Agricultural Land Classification:

Westhide Solar Farm, Herefordshire

Prepared for:
Ersun (Westhide SPV) Ltd

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Date:
26th November 2021

Project Number:
C790

Contract/Proposal No:	C790
Issue:	3
Author:	Rob Askew
Date:	26th November 2021

Our interpretation of the site characteristics is based on available data made during our desktop study and soil survey. This desktop study and soil survey has assessed the characteristics of the site in relation to the assessment of its Agricultural Land Classification. It should not be relied on for alternative end-uses or for other schemes. This report has been prepared solely for the benefit of Ersun (Westhide SPV) Ltd.

Version Control Record			
Issue	**Description of Status**	**Date**	**Initials**
A	First draft	26/06/2021	RWA
1	Fist issue	28/06/2021	RWA
2	Second issue incorporating Client's comments	30/06/2021	RWA
3	Third issue incorporating revised red line	26/11/2021	RWA

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1 INTRODUCTION

1.1 Background

1.1.1 This report was commissioned by Ersun (Westhide SPV) Ltd to determine the quality of agricultural land proposed for solar photovoltaic (PV) array at Westhide, Herefordshire, HR1 3QQ ('the Site'). The assessment was made in accordance with the Agricultural Land Classification (ALC) system for England and Wales (see 'Methodology' below). The approximately 61.7 hectare (ha) Site is located to the north east of Hereford. The approximate centre of the main Site is located at British National Grid (BNG) reference SO 57726 44495. The boundary of the Site is shown on **Figure 1**.

1.2 Competency

1.2.1 The work has been carried out by a Chartered Scientist (CSci), who is a Fellow (F.I. Soil Sci) of the British Society of Soil Science (BSSS). The soil surveyor meets the requirements of the BSSS Professional Competency Standard (PCS) scheme for ALC (see BSSS PCS Document 2 '*Agricultural Land Classification of England and Wales*'[1]. The BSSS PCS scheme is endorsed, amongst others, by the Department for Environment, Food and Rural Affairs (Defra), Natural England, the Science Council, and the Institute of Environmental Assessment and Management (IEMA).

1.3 Methodology

1.3.1 This assessment is based upon the findings of a study of published information on climate, geology and soil in combination with a soil investigation carried out in accordance with the Ministry of Agriculture, Fisheries and Food (MAFF)[2] '*Agricultural Land Classification of England and Wales: Revised Guidelines and Criteria for Grading the Quality of Agricultural Land*', October, 1988 (henceforth referred to as the 'the ALC Guidelines').

1.3.2 The ALC system 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 ALC system divides agricultural land into five grades (Grade 1 '*Excellent*' to Grade 5 '*Very Poor*'), with Grade 3 subdivided into Subgrade 3a '*Good*' and Subgrade 3b '*Moderate*'. Agricultural land classified as Grade 1, 2 and Subgrade 3a falls in the '*best and most versatile*' category in Paragraph 174 and 175 of the National Planning Policy Framework (NPPF) revised on the 20th of July 2021. Further details of the ALC system and national planning policy implications are set out by Natural England in Technical Information Note 049[3].

1.3.3 A detailed ALC survey of the approximately the 61.7 ha Site was carried out in June 2020. The detailed survey involved examination of the soil's physical properties at 60 locations located on a 100m by 100m grid, i.e. at a density of approximately 1 auger bore per 1 ha of agricultural land

[1] British Society of Soil Science. Professional Competency Scheme Document 2 'Agricultural Land Classification of England and Wales'. Available online @ https://www.soils.org.uk/sites/default/files/events/flyers/ipss-competency-doc2.pdf Last accessed November 2021

[2] The Ministry of Agriculture, Fisheries and Food (MAFF) was incorporated within the Department for Environment, Food and Rural Affairs (Defra) in June 2001

[3] Natural England (December, 2012). 'Agricultural Land Classification: protecting the best and most versatile agricultural land (TIN049)'. Available online @ http://publications.naturalengland.org.uk/publication/35012 Last accessed June 2021

surveyed. The soil profile was examined at each sample location to a maximum depth of approximately 1.2 m by hand with the use of a 5 cm diameter Dutch (Edleman) soil auger. One soil pit was hand dug with a spade to examine certain soil physical properties, such as soil structure and stone content, more closely. The locations of the auger bores and soil pits are shown on **Figure 1**. A log of the auger bores examined on Site is given as **Appendix 1**. A description of the soil pit is given as **Appendix 2**.

1.3.4 The sample locations were located using a hand-held Garmin E-Trec Geographic Information System (GIS) to enable the sample locations to be relocated for verification, if necessary. Where the auger locations fell close to a hedgerow, tree or gateway, the auger location was moved to at least 3m away, i.e., to avoid areas affected by tree roots or which maybe compacted.

1.3.5 The soil profile was examined at each sample location to a maximum depth of approximately 1.2 m by hand with the use of a 5 cm diameter Dutch (Edleman) soil auger. A soil pit was excavated at auger location 1 with a spade in order to examine physical soil profile characteristics, including subsoil structure, of the main representative soil types determined at the Site.

1.3.6 The soil profile at each sample location was described using the 'Soil Survey Field Handbook: Describing and Sampling Soil Profiles' (Ed. J.M. Hodgson, Cranfield University, 1997). Each soil profile was ascribed an Agricultural Land Classification (ALC) grade following the MAFF ALC Guidelines.

1.3.7 A sample of topsoil was collected at two auger-bore locations, i.e., 4 and 56. The samples of topsoil were sent to an accredited laboratory for particle size analysis, i.e., the proportions of sand, silt and clay. This is to determine the definitive texture class of the topsoil, especially to distinguish between medium loams (i.e., <27% clay), heavy loams (27% to 35% clay) and clays (>35% clay). The results of the laboratory analysis are given as a Certificate of Analysis as **Appendix 3**.

1.4 Structure of the Remainder of this Report

1.4.1 The remainder of this report is structured as follows:

- Section 2 – Planning Policy Framework;
- Section 3 – Detailed Agricultural Land Classification;
- Section 4 – ALC at the Site in a Wider Geographical Context; and
- Section 5 – Summary and Conclusions.

2 PLANNING POLICY FRAMEWORK

2.1 Background

2.1.1 This section of the report sets out the national and local planning framework in which to assess the opportunities and constraints to development at the Site in agricultural land quality terms.

2.2 National Planning Policy Statement (NPPF) July 2021

2.2.1 National planning policy guidance on development involving agricultural land is set out in National Planning Policy Framework (NPPF), which was revised on the 20th July 2021. The NPPF aims to provide a simplified planning framework which sets out the Government's economic, environmental and social planning policies for England. The NPPF includes policy guidance on '*Conserving and Enhancing the Natural Environment*' (Section 15). Paragraph 174 (a and b) (page 50) are of relevance to this assessment of agricultural land quality and soil and state that:

'174…Planning policies and decisions should contribute to and enhance the natural and local environment by:

a) protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan);

b) recognising the intrinsic character and beauty of the countryside, and the wider benefits from natural capital and ecosystem services – including the economic and other benefits of the best and most versatile agricultural land, and of trees and woodland;…' National planning *other benefits of the best and most versatile agricultural land, and of trees and woodland;…'*

2.2.2 Paragraph 175 of the NPPF (2021) goes on to describe that:

'175. Plan should: distinguish between the hierarchy of international, national and locally designated sites; allocate land with the least environmental or amenity value, where consistent with other policies in this Framework[58] …'

2.2.3 Footnote number 58 states that:

'[58] Where significant development of agricultural land is demonstrated to be necessary, areas of poorer quality land should be preferred to those of a higher quality.'

2.3 Soil Health

2.3.1 Aims and objectives for safeguarding and, where possible, improving soil health are set out in the Government's 'Safeguarding our soils: A strategy for England'[4]. The Soil Strategy for England, which

[4] Department for Environment, Food and Rural Affairs (2009). Safeguarding our soils: A strategy for England'. Available online @ https://www.gov.uk/government/publications/safeguarding-our-soils-a-strategy-for-england Last accessed November 2021

builds on Defra's '*Soil Action Plan for England (2004-2006)*, sets out an ambitious vision to protect and improve soil to meet an increased global demand for food and to help combat the adverse effects of climate change.

2.3.2 The Soil strategy for England states that '…*soil is a fundamental and essentially non-renewable natural resource, providing the essential link between the components that make up our environment. Soils vary hugely from region to region and even from field to field. They all perform a number of valuable functions or ecosystem services for society including:*

- *nutrient cycling;*
- *water regulation;*
- *carbon storage;*
- *support for biodiversity and wildlife;*
- *providing a platform for food and fibre production and infrastructure'*

2.3.3 The vision of the Soil Strategy for England has been developed in the Government's 25 Year Plan for the Environment[5]. Soil is recognised as an important national resource, and the Plan states that:

'*We will ensure that resources from nature, such as food, fish and timber, are used more sustainably and efficiently. We will do this* (in part) by:

….improving our approach to soil management: by 2030 we want all of England's soils to be managed sustainably, and we will use natural capital thinking to develop appropriate soil metrics and management approaches…'

2.3.4 The maintenance, and improvement, of soil health is therefore a material consideration when deciding if a development is appropriate on agricultural land. Soil health can be defined as a soil's ability to function and sustain plants, animals and humans as part of the ecosystem.

2.3.5 Of relevance to the proposed development at the Site, the installation of a solar photovoltaic (PV) array is reversible, i.e., the agricultural land can be returned to its former agricultural productivity once the generation of renewable electricity has ceased, and the solar panels and associated infrastructure is removed.

