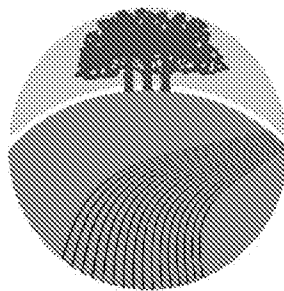


Hanbury (PM) Ltd

**Land at Pagham South,
West Sussex**

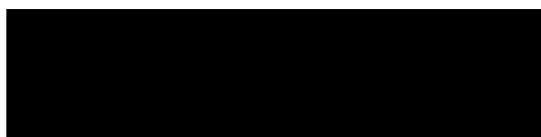
**Agricultural Land Classification
and
Soil Resources**

September 2016



Reading Agricultural Consultants Ltd

Beechwood Court, Long Toll, Woodcote, RG8 0RR



1. Introduction

- 1.1.1. Reading Agricultural Consultants Ltd (RAC) is instructed by Hanbury (PM) Ltd to investigate the Agricultural Land Classification (ALC) and soil resources of land to the west of Pagham, West Sussex, by means of a detailed survey of soil and site characteristics.
- 1.1.2. 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 (1988¹), and summarised in Natural England's Technical Information Note 049².
- 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.
- 1.1.4. 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.
- 1.1.5. As explained in Natural England's TIN049, the whole of England and Wales was mapped from reconnaissance field surveys in the late 1960s and early 1970s, to provide general strategic guidance on agricultural land quality for planners. This Provisional Series of maps was published on an Ordnance Survey base at a scale of One Inch to One Mile (1:63,360). The Provisional ALC map shows the site to be mostly of Grade 2 quality, with undifferentiated Grade 3 to the immediate west. However, TIN049 explains that:

"These maps are not sufficiently accurate for use in assessment of individual fields or development sites, and should not be used other than as general guidance. They show only five grades: their preparation preceded the subdivision of Grade 3 and the refinement of criteria, which occurred after 1976. They have not been updated and are out of print. A 1:250 000 scale map series based on the same information is available. These are more appropriate for the strategic use originally intended ..."

- 1.1.6 TIN049 goes on to explain that a definitive ALC grading should be obtained by undertaking a detailed survey according to the published guidelines, at an

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

² **Natural England (2012).** *Technical Information Note 049 - Agricultural Land Classification: protecting the best and most versatile agricultural land,* Second Edition 19th December 2012.

observation density of one boring per hectare. This survey follows the detailed methodology set out in the MAFF guidelines.

2. Site and Climatic Conditions

2.1. General Features, Land Form and Drainage

- 2.1.1. The site extends to 22.97ha in total, of which a majority is agricultural land in arable use, as outlined in Figure RAC7388-1. The site is bounded to the north by Summer Lane, to the east by Pagham Road and the settlement of Pagham, and to the south and west by other agricultural land and Church Barton House.
- 2.1.2. Topography at the site is largely level and sits at around 5m above Ordnance Datum (AOD).

2.2. Agro-climatic Conditions

- 2.2.1. 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 5m AOD, and are given in Table 1. The site is warm and moderately moist with large to very large crop moisture deficits. The Field Capacity Day (FCD) regime is slightly shorter than is typical for lowland England and is considered to be favourable for providing opportunities for agricultural field work.

Table 1: Local agro-climatic conditions

Average Annual Rainfall	729mm
Accumulated Temperatures >0°C	1,547 day°
Field Capacity Days	147 days
Average Moisture Deficit, wheat	122mm
Average Moisture Deficit, potatoes	119mm

2.3. Soil Parent Material and Soil Type

- 2.3.1. The principal underlying geology of the site as mapped by the British Geological Survey³ is of the London Clay Formation, mainly comprising silty clay, clayey silt and occasionally silt, with some sandy clay layers also present. Superficial River Terrace deposits are mapped across the site and include sand, silt and clay.

