	Details					
	WT >120 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC II	From (cm)	To (cm)		%	Type	%	Type	
	Ap	0	25	MSL	3	HR	0		TS
	Bw	25	32	MSL	3	HR	0		M

Sidebar	**KEY**								
Easting	**Northing**			soil	soil				
	2BCg	32	42	C	0		0		P
	BC	42	50	LMS	8	HR	0		M
	Cg	50	115	SCL	0		0		M
	Cu	115	120	LMS	0		0		M
506000	**157500**	**Profile:**	**8**	**9.20**	**disturbed soils**			**Altitude:**	**24**
	PGR/REC		Profile	Details					
	WT 8, 14, 26 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC II	From (cm)	To (cm)		%	Type	%	Type	
	Ap	0	24	MSL	4	HR	0	0	TS
	Bw	24	32	MSL	8	HR	0	CH	M
	2BCg	32	45	C	0	0	0	CH	P
	bBs	45	50	MSL	20	HR	0	CH	M
	bCu	50	120	LMS	20	HR	0	CH	M
506000	**157600**	**Profile:**	**9**	**8.31**	**Ww Wigton Moor**			**Altitude:**	**20**
	RGR		Profile	Details					
	WT 20 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC V	From (cm)	To (cm)		%	Type	%	Type	
	Ap	0	16	MSL	0		0		TS
	Bw	16	25	SCL	0		0		M
	Bw(g)	25	45	HCL	0		0		P
	BCg	45	80	MSL	0		0		M
		80	107	SCL	0		0		M
		107	120	SCL	0		0		M
506062	**157400**	**Profile:**	**10**	**5.41**	**wQ Wick**			**Altitude:**	**24**
	PGR		Profile	Details					
	WT >120 cm	Depth	Depth	Texture	Stone1	Stone1	Stone2	Stone2	Structure
	WC I	From (cm)	To (cm)		%	Type	%	Type	
	Ap	0	25	MSL	8	HR	0		TS
	Bw1	25	40	MSL	8	HR	0		M
	BC1	40	50	LMS	15	HR	0		M
	BC2	50	80	LMS	20	HR	0		M
	Cu	80	120	MS	25	HR	0		M

13.5.1.2 Soil observations show the land to have a variety of soil profile types and a variety of layers/horizons within each soil profile. There is a range of texture, with light and medium loams and sands the most common layers, and with some clay layers derived from the Bagshot Formation. All investigated topsoils were medium grade sandy loam (mSL) in texture. No alluvium, silt and clay from

suspension in the flood water from the stream, was found in the narrow stream valley.

13.5.1.3 Clay (C) and heavy clay loam (hCL) subsoil layers were found to be too thin (bores 7, 8 and 9) or too deep (bore 4) to form slowly permeable layers, by definition.

13.5.1.4 Water tables during the survey were recorded in the subsoils on lower slopes (bores 6 and 9) from ground water, and at bore 8 from slowly permeable clay layers in the upper subsoil, causing some top ponding. A wide area around bore 8 may have disturbed ground with compacted layers. Figures 13.5, 13.6, 13. 7 and 13. 8 illustrate the conditions of the bores (8, 9 and 10).

13.5.1.5 Many soil profiles formed in superficial drift contain hard stones, usually flints; moderately stony sandy seams occur in lower subsoils of river terrace deposits.