2.3.6 In many respects, the management of the land under solar PV panels as grassland can benefit soil health, as described in detail in **Appendix 4**. A healthy soil has a well-developed soil structure, where soil particles are aggregated into soil peds (structural units) separated by pores or voids. This allows the free movement of water (precipitation) through the soil and facilitates gaseous exchange between the plant roots and the air. These soils are well aerated (oxygenated), which encourages healthy plant (crop) growth and an abundance of soil fauna and aerobic microbes.

[5] Department for Environment, Food and Rural Affairs (2009). A Green Future: Our 25 Year Plan to Improve the Environment. Available online @ https://www.gov.uk/government/publications/25-year-environment-plan Last accessed November 2021

These soils often have high amounts of soil organic matter (SOM), associated with an accumulation of plant and animal matter, and thus are a good store of soil organic carbon (SOC).

2.3.7 The greatest benefits in terms of increase in soil organic matter (SOM), and hence soil organic carbon (SOC), can be realised through land use change from intensive arable to grasslands. Likewise, SOM and SOC are increased when cultivation of the land for crops (tillage) is stopped and the land is uncultivated (zero tillage). Global evidence suggests that zero tillage results in more total soil carbon storage when applied for 12 years or more. Therefore, there is evidence that conversion of land from arable to grassland which is uncultivated over the long-term (>12 years), such as that under solar PV arrays, increases SOC and SOM.

2.3.8 Soils are habitats for millions of species, ranging from bacteria, fungi, protozoa, and microscopic invertebrates to mites, springtails, ants, worms and plants. Soil biota are strongly influenced by land management. Modern farming has led to the loss of soil biodiversity. Changes in land management practice and land use can have large effects on soil biodiversity over relatively short-time scales. Reducing the intensity of management, introducing no-tillage management, and converting arable land to pasture, such as grassland under solar PV arrays, has substantial beneficial effects.

2.3.9 In a well-structured soil, water and air can move freely through cracks and pores. However, a poor soil structure prevents water and air movement, and increases the risk of runoff. Soil structure is improved when the land is uncultivated over time (no tillage), and when soil organic matter content (SOM) is increased through the accumulation of plant material, such as roots, in the soil. The aerobic (oxygenated) decomposition of SOM helps to bind soil particles together into aggregates (peds). Therefore, the conversion of land which is tilled for arable to long-term grassland (no tillage), such as that under solar PV arrays, improves soil structure over time.

2.4 Best Practice Guidance

2.4.1 The Department for Environment, Food and Rural Affairs (Defra) has published '*Safeguarding our Soils – A Strategy for England*' (24th September 2009). The Soil Strategy was published in tandem with a '*Code of Practice for the Sustainable Use of Soils on Construction Sites*'[6].

[6] Department for Environment, Food and Rural Affairs (September, 2009) '*Code of Practice for the Sustainable Use of Soils on Construction Sites*'. Available online @ https://www.gov.uk/government/publications/code-of-practice-for-the-sustainable-use-of-soils-on-construction-sites. Last accessed November 2021

3 DETAILED AGRICULTURAL LAND CLASSIFICATION

3.1 Background

3.1.1 This section of the report sets out the findings of a detailed Agricultural Land Classification (ALC). It is based on a desktop study of relevant published information on climate, topography, geology, and soil in conjunction with a soil survey carried out on Site by a Chartered Soil Scientist in June 2021 (see 'Methodology' in Section 1.0).

3.1.2 As described in the ALC Guidelines, the main physical factors influencing agricultural land quality are:

- climate;
- site;
- soil; and
- interactive limitations.

3.1.2 These factors are considered in turn below.

3.2 Climate

3.2.1 Interpolated climate data relevant to the determination of the Agricultural Land Classification (ALC) grade of land at the Site is given in Table 3.1 below.

Table 3.1: Interpolated ALC Climate Data for Westhide Estate, Herefordshire

Climate Parameter	National Grid Reference SO 574 445 (Site A)	National Grid Reference SO 576 442 (Site B)	National Grid Reference SO 576 442 (Site C)
Average Altitude (m)	59	59	62
Average Annual Rainfall (mm)	676	677	678
Accumulated Temperature above 0˚C (January – June)	1451	1451	1447
Field Capacity Days (FCD)	145	145	146
Moisture Deficit (mm) Wheat	107	107	107
Moisture Deficit (mm) Potatoes	99	99	99
Best ALC Grade According to Climate Limitation	1	1	1

3.2.2 With reference to Figure 1 '*Grade according to climate*' on page 6 of the ALC Guidelines, the quality of agricultural land at the Site is not limited by overall climate, meaning that agricultural land at the Site could be graded as high as Grade 1, in the absence of any other limiting factor.

3.2.3 Agricultural land at the Site is predicted to be at field capacity (i.e., the amount of soil moisture or water content held in the soil after excess water has drained away) for between 145 and 146 days per year, over the late autumn, winter and early spring. This is slightly below the average for central, lowland England (i.e., 150 Field Capacity Days).

3.2.4 The climate can interact with physical properties of the soil, e.g., topsoil texture and subsoil drainage (Wetness Class). This is assessed further under 'interactive limitations' below.

3.3 Site

3.3.1 The Site measures approximately 61 ha in area and comprises land currently in agricultural production. The location and boundary of the Site is shown in **Figure 1**.

3.3.2 With regard to the ALC Guidelines, agricultural land quality can be limited by one or more of three main site factors as follows:

- gradient;
- micro-relief (i.e., complex change in slope angle over short distances); and
- risk of flooding.

I. Gradient and Micro-Relief

3.3.3 The study area is gently undulated, at an elevation of between 70 metres (m) Above Ordnance Datum (AOD) at the highest point in the north-eastern region, and 57 mAOD at the lowest elevation in the west and centre regions of the Site. Gradient is not a limiting factor to agricultural land quality at this Site (re Table 1 of the ALC Guidelines). Likewise, micro-relief, i.e., complex changes in slope angle and direction over short distances, is not limiting to agricultural land quality at the Site.

II. Risk of Flooding

3.3.4 From the Government Flood Map for Planning website[7], the Site is mainly in Flood Zone 1, with a small region in Flood Zone 2 and Flood Zone 3 bordering a water-course along the northern boundary. However, there is no evidence the quality of agricultural land is limited by flood risk with regard to the criteria for duration and frequency set out in the ALC Guidelines (re Table 2 'Grade according to flood risk in summer' and/or Table 3 'Grade according to flood risk in winter' of the ALC Guidelines.

3.4 Soil

I. Geology/Soil Parent Material

3.4.1 British Geological Survey (BGS) information available online has been utilised to show the Superficial Deposits (Drift) and Bedrock underlying the Site[8]. This provides information on the geological materials in which the soil has formed.

[7] Government Flood Map for Planning. Available online @ https://flood-map-for-planning.service.gov.uk/ Last accessed November 2021
[8] British Geological Survey 'Geology of Britain Viewer'. Available online @

3.4.2 The BGS describes how the Site is underlain mainly by the Raglan Mudstone Formation (siltstone and mudstone, interbedded) with a small band sandstone in the Raglan Mudstone Formation (sandstone) in the centre of the Site.

3.4.3 The bedrock is covered Head (clay, silt, sand and gravel) and Alluvium (clay, silt, sand and gravel) in the north and western regions of the Site. There are no superficial deposits in the south-eastern parts of the Site, where the soils are developed from mudstone.

II. Published Information on Soil

3.4.4 Provisional information for soils at the Site was gathered from the Soil Survey of England and Wales (SSEW) soil map of Midland and Western England (Sheet 3) at a scale of 1:250,000 and accompanying Bulletin '*Soils and their Use in Midland and Western England* (J. M. Ragg *et al,* Harpenden, 1984). This provisional soil map indicates that land at the Site is covered soils grouped in the Bromyard Association and Middleton Association.

3.4.5 As described by the SSEW, the Bromyard Association consist of reddish fine silty soils over silty shales and soft siltstones and occasionally coarse loamy soils over sandstones. In dry districts, these soils, with moderate permeability, are waterlogged for short periods only in winter, the duration depending on slope or long-term land use (Wetness Class I to II).

3.4.6 The Middleton Association consist of reddish fine silty and fine loamy soils on soft red Devonian silty shales and siltstones. These soils are seasonally waterlogged (Wetness Class III) but respond well to artificial drainage.

III. Soil Survey

3.4.7 The ALC soil survey in June 2021 confirmed the occurrence of silty clay and clay soils which are predominantly slowly permeable and seasonally waterlogged (Wetness Class III). A log of the soil profiles recorded on Site is give as **Appendix 1**. A description of a soil pit (i.e., Soil Pit 1, located near auger-bore 42, **Figure 1**), is given as **Appendix 2**.

IV. Topsoil Texture

3.4.8 In order to determine the topsoil texture, a sample of topsoil was collected from auger-bore location 4 and 56, as shown on **Figure 1**. The topsoil samples were sent to an accredited laboratory for analysis of particle size distribution (PSD), based on the British Standard Institution particle size grades. The certificate of analysis is provided as **Appendix 3**. The findings of the PSD analysis are shown in Table 3.2 below:

http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html Last accessed November 2021

Table 3.2: Topsoil Texture (re Table 10, ALC Guidelines)				
Topsoil Sample Location (See Fig. 1)	**% sand 0.063-2.0 mm**	**% silt 0.002-0.063 mm**	**% clay <0.002 mm**	**ALC Soil Texture Class**
AB4	8	32	60	Clay
AB56	34	46	20	Medium Clay Loam

3.5 Interactive Limitations

3.5.1 From the published information above, together with the findings of the detailed soil survey, it has been determined that the quality of agricultural land at the Site is limited by soil wetness.