³ **British Geological Survey (2016).** *Geology of Britain viewer*, <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

- 2.3.2. The Soil Survey of England and Wales soil association mapping⁴ (1:250,000 scale) shows the Park Gate association to be present across the site. Park Gate soils are characterised by profiles of stoneless silty clay loam. Profiles are mottled throughout their subsoil layers and are variably affected by groundwater, commonly of Wetness Class (WC) III or IV⁵.

3. Agricultural Land Quality

3.1. Soil Survey Methods

- 3.1.1. Twenty soil profiles were examined across the site using an Edelman (Dutch) auger at an observation density of approximately one per hectare in accordance with the recommendations set out in Natural England's TIN049². One observation pit was also excavated to examine subsoil characteristics. The locations of observations are indicated on Figure RAC7388-1. The following characteristics were assessed for each observable soil horizon up to a maximum of 120cm or any impenetrable layer:
- soil texture;
 - significant stoniness;
 - colour (including local gley and mottle colours);
 - consistency;
 - structural condition;
 - free carbonate; and
 - depth.
- 3.1.2. Two topsoil samples were submitted for laboratory determination of particle size distribution, pH, organic matter content and nutrient contents (P, K, Mg). Results are given in Appendix 1.
- 3.1.3. Soil Wetness Class (WC) was inferred from the matrix colour, presence or absence of, and depth to, greyish and ochreous gley mottling and/or poorly permeable subsoil layers at least 15cm thick, in relation to the number of Field Capacity Days at the location.
- 3.1.4. 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

⁴ **Soil Survey of England and Wales (1984).** *Soils of South East England (1:250,000), Sheet 6*

⁵ **Jarvis *et al.* (1984).** *Soils and Their Use in South East England, Soil Survey of England and Wales, Bulletin 15.* Harpenden

evapotranspiration and rainfall. Grading of the land can be affected if the AP is insufficient to balance the MD and droughtiness occurs.

3.2. Agricultural Land Classification and Site Limitations

- 3.2.1. Assessment of quality has been carried out according to the MAFF revised guidelines (1988¹). Soil profiles have been described according to Hodgson (1997⁶) which is the recognised source for describing soil profiles and characteristics according to the MAFF revised ALC guidelines.
- 3.2.2. Agricultural land quality at this site is most affected by soil droughtiness which limits most of the site to Grade 2. In the south of the site, the land is imperfectly to poorly drained and the profiles are limited to Subgrade 3a by soil wetness. Several observations in the north were of restricted depth as deeper observation was prevented due to the soils being so dry at the time of survey. The analysis of these profiles is based upon reasonable assumption, taking into consideration surrounding observations.
- 3.2.3. There is one uniform topsoil type present across the site. The topsoil comprises brown (10YR4/3 in the Munsell soil colour charts⁷) medium silty clay loam which is slightly stony (2-5% by volume). The structure is weakly developed and forms medium subangular blocky peds. The distributions of pores and fine roots are restricted. There is some compaction in the topsoil layer, evidenced by roots growing horizontally rather than vertically, though the topsoil layer remains permeable.
- 3.2.4. In the north of the site, upper and lower subsoil horizons are distinguishable. Upper subsoil comprises medium silty clay loam which is dark yellowish brown (10YR4/4) and continues to be slightly stony. Pit 1 was excavated in an area of this soil type and coincided with the area in which the soils were too dry to penetrate with the auger. The pit showed the upper subsoil structure to be weakly developed with fine angular and subangular blocky peds, with some very firm dry angular clods. Few fine roots were also present. As shown in Appendix 3, the subsoil was too dry to make further observation.
- 3.2.5. Lower subsoil is of dark yellowish brown heavy silty clay loam which is stoneless. Occasionally fine, faint ochreous mottles are present in this subsoil layer, though the consistency is friable and the horizon is permeable. Beneath this, the deepest subsoil horizon observed comprises heavy silty clay loam or silty clay which is brown or yellowish brown (10YR5/3 or 5/4). There is some mottling and evidence of wetness at depth though most of the profiles are permeable throughout, of WC I. At Observations 4 and 10, the brown silty clay lower horizon is gleyed and is poorly permeable, though occurs at too great a depth to affect the wetness grade of the latter. Observation 4 is of WC II.
- 3.2.6. All of the north is affected slightly by droughtiness due to climate and the resulting large crop moisture deficits, and is limited to Grade 2: the profile at Observation 4 is also equally affected by slight wetness.