Figure 13.5 View of waterlogged pasture near bore 8

Figure 13.6 Disturbed waterlogged ground near bore 8, with subsoil material at the soil surface

Figure 13.7 The stream valley from the bridge from Mill Lane eastwards towards bore 9 on the right

Figure 13.8 High ground from bore 10 looking towards bore 5, showing a large frequency of molehills and a dense brambles stand to the left

13.6 The Agricultural Land Classification (ALC)

13.6.1 Introduction

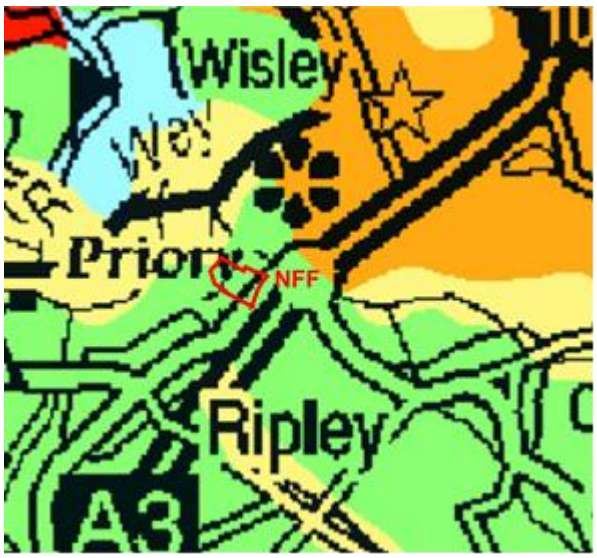
13.6.1.1 The assessment has been made in accordance with the revised guidelines and criteria (MAFF 1988, Natural England 2012) for Agricultural Land Classification. The scheme provides a framework for classifying land according to the extent to which its physical or chemical characteristics impose long-term 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).

13.6.1.2 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.

13.6.1.3 A Provisional Agricultural Land Classification 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.

13.6.1.4 The Provisional ALC map indicates Grade 3 for the Nutberry Fruit Farm survey site (Figure 13.9).

Figure 13.9: The Provisional ALC map – grade key: blue Grade 2, green Grade 3 (undivided), yellow Grade 4, orange non-agricultural, red urban



13.6.1.5 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.

13.7 Investigation results

13.7.1 Climatic limitations

13.7.1.1 Climatic details for the land are provided as Agricultural Climatic Data below. Average annual rainfall for the area is calculated at 681 mm. There is a winter field capacity period, when the soil is fully recharged with water and susceptible to trafficking and structure damage, of 143 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.