I. Soil Wetness

3.5.2 A soil wetness limitation occurs where the soil water regime adversely affects plant growth or imposes restrictions on cultivations or grazing by livestock. The ALC grade according to soil wetness at the Site is given in Table 3.3 below (based on Table 6 'Grade According to Soil Wetness – Mineral Soils' in the ALC Guidelines).

Table 3.3: ALC Grade According to Soil Wetness		
Wetness Class	**Texture of the Top 25 cm**	**126-150 Field Capacity Days**
II	Sand, Loamy Sand, Sandy Loam, Sandy Silt Loam Sandy Clay Loam/Medium Silty Clay Loam /Medium Clay Loam* Heavy Clay Loam** Sandy Clay/Silty Clay/Clay	1 2 3a(2) 3b(3a)
III	Sand, Loamy Sand, Sandy Loam, Sandy Silt Loam Sandy Clay Loam/Medium Silty Clay Loam /Medium Clay Loam* Heavy Clay Loam** Sandy Clay/Silty Clay/Clay	2 3a (2) 3b (3a) 3b (3a)
IV	Sand, Loamy Sand, Sandy Loam, Sandy Silt Loam Sandy Clay Loam/Medium Silty Clay Loam /Medium Clay Loam* Heavy Clay Loam** Sandy Clay/Silty Clay/Clay	3a 3b 3b 3b
Key: (x) For naturally calcareous soils with more than 1% $CaCO^3$ and 18% - 50% clay * <27% clay; and ** >27% clay		

3.5.3 In a climate area with 145-146 FCD, soil profiles with medium clay loam or medium silty clay loam topsoil are limited by soil wetness to Grade 2 where they are slightly seasonally waterlogged (Wetness Class II), Subgrade 3a where they are slowly permeable and seasonally waterlogged (Wetness Class III), or Subgrade 3b where they are seasonally waterlogged for long periods over the winter. Some well drained profiles (Wetness Class I) on higher ground in the central and eastern parts of the Site have no significant wetness limitation are placed in Grade 1.

3.5.4 Soil profiles with heavy clay loam, heavy silty clay loam, silty clay or clay topsoil are limited by soil wetness to Subgrade 3b where they are slowly permeable and seasonally waterlogged (Wetness Class III).

3.6 Detailed ALC Grading at the Site

3.6.1 The area of land in each ALC grade has been measured from **Figure 2** and the area (ha) and proportion (% of Site) is given in Table 3.4.

Table 3.4: Detailed Agricultural Land Classification – Westhide, Herefordshire

ALC Grade	Area (Ha)	Area (%)
Grade 1 (Excellent)	12.0	19.5
Grade 2 (Very Good)	11.5	18.6
Subgrade 3a (Good)	4.0	6.5
Subgrade 3b (Moderate)	29.0	47.0
Grade 4 (Poor)	0	0
Grade 5 (Very Poor)	0	0
Other Land / Non-agricultural	5.2	8.4
Total	**61.7**	**100**

4 ALC AT THE SITE IN A WIDER GEOGRAPHICAL CONTEXT

4.1 Introduction

4.1.1 The aim of this section is to consider information on agricultural land quality at the Site produced by the former MAFF, now part of Defra.

4.2 Pre-1988 ALC Information

4.2.1 During the 1960's and 1970's MAFF produced a series of maps to show the provisional ALC grade of agricultural land over the whole of England and Wales at a scale of 1:250,000. These provisional ALC maps are suitable for strategic land use planning only, i.e., they appropriate for land areas greater than 80 ha. The Provisional (1:250 000) scale ALC information indicates that agricultural land at the Site is Grade 2 and Grade 3 (not differentiated between Subgrade 3a and Subgrade 3b). The proportion of agricultural land in each of the ALC grades (derived from MAFF provisional or pre-1988 ALC information) in England, West Midlands Region, and Herefordshire County is shown for comparison in Table 4.1 below.

Table 4.1: Provisional ALC – National, Regional and Local Context (Proportion of ALC Grades as % of Total Land Area)[9]

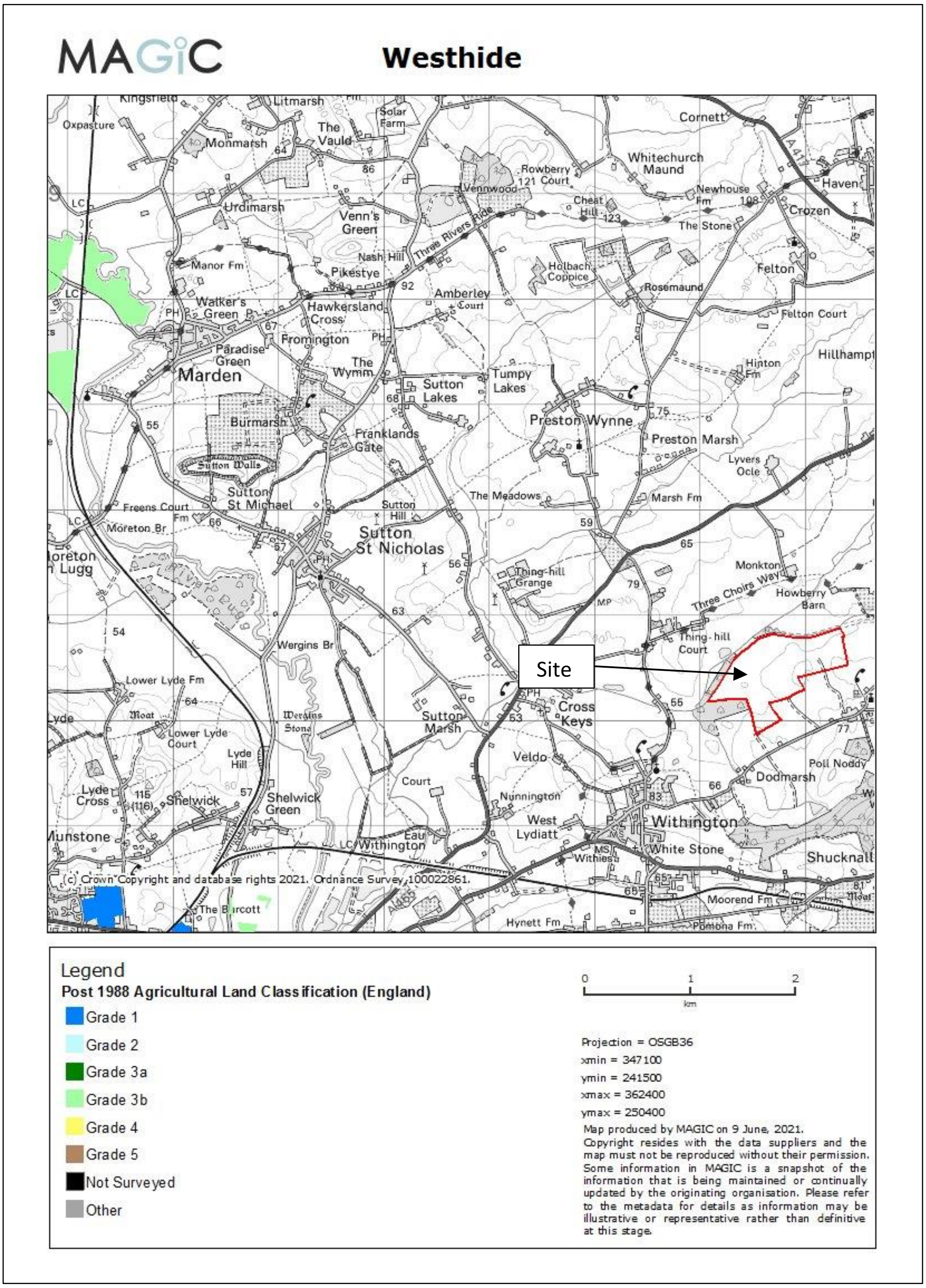
ALC Grade	England	West Midlands Region	Herefordshire County
1 (excellent)	2.7	1.1	4.1
2 (very good)	14.2	17.7	38.6
3 (good to moderate)	48.2	53.3	39.7
4 (poor)	14.1	14.6	12.4
5 (very poor)	8.4	2.5	1.4
Non-Agricultural	5.0	2.3	2.7
Urban	7.3	8.6	1.2

4.2.2 Of note, the provisional (Pre 1988) ALC information shows that Herefordshire has a high proportion of agricultural land in Grade 1, i.e., 4.1% compared with 2.7% in England as a whole. Therefore, the presence of Grade 1 land at the Site is unsurprising, as it is widespread in the area. However, the high proportion of Subgrade 3b at the Site indicates that it is some of the poorest quality land within Herefordshire.

[9] Ministry of Agriculture, Fisheries and Food, Land and Water Service, Technical Notes, Resource Planning (February 1983) 'Agricultural Land Classification of England and Wales – The Distribution of the Grades' (TN/RP/01 TFS 846)

4.3 Post-1988 ALC Information

4.3.1 From the MAGIC website[10], it has been determined that no post-1988 ALC survey has been undertaken by MAFF at the Site. However, MAFF has determined a mixture of Grade 1 and Subgrade 3b to the west of the Site (see below).