⁶ **Hodgson, J. M. (Ed.) (1997).** *Soil survey field handbook*. Soil Survey Technical Monograph No. 5, Silsoe.

⁷ **Munsell Color (2009).** *Munsell Soil Color Book*, Grand Rapids, MI, USA

- 3.2.7. In the south of the site, the topsoil is uniform and is as described above. There is one distinct subsoil horizon comprising heavy silty clay loam (and one instance of silty clay). The subsoil is brown (10YR5/3) and contains distinct ochreous mottling. Two profiles are gleyed but permeable and are of WC II, though across most of the south, the consistency is firm and the structure weakly developed (shown in Appendix 3). Most profiles are therefore gleyed and poorly permeable immediately below the topsoil, which at all but one of the profiles (Observation 18) is from 40cm depth.
- 3.2.8. According to Figure 7 of the ALC guidelines¹, under the climatic conditions of the site, profiles which are gleyed within 40cm and poorly permeable within 80cm are of WC III if the poorly permeable layer begins at depths between 40 and 67cm, or of WC IV if the poorly permeable layer begins within 40cm. Most of the south is within the criteria of WC III, and therefore is of Subgrade 3a, but it should be noted that it is on the borderline to WC IV and Subgrade 3b.
- 3.2.9. One profile becomes poorly permeable at 35cm, though this is an isolated occurrence and has been incorporated into the surrounding Subgrade 3a. One additional point (Observation 15) is also affected by flood risk and lies within the Environment Agency's Flood Zone 3.
- 3.2.10. The areas of each ALC grade are given in Table 2 and are shown in Figure RAC7388-2.

Table 2: ALC Areas

Grade	Description	Area (ha)	% of agric. land
2	Very good quality	15.4	71
3a	Good quality	6.3	29
	Total Agricultural	21.7	100
	Non-Agricultural	1.3	-

4. Regional Context

- 4.1.1. The site is located within the Arun District of West Sussex, a region that includes several character landscape areas, most notably the West Sussex Coastal Plain and the South Downs. These areas give rise to variable soil types and therefore variable land quality. The areas and proportions of each ALC grade present across the district, as derived from the Provisional ALC map, are given in Table 3 and are shown in Figure RAC7388-3.

Table 3: Arun District ALC Statistics

Grade	Hectares	%
Grade 1	2,801	12.6
Grade 2	3,870	17.5
Grade 3	8,226	37.2
Grade 4	1,976	8.9
Grade 5	0	0.0
Non Agricultural	2,624	11.9
Urban	2,643	11.9

- 4.1.2. Approximately 67% of agricultural land in the region is of relatively high quality, including 55% in Grades 2 and 3. The loss of 21.7ha of best and most versatile land at Pagham would represent a reduction of 0.18% of the collective Grade 2 and 3 quality agricultural land in the district. This is not considered to be a significant loss.

Appendix 1: Laboratory Data

Determinand	Site 7	Site 16	Units
Sand 2.00-0.063 mm	13	18	% w/w
Silt 0.063-0.002 mm	68	63	%w/w
Clay <0.002 mm	19	19	% w/w
Organic Matter WB	2.2	2.0	% w/w
Texture	Medium silty clay loam	Medium silty clay loam	% w/w