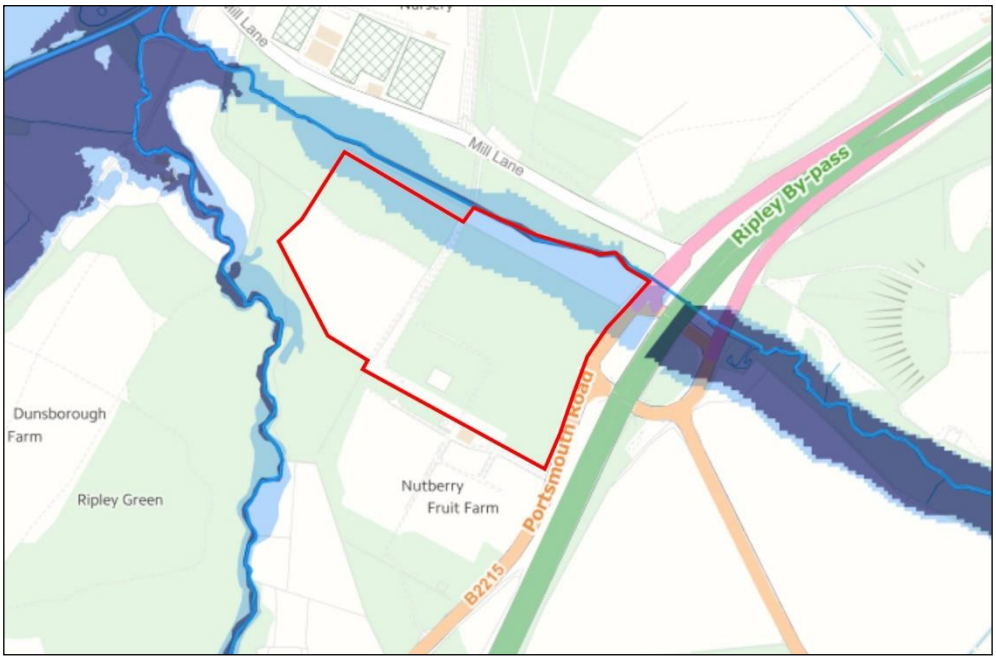
13.7.2 Site limitations

13.7.2.1 Gradient on this level land and gently sloping land is not limiting.

13.7.2.2 Microrelief and Pattern are not considered limiting.

13.7.2.3 Flooding risk: Figure 13.10 shows there is a Low flood risk from surface flooding as determined by the Environment Agency, from a stream discharging from east of the A3 Ripley By-pass towards the north west and the River Wey floodplain. The map shows a range of shades of blue indicating the flooding risk. By definition, '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 13.10: EA determined risk from surface flooding



Dark, mid- and light blue indicate High, Medium and Low Risk, white/green Very Low, respectively

Nutberry Farm, Ripley, Surrey
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 0592 5748	25	681	0.7	328	0.34	1493	2481	116	112	143	1

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 143 Field Capacity Days (FCD)

where gleying starts within 40 cm depth, and where SPL within 80 cm depth		where gleying starts between 40-70 cm depth, and where SPL within 80 cm depth	
SPL within 39 cm depth	= WC IV		
SPL between 39-66 cm depth	= WC III	SPL within 49 cm depth	= WC III
SPL deeper than 66 cm	= WC II	SPL deeper than 49 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

13.7.2.4 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.

13.7.2.5 The guidelines given by MAFF (1988, Tables 13.2 and 13.3) take account of frequency, duration and timing of flooding and apply to soils of good or moderate permeability, as were found beside the stream of Nutberry Fruit Farm (bore 9). 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.

13.7.2.6 In considering the factors in the guidelines, the nature of the surrounding topography directing runoff on to the site, the narrow stream channel and lack of effective arterial drainage, and backing up caused by the road infrastructure, a thin strip of valley bottom land and lower slopes has been assessed as being subgrade 3b. This designation is according primarily to the surface-water flood risk in winter where it is subjected to frequent (more than once in 3 years) and medium (of more than two but not more than four days' duration) periods of shallow flooding.

13.7.3 Soil limitations

13.7.3.1 Nowhere is there a direct limitation from **topsoil texture.** There is no limitation from **soil depth** or **topsoil stone content. Chemical conditions** are not directly limiting anywhere in the survey site.

13.7.3.2 However, the observation sites are affected to variable degrees by **‘soil and interactive limitations’**, including soil (subsoil) texture and structure, soil wetness and soil droughtiness.