[10] Source: www.magic.gov.uk Last accessed June 2021

5 SUMMARY AND CONCLUSIONS

5.1.1 An assessment of agricultural land quality, involving a desktop study and a detailed Agricultural Land Classification (ALC) survey, has been undertaken to determine the quality of agricultural land proposed for a solar photovoltaic (PV) array at Westhide, Herefordshire, HR1 3QQ ('the Site'). The assessment was made in accordance with the Agricultural Land Classification (ALC) system for England and Wales. The approximately 61.7 hectare (ha) Site is located to the north east of Hereford. The Site is located at British National Grid (BNG) reference SO 57726 44495.

5.1.2 British Geological Survey (BGS) information at a scale of 1:50,000 indicates that the ALC study area is underlain by the Raglan Mudstone Formation (siltstone and mudstone, interbedded) with a narrow band of Raglan Mudstone Formation (sandstone) in the centre of the Site. The bedrock is covered Head (clay, silt, sand and gravel) and Alluvium (clay, silt, sand and gravel) in the north and western regions of the Site. There are no superficial deposits in the south-eastern parts of the Site, where the soils are developed from mudstone.

5.1.3 The Soil Survey of England and Wales provisional soil map (1:250,000) indicates that the Site is covered by soils in the Bromyard and Middleton Association. The Bromyard Association consists of reddish fine silty soils that are waterlogged for short periods only in winter, depending on slope or long-term land use (Wetness Class I to II). Whilst, the Middleton Association consists of reddish fine silty and fine loamy soils that are seasonally waterlogged (Wetness Class III). The ALC soil survey in June 2021 confirmed the occurrence of silty clay and clay soils which are predominantly slowly permeable and seasonally waterlogged (Wetness Class III).

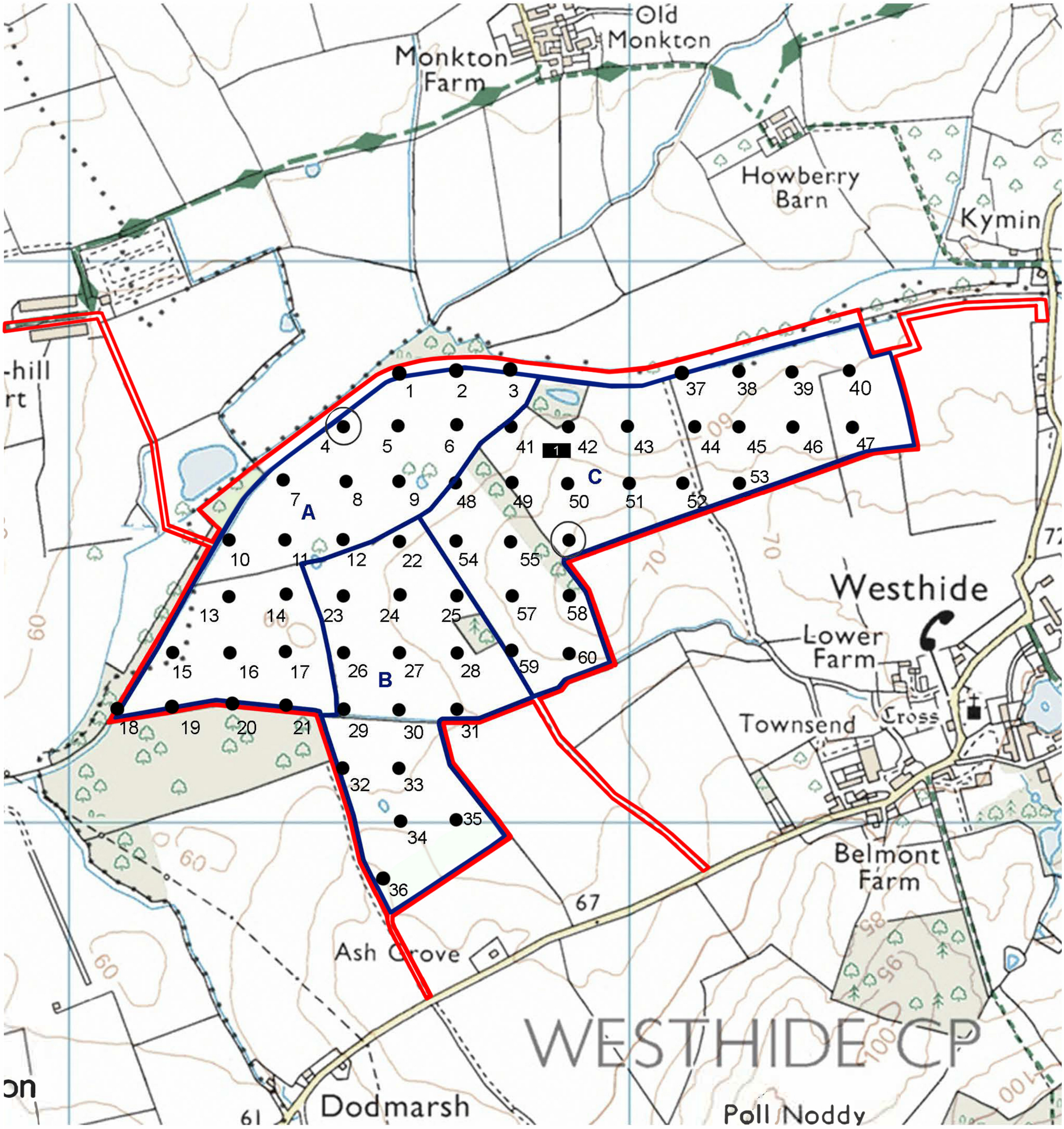
5.1.4 The land classified as Grade 1 (i.e., 12.0ha, or 19.5% of the Site), Grade 2 (i.e., 11.5ha, or 18.6%), Subgrade 3a (i.e., 4.0ha, or 6.5%) and Subgrade 3b (i.e., 29.0ha, or 47.0%) is limited by soil wetness. Approximately 5.2ha (or 8.4%) is classified as non-agricultural/other land. i.e., woodland/tree-planting and farm tracks.

5.1.5 Ministry of Agriculture, Fisheries and Food (MAFF) provisional (Pre 1988) ALC information shows that the Herefordshire has a high proportion of agricultural land in Grade 1, i.e., 4.1% compared with 2.7% in England as a whole. Therefore, the presence of Grade 1 land at the Site is unsurprising, as it is widespread in the area. However, the high proportion of Subgrade 3b at the Site indicates that it is some of the poorest quality land in Herefordshire.

5.1.6 Of relevance to the proposed development at the Site, the installation of a solar photovoltaic (PV) array is reversible, i.e., the agricultural land can be returned to its former agricultural productivity once the generation of renewable electricity has ceased, and the solar panels and associated infrastructure is removed. The management of grassland under solar PV panels can improve soil health, such as increasing soil organic matter (SOM), and hence soil organic carbon (SOC), increasing soil biodiversity, and improving soil structure. This is consistent with aims and objectives for improving soil health in the Government's 25 Year Plan for the Environment.

5.1.7 Therefore, the reversible development of agricultural land at this Site for the proposed solar farm at Westhide would not significantly harm national interests regarding agricultural land quality and soil.