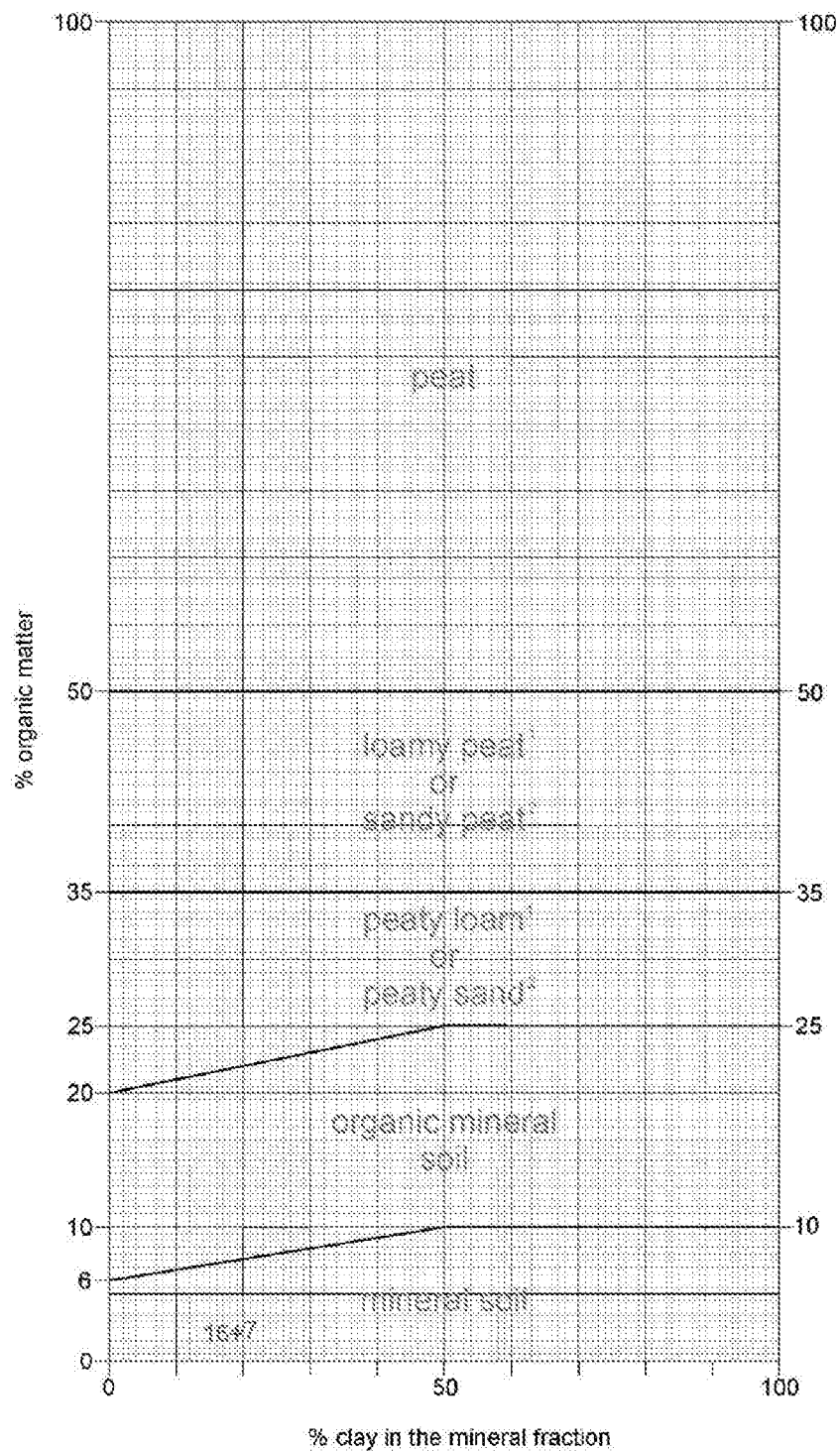
Determinand	Site 7	Site 16	Units
Soil pH	6.7	5.0	
Phosphorus (P)	16.6	29.8	mg/l (av)
Potassium (K)	68.3	140	mg/l (av)
Magnesium (Mg)	68.3	63.2	mg/l (av)