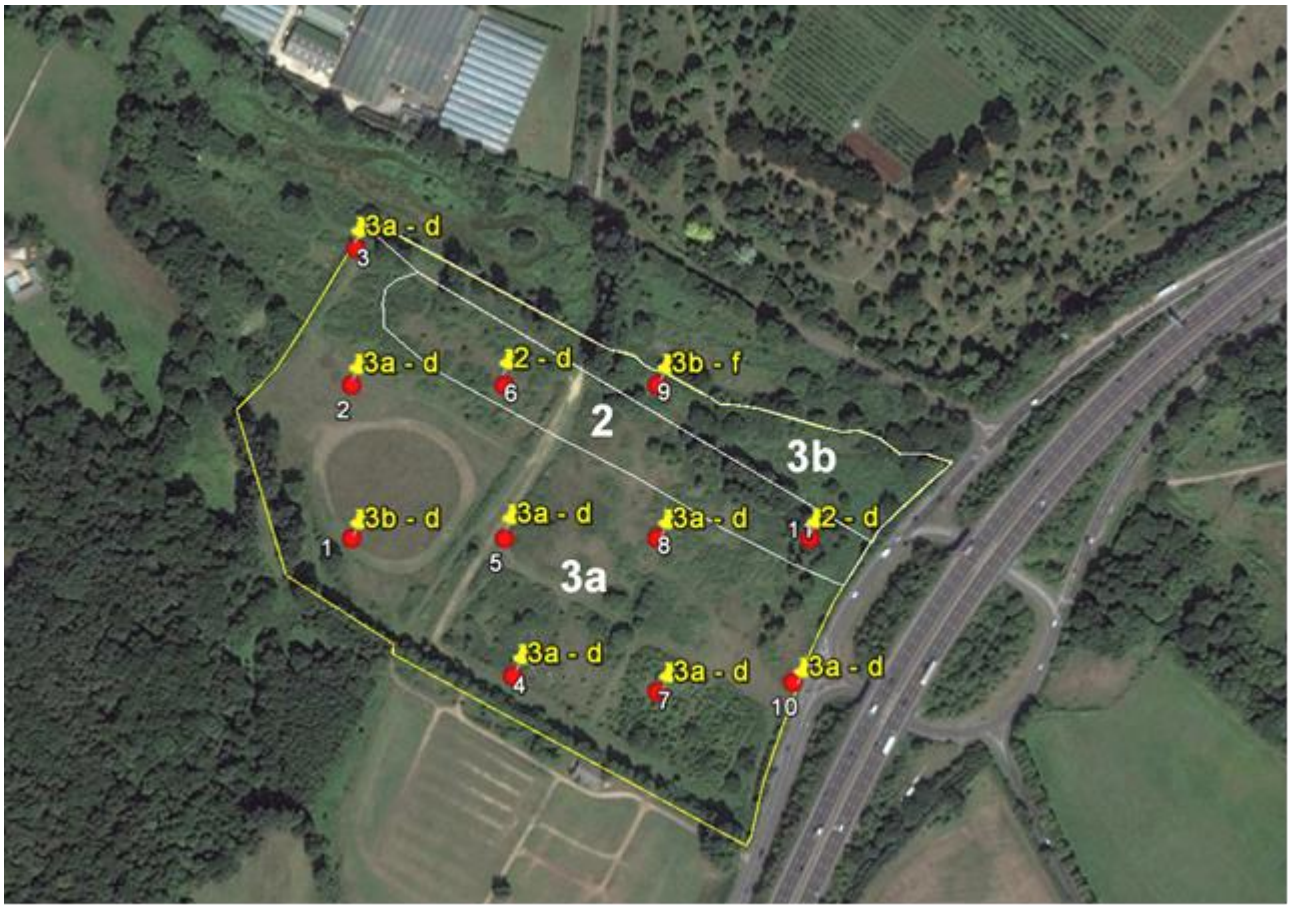
13.7.3.3 **Soil texture and structure:** these features have a major influence on water retention and movement in a soil, and on workability, trafficability and suitability as a growing medium. They are significant parameters in the assessment of wetness and droughtiness; texture (as explained in Annex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

13.7.3.4 **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, 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.

13.7.3.5 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 13.5 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 7, Tables 12 & 13), which was not found in the survey area. Whether Wetness Class I or II, sandy loam topsoils over permeable subsoils are not limiting, i.e. they qualify for Grade 1. The surface wetness occurring on the ridge around bore 8 (Figure 13.5 and Figure 13.6) is considered an artefact of being trafficked and the soil structure should be able to be restored. Only in the valley bottom (at bore 9) is the land classed as Wetness Class IV and subgrade 3a.

13.7.3.6 **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 Table 13.4. The limitations for each site for the two reference crops are given in Table 13.5, ranging from Grade 2 to subgrade 3b for both wheat and potatoes.