Figures



Site Parcel

Site boundary

Auger location

Topsoil Sample

Soil Pit

N

Client

Ersun (Westhide SPV) Ltd

Project No C790

Dwg. No 01

Scale NTS

Date 24/11/2021

Drawn By ELA

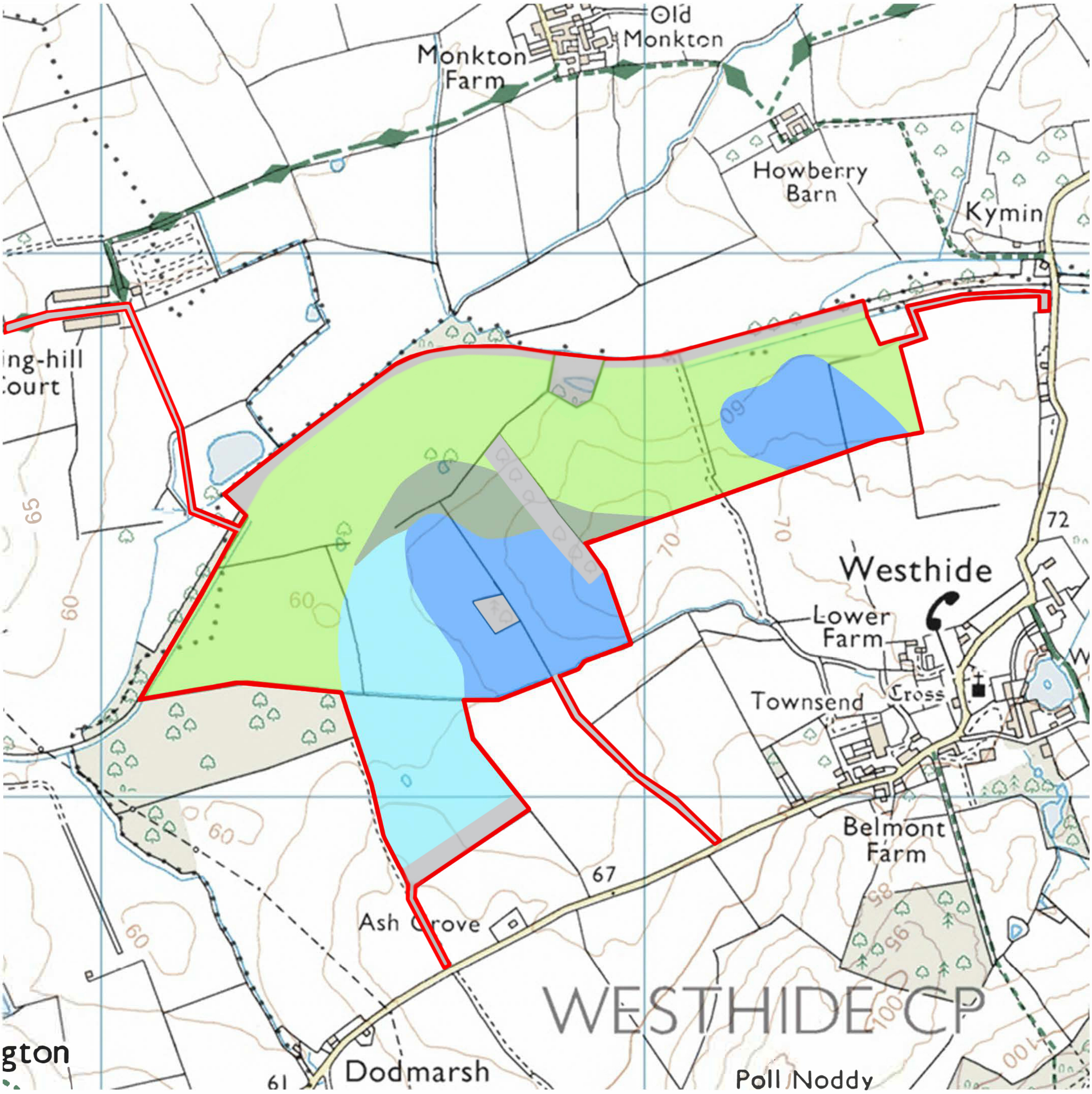
Figure 1

Sample Locations

Project Name

Westhide, Herefordshire

R W Askew BSc(Hons) MISoilSci MSc CSCi
The Old Stables, Upexe, Exeter, EX5 5ND
Tel: 07753 227 224
Email: rw.askew@btinternet.com



ALC Grade

- Grade 1
- Grade 2
- Subgrade 3a
- Subgrade 3b
- Grade 4
- Grade 5
- Non-agricultural

Site Boundary

N

Client	Ersun (Westhide SPV) Ltd
Project No	C790
Dwg. No	01
Scale	NTS
Date	24/11/2021
Drawn By	ELA

Figure 2:

Agricultural Land Classification

Project Name

Westhide, Herefordshire

R W Askew BSc(Hons) MISoilSci MSc CSci
The Old Stables, Upexe, Exeter, EX5 5ND
Tel: 07753 227 224
Email: rw.askew@btinternet.com

Appendix 1:
Soil Profile Logs

Project Number	Project Name	Parcel
C790	Westhide, Herefordshire	A,B,C

Date of Survey	Survey Type	Surveyor(s)	Company
18/05/2021	ALC	RDM	Askew Land and Soil

Weather	Relief	Land use and vegetation
Cloudy, showers	Level	Mainly grassland, including turf

Grid Reference	Postcode	Altitude	Area
SO579446	HR13QQ	62	56

MAFF prov	MAFF detailed	Flooding
Grade 2/3	None	Flood Zone 1/2/3

AAR	AT0	MDw	MDp	FCD	Climate grade
678	1447	107	99	146	1

Bedrock	Superficial deposits
Raglan Mudstone	Alluvium/Head in north

Soil association(s) 1:250,000	Detailed soil information
Bromyard/Middleton	None

Revision Number	Date Revised
2	09/06/2021

Point	Grid ref.			Alt (m)	Slope °	Aspect	Land use	Depth (cm)			Matrix	Ochreous Mottles		Grey Mottles		Gley	Texture	Stones - type 1				Stones - type 2				Ped			SUBS STR	CaCO3	Mn C	SPL	Drought			Wet		Final ALC			
	NGR	X	Y					Top	Bttm	Thick	Munsell colour	Form	Munsell colour	Form	Munsell colour			%	> 2cm	> 6cm	Type	%	> 2cm	> 6cm	Type	Strength	Size	Shape					MBw	MBp	Gd	WC	Gw	Limitation 1	Limitation 2	Limitation 3	Grade
1	SO 57620 44780	357620	244780	57	≤7	E		0	35	35	5YR4/3					No	ZC - Silty clay												Not Applicable		No	No	38	6	2	WC III	3b	Wetness			3b
								35	40	5	5YR5/3					No	ZC - Silty clay												Moderate		Yes	No									
								40	65	25	5YR5/3	CD - C	7.5YR5/6			No	ZC - Silty clay												Poor		Yes	Yes									
								65	100	35	5YR5/2	CD - C	7.5YR5/6			No	SCL - Sandy clay loam												Moderate		Yes	Yes									
								100	120	20							SCL - Sandy clay loam												Moderate			Yes									
2	SO 57700 44800	357700	244800	57	≤7	E		0	35	35	2.5YR4/4					No	HZCL - Silty clay loam (heavy)												Not Applicable		No	No	38	25	1	WC II	3a	Wetness			3a
								35	65	30	2.5YR3/6					No	HZCL - Silty clay loam (heavy)												Moderate		No	No									
								65	80	15	5YR5/2	MD - M	7.5YR5/6			No	C - Clay												Poor		Yes	Yes									
								80	100	20	5YR5/3	MD - M	7.5YR5/6			No	C - Clay												Poor		Yes	Yes									
								100	120	20							C - Clay												Poor			Yes									
3	SO 57800 44780	357800	244780	60	≤7	E		0	30	30	5YR4/3					No	HZCL - Silty clay loam (heavy)												Not Applicable		No	No	29	14	2	WC III	3b	Wetness			3b
								30	40	10	5YR4/3					No	HZCL - Silty clay loam (heavy)												Moderate		No	No									
								40	75	35	5YR5/4	CD - C	7.5YR5/6			No	C - Clay												Poor		Yes	Yes									
								75	80	5	5YR5/4					No	C - Clay												Poor		No	Yes									
								80	100	20	5YR5/2	MD - M	7.5YR5/6			No	C - Clay												Poor		No	Yes									
								100	120	20							C - Clay												Poor			Yes									
4	SO 57500 44700	357500	244700	60	≤7	E		0	30	30	5YR4/3					No	ZC - Silty clay												Not Applicable		No	No	36	10	2	WC III	3b	Wetness			3b
								30	35	5	5YR4/3					No	ZC - Silty clay												Moderate		Yes	No									
								35	50	15	5YR5/3	No					C - Clay												Moderate		Yes	No									
								50	80	30	7.5YR5/4	CD - C	7.5YR5/6			No	C - Clay												Poor		Yes	Yes									
								80	100	20	7.5YR5/3	CD - C	7.5YR5/6			Yes	SCL - Sandy clay loam												Moderate		Yes	Yes									
								100	120	20							SCL - Sandy clay loam												Moderate			Yes									
5	SO 57600 44700	357600	244700	57	≤7	E		0	30	30	5YR4/2					No	HZCL - Silty clay loam (heavy)												Not Applicable		No	No	50	22	1	WC IV	3b	Wetness			3b
								30	65	35	7.5YR5/3	CD - C	7.5YR4/6			Yes	C - Clay												Moderate		Yes	No									
								65	80	15	5YR5/3					No	MSZL - Medium sandy silt loam												Moderate		No	No									
								80	100	20	7.5YR5/3					Yes	SCL - Sandy clay loam												Moderate		No	No									
								100	120	20							SCL - Sandy clay loam												Moderate			No									
6	SO 57700 44700	357700	244700	57	≤7	E		0	38	38	5YR5/3					No	HZCL - Silty clay loam (heavy)												Not Applicable		No	No	45	15	1	WC III	3b	Wetness			3b
								38	40	2	5YR5/4					No	C - Clay												Moderate		Yes	No									
								40	70	30	5YR5/3	CD - C	7.5YR5/6			No	C - Clay												Poor		Yes	Yes									
								70	80	10	5YR5/4	CD - C	7.5YR5/6			No	SCL - Sandy clay loam												Moderate		Yes	No									
								80	120	40							SCL - Sandy clay loam												Moderate			No									
7	SO 57400 44600	357400	244600	59	≤7	E		0	30	30	5YR4/3					No	C - Clay												Not Applicable		No	Yes	4	10	3a	WC III	3b	Wetness			3b
								30	50	20	5YR4/3					No	C - Clay												Moderate		Yes	No									
								50	70	20	5YR5/3	CD - C	7.5YR5/6			No	C - Clay												Poor		Yes	Yes									
								70	75	5	5YR4/3						LCS - Loa	50			GH - Gravel with non-porous (hard) stones								Moderate		No	Yes									
								75	120	45							LCS - Loa	50			GH - Gravel with non-porous (hard) stones								Moderate			Yes									
8	SO 57500 44600	357500	244600	60	≤7	E		0	35	35	5YR3/4					No	ZC - Silty clay												Not Applicable		No	Yes	7	13	2	WC III	3b	Wetness			3b
								35	40	5	5YR4/4					No	ZC - Silty clay												Moderate		No	Yes									
								40	70	30	5YR5/3					No	ZC - Silty clay												Moderate		Yes	Yes									
								70	80	10	5YR5/4					No	CS - Coarse Sand												Moderate		No	No									
								80	120	40							CS - Coarse Sand												Moderate			No									
9	SO 57580 44600	357580	244600	57	≤7	E		0	20	20	5YR4/2	CF - C	7.5YR5/6			No	HZCL - Silty clay loam (heavy)												Not Applicable		No	No	18	24	2	WC II	3a	Wetness			3a
								20	38	18	5YR4/1	CD - C	7.5YR5/6			No	HZCL - Silty clay loam (heavy)												Moderate		No	No									
								38	40	2	5YR5/2	CD - C	7.5YR5/6			No	C - Clay												Moderate		Yes	No									
								40	70	30	5YR4/4					No	MZCL - Silty clay loam (medium)												Moderate		No	Yes									
								70	120	50							CS - Coarse Sand												Moderate			No									
10	SO 57300 44500	357300	244500	59	≤7	E		0	35	35	5YR4/3					No	C - Clay												Not Applicable		No	No	26	10	2	WC III	3b	Wetness			3b
								35	50	15	5YR4/4	CD - C	7.5YR5/6			No	C - Clay												Moderate		Yes	No									
								50	70	20	5YR4/4	CD - C	7.5YR5/6			No	C - Clay												Poor		Yes	Yes									
								70	100	30	5YR5/3	CD - C	7.5YR5/6			No	C - Clay												Poor		Yes	Yes									
								100	120	20							C - Clay												Poor			Yes									
11	SO 57400 44500	357400	244500	59	≤7	E		0	30	30	5YR4/3					No	C - Clay												Not Applicable		Yes	No	24	9	2	WC III	3b	Wetness			3b
								30	50	20	5YR4/6					No	C - Clay	3			GH - Gravel with non-porous (hard) stones								Moderate		Yes	No									
								50	60	10	5YR4/6						C - Clay	3			GH - Gravel with non-porous (hard) stones								Poor		Yes	Yes									
								60	90	30	5YR4/4	FF - Fe	7.5YR5/6			No	C - Clay												Poor		Yes	Yes									
								90	120	30							C - Clay												Poor			Yes									
12	SO 57500 44500	357500	244500	58	≤7	E		0	30	30	5YR4/3					No	C - Clay												Not Applicable		No	No	11	7	2	WC III	3b	Wetness			3b
								30	40	10	5YR4/4					No	C - Clay												Moderate		No	No									
								40	80	40	5YR5/3	MF - M	7.5YR5/6			No	C - Clay												Poor		Yes	Yes									
								80	90	10	5YR5/4					No	C - Clay												Poor		No	Yes									
								90	120	30							CS - Coarse Sand												Moderate			No									