Determinand	Site 7	Site 16	Units
Phosphorus (P)	2	3	ADAS Index
Potassium (K)	1	2-	ADAS Index
Magnesium (Mg)	2	2	ADAS Index

RAC7388



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		
%	TA _v	E _{av}
hard	1	0.5
chalk	10	7

hard flint & pebble

Climate Data	
MDwheat	122
MDpotato	119
FCD	147

Wetness Class Guidelines	II	III	IV	V
SPL within 80cm, gleying within 40cm	>67cm	40-67cm	<40cm	
SPL within 80cm, gleying at 40-70cm	>51cm	<51cm		
No SPL but gleying within 40cm	coarse subsoil	/	other cases	//

Maximum depth of auger penetration is underlined

Site No.		Depth cm	Texture	CaCO ₃	Colour	Mottle colour	abundance	stone% hard	stone% chalk	Structure	APwheat mm	AP potato mm	Gley	SPL	WC	Wetness grade WE	Final Grade	Limiting Factor(s)
1	T	0	22	MZCL	10YR4/3			2			41	41	n	n	/	1	2	DR
		22	46	MZCL	10YR4/4			2			40	40	n	n				
		46	80	HZCL	10YR4/4			0			37	41	n	n				
		80	120	HZCL	10YR5/4	och	cll	0			40	0	n	n				
										Total	156	122						
										MD	36	3						
										Droughtiness grade (DR)	1	2						
2	T	0	20	MZCL	10YR4/3			5		-	36	36	n	n	/	1	2	DR
		20	25	MZCL	10YR4/4			5			8	8	n	n				
		25	50	HZCL	10YR4/4			0			43	43	n	n				
		50	120	HZCL	10YR5/4	och	cll	0			70	34	n	n				
										Total	157	121						
										MD	35	2						
										Droughtiness grade (DR)	1	2						
3	T	0	20	MZCL	10YR4/3			2		-	37	37	n	n	/	1	2	DR
		20	40	MZCL	10YR4/4			2			33	33	n	n				

		40	82	HZCL	10YR4/4	och	cff	0		49	51	n	n			
		<u>62</u>	120	HZCL	10YR4/4	och	cff	0		38	0	n	n			
					Total					158	122					
					MD					36	3					
					Droughtiness grade (DR)					1	2					
4	T	0	25	MZCL	10YR4/3			2	-	47	47	n	n	//	1	2 DR
		25	35	MZCL	10YR4/4			2		17	17	n	n			
		35	70	HZCL	10YR4/4			0		46	60	n	n			
		70	120	ZC	10YR5/3	och	cff	0	poor	35	0	y	y			
					Total					144	123					
					MD					22	4					
					Droughtiness grade (DR)					2	2					
5	T	0	20	MZCL	10YR4/3			5	-	36	36	n	n	/	1	2 DR
		20	25	MZCL	10YR4/4			5		8	8	n	n			
		<u>25</u>	50	HZCL	10YR4/4			0		43	43	n	n			
		50	120	HZCL	10YR5/4	och	cff	0		70	34	n	n			
					Total					157	121					
					MD					35	2					
					Droughtiness grade (DR)					1	2					
6	T	0	20	MZCL	10YR4/3			5	-	36	36	n	n	/	1	2 DR
		20	30	MZCL	10YR4/4			5		16	16	n	n			
		<u>30</u>	50	HZCL	10YR4/4			0		34	34	n	n			
		50	120	HZCL	10YR5/4	och	cff	0		70	34	n	n			
					Total					156	120					
					MD					34	1					
					Droughtiness grade (DR)					1	2					
7	T	0	20	MZCL	10YR4/3			5	-	36	36	n	n	/	1	2 DR
		20	30	MZCL	10YR4/4			5		16	16	n	n			
		<u>30</u>	50	HZCL	10YR4/4			0		34	34	n	n			
		50	120	HZCL	10YR5/4	och	cff	0		70	34	n	n			