Figure 13.11: Agricultural Land Classification overall grade allocated to each soil investigation site



The suffix indicates the determining limitation(s) – d drought, f flooding; w wetness and texture and other site and soil interactive limitations are not dominant or limiting

Table 13.5: Site, soil characteristics and ALC limitations - summary

Site location					Soil characteristics						ALC Grade/Subgrade limitations						
Easting	Northing	Bore	Slope °	Land use	Soil_Series	Symbol	Subgroup	Topsoil texture	SPL depth (cm)	WC	Wetness + Texture	Gradient	Stones	Drought wheat	Drought potatoes	Flooding	Overall Grade
505800	157500	1	2	PGR	Wick	wQ	5.41	mSL	–	I	1	1	1	3b	3b	1	3b
505800	157600	2	1	PGR	Wick	wQ	5.41	mSL	–	I	1	1	1	3a	3a	1	3a
505801	157688	3	2	PGR	Wick	wQ	5.41	mSL	–	I	1	1	1	3a	3a	1	3a
505900	157400	4	0	BRA	Loshes	Lsh	5.72	mSL	–	I	1	1	1	2	3a	1	3a
505900	157412	5	1	PGR/REC	Wick	wQ	5.41	mSL	–	I	1	1	1	3a	3a	1	3a
505900	157600	6	1	PGR	Arrow	aO	5.43	mSL	–	II	1	1	1	2	2	1	2
506000	157400	7	0	ORC	Loshes	Lsh	5.72	mSL	–	II	1	1	1	2	3a	1	3a
506000	157500	8	0	PGR/REC	disturbed	d	9.2	mSL	–	II	1	1	1	3a	3a	1	3a
506000	157600	9	0	RGR	Wigton Moor	Ww	8.31	mSL	–	IV	3a	1	1	2	2	3b	3b
506062	157400	10	<1	PGR	Wick	wQ	5.41	mSL	–	I	1	1	1	3a	3a	1	3a
506100	157500	11	1	DCD	Arrow	aO	5.43	mSL	–	II	1	1	1	2	2	1	2

13.7.3.7 Figure 13.11 shows that droughtiness is the dominant limitation over the whole site with the exception of the stream valley. Two bores of Grade 2 (6 and 11) have been linked along the slope bordering the valley, but there is no evidence without further investigation that this strip of land of 1.53 ha is entirely Grade 2.

13.7.3.8 The bulk of the site, 6.91 ha, is subgrade 3a based on droughtiness of one or both of the indicator crops. One bore of subgrade 3b occurs (bore 1) where the subsoil below 30 cm depth is particularly sandy and stony; this is a chance find and other such profiles may occur throughout the designated allocation.

13.7.3.9 The valley bottom and lower slopes in rough grass and occasional trees are graded 3b because of the flooding risk over 1.18 ha.

13.7.4 Conclusions

13.7.4.1 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 13.5 and the distribution is mapped in Figure 13.11.

13.7.4.2 Of the total 9.62 ha of Temporary Land Replacement Area 8 the division into Grades and subgrades is summarised in Table 6.

Table 13.6: ALC Grades and Subgrades for the potential Temporary Land Replacement Area 8 at Nutberry Farm

	ha	%
1	0.00	0.0
2	1.53	15.9
3a	6.91	71.8
3b	1.18	12.3
4	0.00	0.0
non-ag	0.00	0.0
Total	9.62	100.0

13.7.4.3 Best and most versatile land (BMV) is defined as Grades 1, 2 and 3a. There is 8.44 ha of such land within the survey area at Nutberry Fruit Farm, Ripley, 87.7% of the total area.

13.8 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.

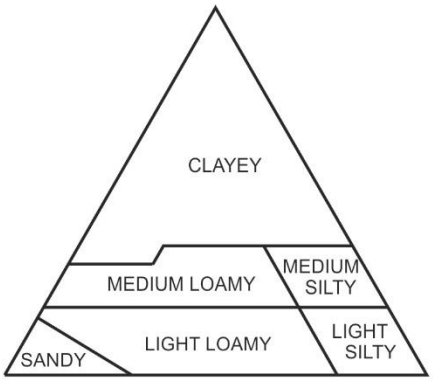
Series refers to the named Soil Type in the National Soil Classification of the National Soil Resources Institute (NSRI) of Cranfield University, formerly the Soil Survey of England and Wales (SSEW).