Point	Grid ref. NGR	X	Y	Alt (m)	Slope °	Aspect	Land use	Depth (cm) Top	Bttm	Thick	Matrix Munsell colour	Ochreous Mottles Form	Munsell colour	Grey Mottles Form	Munsell colour	Gley	Texture	Stones - type 1 %	> 2cm	> 6cm	Type	Stones - type 2 %	> 2cm	> 6cm	Type	Ped Strength	Size	Shape	SUBS STR	CaCO3	Mn C	SPL	Drought MBw	MBp	Gd	Wet WC	Gw	Final ALC Limitation 1	Limitation 2	Limitation 3	Grade
13	SO 57300 44400	357300	244400	59	≤7	E		0 40 100	40 100 120	40 60 20	5YR4/4 5YR3/4					No No	ZC - Silty clay ZC - Silty clay ZC - Silty clay												Not Applicable Moderate Moderate		No Yes	No Yes Yes	32	14	1	WC III	3b	Wetness			3b
14	SO 57400 44400	357400	244400	59	≤7	E		0 30 40 80 100	30 40 80 100 120	30 10 40 20 20	5YR4/4 5YR3/4 5YR3/4 2.5YR4/4					No No No No	ZC - Silty clay ZC - Silty clay ZC - Silty clay HZCL - Silty clay loam (heavy) HZCL - Silty clay loam (heavy)												Not Applicable Moderate Poor Moderate Moderate		No No Yes No	No No Yes No No	32	3	2	WC III	3b	Wetness			3b
15	SO 57200 44300	357200	244300	57	≤7	E		0 40 80 100	40 80 100 120	40 40 20 20	5YR4/4 5YR4/4 5YR4/4					No No No	ZC - Silty clay ZC - Silty clay ZC - Silty clay ZC - Silty clay												Not Applicable Moderate Poor Poor		No Yes Yes	No Yes Yes Yes	28	14	2	WC III	3b	Wetness			3b
16	SO 57300 44300	357300	244300	57	≤7	E		0 30 50 70 100	30 50 70 100 120	30 20 20 30 20	5YR4/4 5YR4/4 5YR4/4 5YR4/6					No No No No	ZC - Silty clay ZC - Silty clay ZC - Silty clay ZC - Silty clay ZC - Silty clay												Not Applicable Moderate Poor Poor Poor		No Yes Yes	No No Yes Yes Yes	23	6	2	WC III	3b	Wetness			3b
17	SO 57400 44300	357400	244300	57	≤7	E		0 40 50	40 50 120	40 10 70	5YR4/4					No	HZCL - Silty clay loam (heavy) ZC - Silty clay ZC - Silty clay												Not Applicable Poor Poor		No	No Yes Yes	30	13	1	WC III	3b	Wetness			3b
18	SO 57100 44200	357100	244200	58	≤7	E		0 30 50 80 100	30 50 80 100 120	30 20 30 20 20	5YR4/3 5YR4/3 5YR4/4 5YR5/1	 CD - C	 7.5YR5/6			No No No No	ZC - Silty clay ZC - Silty clay ZC - Silty clay ZC - Silty clay ZC - Silty clay												Not Applicable Moderate Poor Poor Poor		No No Yes Yes	No No Yes Yes Yes	23	6	2	WC III	3b	Wetness			3b
19	SO 57200 44200	357200	244200	57	≤7	E		0 30 40 50 80	30 40 50 80 120	30 10 10 30 40	5YR4/3 5YR4/3 5YR4/3 5YR4/4					No No No No	C - Clay C - Clay C - Clay ZC - Silty clay ZC - Silty clay												Not Applicable Moderate Poor Poor Poor		No Yes Yes Yes Yes	No No Yes Yes Yes	22	5	2	WC III	3b	Wetness			3b
20	SO 57300 44220	357300	244220	57	≤7	E		0 33 50 90	33 50 90 120	33 17 40 30	5YR4/4 5YR4/4 5YR4/4					No No No	HZCL - Silty clay loam (heavy) ZC - Silty clay ZC - Silty clay ZC - Silty clay												Not Applicable Moderate Poor Poor		No Yes Yes	No No Yes Yes	30	13	1	WC III	3b	Wetness			3b
21	SO 57400 44200	357400	244200	57	≤7	E		0 30 50 90	30 50 90 120	30 20 40 30	5YR4/4 5YR4/4 5YR4/4					No No No	ZC - Silty clay ZC - Silty clay ZC - Silty clay ZC - Silty clay												Not Applicable Moderate Poor Poor		No Yes Yes	No No Yes Yes	23	6	2	WC III	3b	Wetness			3b
	END																																								