												Total	156	120				
												MD	34	1				
												Droughtiness grade (DR)	1	2				
8	T	0	15	MZCL	10YR4/3			5		27	27	n	n	/	1	2	DR	
		15	24	MZCL	10YR4/4			5		15	15	n	n					
		24	50	HZCL	10YR4/4			0		44	44	n	n					
		50	120	HZCL	10YR5/4	och	cll	0		70	34	n	n					
												Total	156	120				
												MD	34	1				
												Droughtiness grade (DR)	1	2				
9	T	0	20	MZCL	10YR4/3			5		36	36	n	n	/	1	2	DR	
		20	25	MZCL	10YR4/4			5		8	8	n	n					
		25	50	HZCL	10YR4/4			0		43	43	n	n					
		50	120	HZCL	10YR5/4	och	cll	0		70	34	n	n					
												Total	157	121				
												MD	35	2				
												Droughtiness grade (DR)	1	2				
10	T	0	20	MZCL	10YR4/3			2		37	37	n	n	/	1	2	DR	
		20	40	MZCL	10YR4/4			2		33	33	n	n					
		40	80	HZCL	10YR4/4			0		47	51	n	n					
		80	120	ZC	10YR5/3	och	cll	0	poor	28	0	y	y					
												Total	146	122				
												MD	24	3				
												Droughtiness grade(DR)	2	2				
11	T	0	10	MZCL	10YR4/3			2	-	19	19	n	n	/	1	2	DR	
		10	32	MZCL	10YR4/4			2		37	37	n	n					
		32	40	MZCL	10YR5/4			0		14	14	n	n					
		40	120	MZCL	10YR5/4			0		87	51	n	n					

										Total	156	120					
										MD	34	1					
										Droughtiness grade(DR)	1	2					
12	T	0	35	MZCL	10YR4/3			2	-	65	65	n	n	/	1	2	DR
		35	120	HZCL	10YR4/4			2		94	58	n	n				
										Total	159	124					
										MD	37	5					
										Droughtiness grade(DR)	1	2					
13	T	0	40	MZCL	10YR4/3			2	-	75	75	n	n	III-IV	3a	3a	WE
		40	120	HZCL	10YR5/3	och	cld	2	poor	53	35	y	y				
										Total	128	110					
										MD	6	-9					
										Droughtiness grade(DR)	2	2					
14	T	0	40	MZCL	10YR4/3			2	-	75	75	n	n	III-IV	3a	3a	WE
		40	120	HZCL	10YR5/3	och	cld	2	poor	59	41	y	y				
										Total	133	116					
										MD	11	-3					
										Droughtiness grade(DR)	2	2					
15	T	0	40	MZCL	10YR4/3			2	-	75	75	n	n	III-IV	3a	3a	WE
		40	120	HZCL	10YR5/3	och	cld	2	poor	59	41	y	y				
										Total	133	116					
										MD	11	-3					
										Droughtiness grade(DR)	2	2					
16	T	0	35	MZCL	10YR4/3			2	-	65	65	n	n	//	2	2	WE DR
		35	120	HZCL	10YR5/3	och	cld	2		94	58	y	n				
										Total	159	124					
										MD	37	5					
										Droughtiness grade(DR)	1	2					
17	T	0	35	MZCL	10YR4/3			2	-	65	65	n	n	//	2	2	WE DR

		35	120	HZCL	10YR5/3	och	cfd	2		94	58	y	n				
									Total	159	124						
									MD	37	5						
									Droughtiness grade(DR)	1	2						
18	T	0	35	MZCL	10YR4/3			2	-	65	65	n	n	IV	2	3b	WE
		35	120	ZC	10YR5/3	och	clt	2	poor	66	41	y	y				
									Total	131	105						
									MD	9	-13						
									Droughtiness grade(DR)	2	3a						
19	T	0	35	MZCL	10YR4/3			2	-	65	65	n	n	II	2	2	WE DR
		35	120	HZCL	10YR5/3	och	cfd	2		94	58	y	n				
									Total	159	124						
									MD	37	5						
									Droughtiness grade(DR)	1	2						
20	T	0	40	MZCL	10YR4/3			2	-	75	75	n	n	III-IV	3a	3a	WE
		40	120	HZCL	10YR5/3	och	cfd	2	poor	53	35	y	y				
									Total	128	110						
									MD	6	-9						
									Droughtiness grade(DR)	2	2						