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

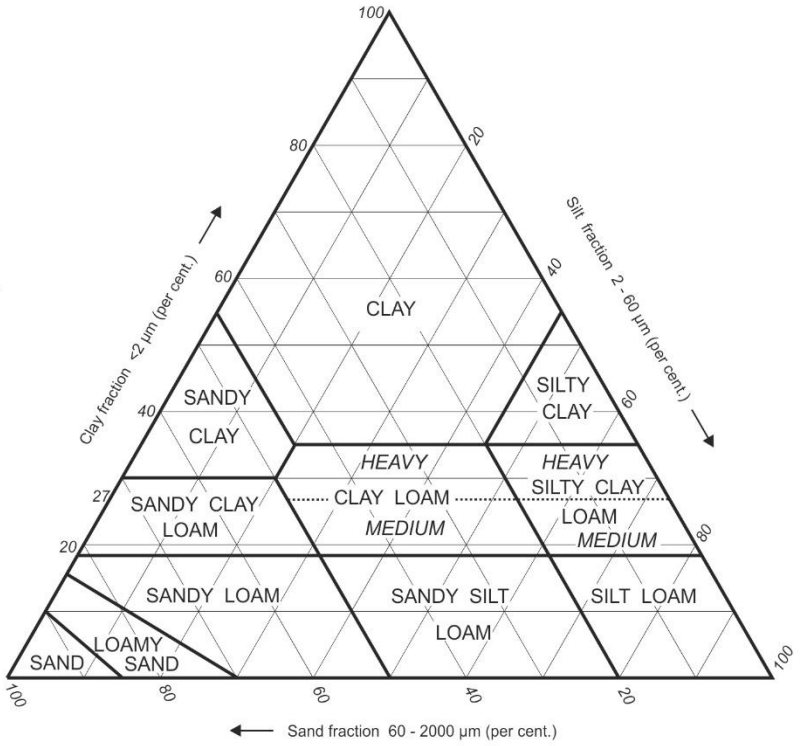
ALC 'Texture' & Stone Type	Code
Silt loam	ZL
Fine sandy silt loam	FSZL
Medium sandy silt loam	MSZL
Coarse sandy silt loam	CSZL
Fine sandy loam	FSL
Medium sandy loam	MSL
Coarse sandy loam	CSL
Loamy fine sand	LFS
Loamy medium sand	LMS
Loamy coarse sand	LCS
Fine sand	FS
Medium sand	MS
Coarse sand	CS
Marine 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
Soft, fine sandstone	FSS
Soft, argillaceous/silty	MST
Chalk or chalk stones	CH
Gravel (hard stones)	GRH
Gravel (soft stones)	GRS

Texture Classification and Abbreviations

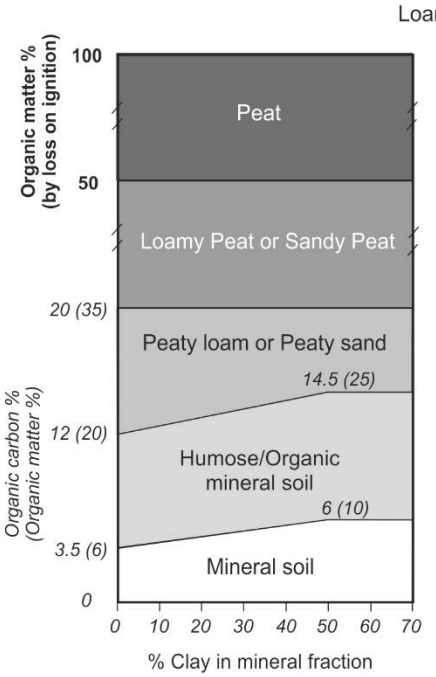
SUBGROUPS



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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