Point	Grid ref.			Alt (m)	Slope °	Aspect	Land use	Depth (cm)			Matrix	Ochreous Mottles		Grey Mottles		Gley	Texture	Stones - type 1				Stones - type 2				Ped			SUBS STR	CaCO3	Mn C	SPL	Drought			Wet		Final ALC			
	NGR	X	Y					Top	Bttm	Thick	Munsell colour	Form	Munsell colour	Form	Munsell colour			%	> 2cm	> 6cm	Type	%	> 2cm	> 6cm	Type	Strength	Size	Shape					MBw	MBp	Gd	WC	Gw	Limitation 1	Limitation 2	Limitation 3	Grade
22	SO 57600 44500	357600	244500	61	≤7	SW		0	38	38	5YR4/3					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	90	44	1	WC I	1	N/A			1
								38	70	32	5YR4/3					No	ZL - Silt loam												Moderate		No	No									
								70	120	50							ZL - Silt loam												Moderate			No									
23	SO 57500 44400	357500	244400	58	≤7	SW		0	38	38	5YR4/4					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	76	28	1	WC II	2	Wetness			2
								38	70	32	5YR4/4					No	HZCL - Silty clay loam (heavy)												Moderate		Yes	No									
								70	90	20	5YR4/3					No	ZL - Silt loam												Moderate		No	No									
								90	120	30							ZL - Silt loam												Moderate			No									
24	SO 57600 44400	357600	244400	61	≤7	SW		0	38	38	5YR4/3					No	MZCL - Silty clay loam (medium)												Not Applicable		No	Yes	56	28	1	WC I	1	N/A			1
								38	90	52	5YR4/3					No	HZCL - Silty clay loam (heavy)												Moderate		No	No									
								90	120	30							HZCL - Silty clay loam (heavy)												Moderate			No									
25	SO 57700 44400	357700	244400	61	≤7	SW		0	30	30	5YR4/3					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	82	36	1	WC I	1	N/A			1
								30	50	20	5YR4/3					No	MZCL - Silty clay loam (medium)												Moderate		No	No									
								50	70	20	2.5YR4/4					No	ZL - Silt loam												Moderate		No	No									
								70	120	50							ZL - Silt loam												Moderate			No									
26	SO 57500 44300	357500	244300	58	≤7	SW		0	38	38	5YR4/3					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	56	28	1	WC I	1	N/A			1
								38	70	32	5YR4/3					No	HZCL - Silty clay loam (heavy)												Moderate		No	No									
								70	90	20	2.5YR4/3					No	HZCL - Silty clay loam (heavy)												Moderate		No	No									
								90	120	30							HZCL - Silty clay loam (heavy)												Moderate			No									
27	SO 57600 44300	357600	244300	59	≤7	SW		0	38	38	5YR4/4					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	56	28	1	WC II	2	Wetness			2
								38	70	32	5YR4/3					No	HZCL - Silty clay loam (heavy)												Moderate		Yes	No									
								70	90	20	2.5YR4/6					No	HZCL - Silty clay loam (heavy)												Moderate		No	No									
								90	120	30							HZCL - Silty clay loam (heavy)												Moderate			No									
28	SO 57700 44300	357700	244300	59	≤7	SW		0	38	38	5YR4/3					No	HZCL - Silty clay loam (heavy)												Not Applicable		No	No	74	28	1	WC I	1	N/A			1
								38	75	37	5YR4/4					No	HZCL - Silty clay loam (heavy)												Moderate		No	No									
								75	90	15	2.5YR4/6					No	ZL - Silt loam												Moderate		No	No									
								90	120	30							ZL - Silt loam												Moderate			No									
29	SO 57500 44200	357500	244200	58	≤7	SW		0	30	30	5YR4/4					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	39	21	1	WC II	2	Wetness			2
								30	45	15	5YR4/3					No	HZCL - Silty clay loam (heavy)												Moderate		Yes	No									
								45	80	35	2.5Y4/3						ZC - Silty clay												Moderate		No	No									
								80	120	40							ZC - Silty clay												Moderate			No									
30	SO 57600 44200	357600	244200	59	≤7	SW		0	38	38	5YR4/4					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	56	28	1	WC II	2	Wetness			2
								38	90	52	5YR4/3					No	HZCL - Silty clay loam (heavy)												Moderate		Yes	No									
								90	120	30							HZCL - Silty clay loam (heavy)												Moderate		No	No									
31	SO 57700 44200	357700	244200	59	≤7	SW		0	30	30	5YR4/4					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	54	26	1	WC I	1	N/A			1
								30	40	10	5YR4/4					No	MZCL - Silty clay loam (medium)												Moderate		Yes	No									
								40	90	50	2.5YR4/4					No	HZCL - Silty clay loam (heavy)												Moderate		No	No									
								90	120	30							HZCL - Silty clay loam (heavy)												Moderate			No									
32	SO 57500 44100	357500	244100	61	≤7	SW		0	35	35	5YR4/3					No	ZL - Silt loam												Not Applicable		No	No	85	41	1	WC II	2	Wetness			2
								35	70	35	5YR4/4					No	MZCL - Silty clay loam (medium)												Moderate		Yes	No									
								70	80	10	5YR4/4					No	HZCL - Silty clay loam (heavy)												Moderate		No	No									
								80	90	10	5YR5/3					No	ZL - Silt loam												Moderate			No									
								90	120	30							ZL - Silt loam												Moderate			Yes									
33	SO 57600 44100	357600	244100	62	≤7	SW		0	38	38	5YR4/3					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	48	28	1	WC II	2	Wetness			2
								38	80	42	2.5YR4/4					No	HZCL - Silty clay loam (heavy)												Moderate		Yes	No									
								80	100	20	2.5YR5/3						C - Clay												Moderate		No	Yes									
								100	120	20							C - Clay												Moderate			Yes									

Point	Grid ref.			Alt (m)	Slope °	Aspect	Land use	Depth (cm)			Matrix	Ochreous Mottles		Grey Mottles		Gley	Texture	Stones - type 1				Stones - type 2				Ped			SUBS STR	CaCO3	Mn C	SPL	Drought			Wet		Final ALC			
	NGR	X	Y					Top	Bttm	Thick	Munsell colour	Form	Munsell colour	Form	Munsell colour			%	> 2cm	> 6cm	Type	%	> 2cm	> 6cm	Type	Strength	Size	Shape					MBw	MBp	Gd	WC	Gw	Limitation 1	Limitation 2	Limitation 3	Grade
34	SO 57600 44000	357600	244000	62	≤7	SW		0	35	35	5YR4/4					Yes	MSZL - Medium sandy silt loam												Not Applicable		No	No	71	27	1	WC II	2	Wetness			2
								35	40	5	5YR4/4					No	MSZL - Medium sandy silt loam												Moderate		Yes	No									
								40	80	40	5YR4/3					No	MZCL - Silty clay loam (medium)												Moderate		Yes	No									
								80	90	10	2.5YR4/4					No	ZL - Silt loam												Moderate			No									
								90	120	30							ZL - Silt loam												Moderate												
35	SO 57700 44000	357700	244000	62	≤7	SW		0	30	30	5YR4/3					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	42	24	1	WC II	2	Wetness			2
								30	40	10	5YR4/3					No	MZCL - Silty clay loam (medium)												Moderate		Yes	No									
								40	60	20	2.5YR4/6					No	HZCL - Silty clay loam (heavy)												Moderate		Yes	No									
								60	100	40	2.5YR4/4					No	ZC - Silty clay												Moderate		Yes	Yes									
								100	120	20							ZC - Silty clay												Moderate			Yes									
36	SO 57570 43920	357570	243920	62	≤7	SW		0	38	38	5YR4/4					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	82	35	1	WC I	1	N/A			1
								38	55	17	5YR4/4					No	HZCL - Silty clay loam (heavy)												Moderate		No	No									
								55	90	35	2.5YR4/4						ZL - Silt loam												Moderate		No	Yes									
								90	120	30							ZL - Silt loam												Moderate			Yes									
	END																																								

Point	Grid ref.			Alt (m)	Slope °	Aspect	Land use	Depth (cm)			Matrix	Ochreous Mottles		Grey Mottles		Gley	Texture	Stones - type 1				Stones - type 2				Ped			SUBS STR	CaCO3	Mn C	SPL	Drought			Wet		Final ALC			
	NGR	X	Y					Top	Bttm	Thick	Munsell colour	Form	Munsell colour	Form	Munsell colour			%	> 2cm	> 6cm	Type	%	> 2cm	> 6cm	Type	Strength	Size	Shape					MBw	MBp	Gd	WC	Gw	Limitation 1	Limitation 2	Limitation 3	Grade
37	SO 58100 44800	358100	244800	61	≤7	W		0	40	40	5YR4/4					No	ZC - Silty clay												Not Applicable		No	No	28	14	2	WC III	3b	Wetness			3b
								40	80	40	5YR4/4					No	ZC - Silty clay												Moderate		Yes	Yes									
								80	100	20	5YR5/3	CD - C	7.5YR5/6			No	ZC - Silty clay												Poor		Yes	Yes									
								100	120	20						No	ZC - Silty clay												Poor			Yes									
38	SO 58200 44800	358200	244800	64	≤7	W		0	40	40	5YR4/4					No	ZC - Silty clay												Not Applicable		No	No	32	14	1	WC III	3b	Wetness			3b
								40	50	10	2.5YR4/3					No	ZC - Silty clay												Moderate		No	No									
								50	70	20	2.5YR4/3					No	ZC - Silty clay												Moderate		No	Yes									
								70	100	30	5YR5/3	CD - C	7.5YR5/6			No	ZC - Silty clay												Moderate		No	Yes									
								100	120	20							ZC - Silty clay												Moderate												
39	SO 58300 44800	358300	244800	64	≤7	W		0	38	38	2.5YR4/4					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	52	28	1	WC I	1	N/A			1
								38	80	42	2.5YR4/4					No	HZCL - Silty clay loam (heavy)												Moderate		No	No									
								80	100	20	2.5YR4/4					No	HZCL - Silty clay loam (heavy)												Moderate		Yes	No									
								100	120	20							C - Clay												Moderate			Yes									
40	SO 58400 44800	358400	244800	64	≤7	W		0	38	38	5YR4/4					No	HZCL - Silty clay loam (heavy)												Not Applicable		No	No	39	26	1	WC III	3b	Wetness			3b
								38	65	27	5YR4/4					No	HZCL - Silty clay loam (heavy)												Moderate		Yes	No									
								65	100	35	2.5YR4/3					No	C - Clay												Poor		Yes	Yes									
								100	120	20							C - Clay												Poor			Yes									
41	SO 57800 44700	357800	244700	60	≤7	W		0	38	38	5YR4/4					No	HZCL - Silty clay loam (heavy)												Not Applicable		No	No	40	24	1	WC III	3b	Wetness			3b
								38	50	12	5YR4/4					No	C - Clay												Moderate		No	No									
								50	100	50	5YR4/4					No	C - Clay												Moderate		No	Yes									
								100	120	20							C - Clay												Moderate			Yes									
42	SO 57900 44700	357900	244700	62	≤7	W		0	40	40	5YR4/4					No	ZC - Silty clay												Not Applicable		No	No	81	14	1	WC III	3b	Wetness			3b
								40	50	10	2.5YR4/4					No	ZC - Silty clay												Moderate		No	No									
								50	100	50	2.5YR4/4						ZC - Silty clay												Poor			Yes									
								100	120	20							ZC - Silty clay												Poor			Yes									
43	SO 58000 44700	358000	244700	61	≤7	W		0	38	38	5YR4/4					No	ZC - Silty clay												Not Applicable		No	No	25	8	2	WC III	3b	Wetness			3b
								38	50	12	5YR4/4					No	ZC - Silty clay												Moderate		Yes	No									
								50	75	25	5YR4/4					No	ZC - Silty clay												Poor		Yes	Yes									
								75	100	25	5YR/3	CD - C	7.5YR5/6			No	ZC - Silty clay												Poor		Yes	Yes									
								100	120	20							ZC - Silty clay												Poor			Yes									
44	SO 58120 44700	358120	244700	61	≤7	W		0	30	30	5YR4/3					No	ZC - Silty clay												Not Applicable		No	No	24	8	2	WC III	3b	Wetness			3b
								30	55	25	5YR4/3					No	ZC - Silty clay												Moderate		Yes	No									
								55	80	25	5YR4/4					No	ZC - Silty clay												Poor		Yes	Yes									
								80	100	20	5YR4/4					No	ZC - Silty clay												Poor		No	Yes									
								100	120	20							ZC - Silty clay												Poor			Yes									
45	SO 58200 44700	358200	244700	64	≤7	W		0	39	39	5YR4/4					No	HZCL - Silty clay loam (heavy)												Not Applicable		No	No	89	43	1	WC I	1	N/A			1
								39	45	6	2.5YR4/4					No	ZL - Silt loam												Moderate		No	No									
								45	120	75							ZL - Silt loam												Moderate			No									
46	SO 58300 44700	358300	244700	64	≤7	W		0	40	40	2.5YR4/4					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	80	33	1	WC I	1	N/A			1
								40	60	20	2.5YR4/4					No	MZCL - Silty clay loam (medium)												Moderate		No	No									
								60	100	40	2.5YR3/6					No	ZL - Silt loam												Moderate		No	No									
								100	120	20							ZL - Silt loam												Moderate			No									
47	SO 58400 44700	358400	244700	64	≤7	W		0	30	30	5YR4/4					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	72	26	1	WC I	1	N/A			1
								30	75	45	5YR4/4					No	MZCL - Silty clay loam (medium)												Moderate		No	No									
								75	100	25	2.5YR3/6					No	ZL - Silt loam												Moderate		No	No									
								100	120	20							ZL - Silt loam												Moderate			No									
48	SO 57700 44600	357700	244600	57	≤7	W		0	35	35	5YR4/3					No	HZCL - Silty clay loam (heavy)												Not Applicable		No	No	55	27	1	WC II	3a	Wetness			3a
								35	100	65	5YR4/3					No	HZCL - Silty clay loam (heavy)												Moderate		Yes	No									
								100	120	20							HZCL - Silty clay loam (heavy)												Moderate			No									