Appendix 3: Site Photographs



Pit 1



Solid Base of Pit 1



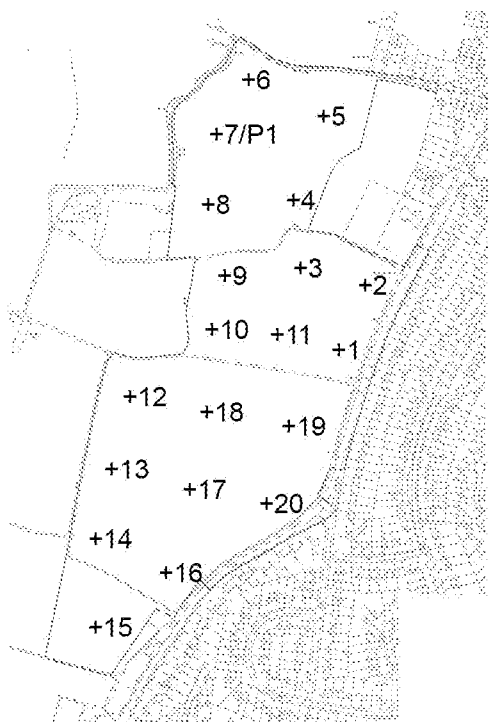
Topsoil



Pit 1 Subsoil



Topsoil and Upper Subsoil, South of Site



- ☐ Survey Area
 .1 Auger Observation
 .P1 Pit Observation



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Scale 1:10,000@A4 Sept/2016

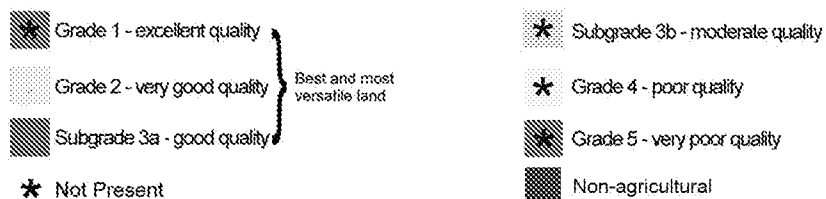
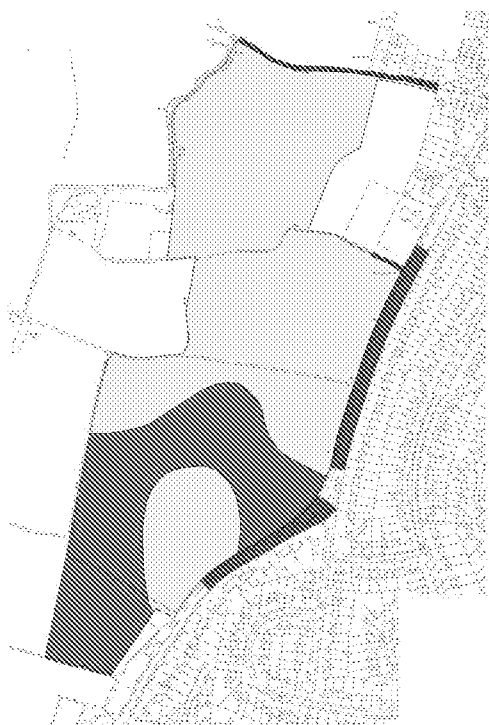
Figure RAC7388-1: Observations

Site: Land at Pagham South, West Sussex

Client: Hanbury (PM) Ltd



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Figure RAC7388-2: Agricultural Land Classification

Site: Land at Pagham South, West Sussex

Client: Hanbury (PM) Ltd



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