Point	Grid ref.			Alt (m)	Slope °	Aspect	Land use	Depth (cm)			Matrix	Ochreous Mottles		Grey Mottles		Gley	Texture	Stones - type 1				Stones - type 2				Ped			SUBS STR	CaCO3	Mn C	SPL	Drought			Wet		Final ALC			
	NGR	X	Y					Top	Bttm	Thick	Munsell colour	Form	Munsell colour	Form	Munsell colour			%	> 2cm	> 6cm	Type	%	> 2cm	> 6cm	Type	Strength	Size	Shape					MBw	MBp	Gd	WC	Gw	Limitation 1	Limitation 2	Limitation 3	Grade
49	SO 57800 44600	357800	244600	60	≤7	W		0	38	38	5YR4/6					No	ZC - Silty clay												Not Applicable		No	No	25	8	2	WC III	3b	Wetness			3b
								38	50	12	5YR4/6	FF - Fe	5YR5/6			No	ZC - Silty clay												Moderate		No	No									
								50	100	50	5YR4/6	FF - Fe	5YR5/6			No	ZC - Silty clay												Poor		No	Yes									
								100	120	20							ZC - Silty clay												Poor			Yes									
50	SO 57900 44600	357900	244600	62	≤7	W		0	40	40	5YR4/4					No	ZC - Silty clay												Not Applicable		No	No	22	5	2	WC III	3b	Wetness			3b
								40	70	30	5YR4/4					No	ZC - Silty clay												Poor		No	Yes									
								70	120	50							ZC - Silty clay												Poor			Yes									
51	SO 58000 44600	358000	244600	61	≤7	W		0	35	35	5YR4/4					No	HZCL - Silty clay loam (heavy)												Not Applicable		No	No	29	12	2	WC III	3b	Wetness			3b
								35	40	5	5YR4/4					No	HZCL - Silty clay loam (heavy)												Moderate		No	No									
								40	50	10	5YR4/4					No	ZC - Silty clay												Poor		No	Yes									
								50	70	20	5YR4/4					No	ZC - Silty clay												Poor		No	Yes									
								70	120	50							ZC - Silty clay												Poor			Yes									
52	SO 58100 44600	358100	244600	61	≤7	W		0	30	30	5YR4/4					No	HZCL - Silty clay loam (heavy)												Not Applicable		No	No	38	20	1	WC III	3b	Wetness			3b
								30	40	10	5YR4/4					No	HZCL - Silty clay loam (heavy)												Moderate		No	No									
								40	50	10	5YR4/4					No	ZC - Silty clay												Moderate		No	No									
								50	70	20	5YR4/4					No	ZC - Silty clay												Moderate		No	Yes									
								70	120	50							ZC - Silty clay												Moderate			Yes									
53	SO 58200 44600	358200	244600	64	≤7	W		0	30	30	2.5YR4/4					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	38	20	1	WC III	3a	Wetness			3a
								30	40	10	2.5YR3/6					No	HZCL - Silty clay loam (heavy)												Moderate		No	No									
								40	50	10							ZC - Silty clay												Moderate			Yes									
								50	120	70							ZC - Silty clay												Moderate			Yes									
54	SO 57700 44500	357700	244500	61	≤7	W		0	38	38	5YR4/3					No	HZCL - Silty clay loam (heavy)												Not Applicable		No	No	60	28	1	WC II	3a	Wetness			3a
								38	100	62	5YR4/3					No	HZCL - Silty clay loam (heavy)												Moderate		Yes	No									
								100	120	20							HZCL - Silty clay loam (heavy)												Good			No									
55	SO 57800 44500	357800	244500	64	≤7	W		0	30	30	5YR4/4					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	87	41	1	WC I	1	N/A			1
								30	40	10	5YR4/4					No	MZCL - Silty clay loam (medium)												Moderate		No	No									
								40	80	40	5YR4/4					No	ZL - Silt loam												Moderate		No	No									
								80	120	40							ZL - Silt loam												Moderate		No	No									
56	SO 57900 44500	357900	244500	70	≤7	W		0	38	38	5YR3/4					No	MCL - Clay loam (medium)												Not Applicable		No	No	40	22	1	WC III	3a	Wetness			3a
								38	42	4	5YR3/4					No	HZCL - Silty clay loam (heavy)												Moderate		No	No									
								42	50	8	2.5YR3/6					No	ZC - Silty clay												Moderate		No	No									
								50	100	50	2.5YR3/6					No	ZC - Silty clay												Moderate		No	Yes									
								100	120	20							ZC - Silty clay												Moderate			Yes									
57	SO 57800 44400	357800	244400	64	≤7	W		0	35	35	5YR4/4					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	79	32	1	WC I	1	N/A			1
								35	60	25	5YR4/4					No	HZCL - Silty clay loam (heavy)												Moderate		Yes	No									
								60	120	60							ZL - Silt loam												Moderate			No									
58	SO 57900 44400	357900	244400	70	≤7	W		0	30	30	5YR4/4					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	87	41	1	WC I	1	N/A			1
								30	40	10	5YR4/3					No	MZCL - Silty clay loam (medium)												Moderate		No	No									
								40	100	60	5YR4/4					No	ZL - Silt loam												Moderate		No	No									
								100	120	20							ZL - Silt loam												Moderate		No	No									
59	SO 57800 44300	357800	244300	60	≤7	W		0	30	30	5YR4/4					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	74	26	1	WC I	1	N/A			1
								30	40	10	5YR4/4					No	MZCL - Silty clay loam (medium)												Moderate		No	No									
								40	70	30	2.5YR4/4					No	HZCL - Silty clay loam (heavy)												Moderate		Yes	No									
								70	90	20	2.5YR4/4					No	ZL - Silt loam												Moderate		No	No									
								90	120	30							ZL - Silt loam												Moderate												
60	SO 57900 44300	357900	244300	63	≤7	W		0	30	30	5YR4/4					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	92	46	1	WC I	1	N/A			1
								30	60	30	5YR4/4					No	ZL - Silt loam												Moderate		No	No									
								60	120	60							ZL - Silt loam												Moderate			No									

Point	Grid ref.			Alt (m)	Slope °	Aspect	Land use	Depth (cm)			Matrix	Ochreous Mottles		Grey Mottles		Gley	Texture	Stones - type 1				Stones - type 2				Ped			SUBS STR	CaCO3	Mn C	SPL	Drought			Wet		Final ALC			
	NGR	X	Y					Top	Bttm	Thick	Munsell colour	Form	Munsell colour	Form	Munsell colour			%	> 2cm	> 6cm	Type	%	> 2cm	> 6cm	Type	Strength	Size	Shape					MBw	MBp	Gd	WC	Gw	Limitation 1	Limitation 2	Limitation 3	Grade
	END																																								

Mottle form

FF - Few Faint
FD - Few Distinct
FP - Few Prominent
CF - Common Faint
CD - Common Distinct
CP - Common Prominent
MF - Many Faint
MD - Many Distinct
MP - Many Prominent
VF - Very many Faint
VD - Very many Distinct
VP - Very many Prominent

Texture

C - Clay
CHK - Chalk
CS - Coarse Sand
CSL - Coarse sandy loam
CSZL - Coarse sandy silt loam
FP - Fibrous and semifibrous peats
FS - Fine Sand
FSL - Fine sandy loam
FSZL - Fine sandy silt loam
HCL - Clay loam (heavy)
HP - Humified peats
HZCL - Silty clay loam (heavy)
IMP - Impenetrable to roots
LCS - Loamy Coarse Sand
LFS - Loamy fine sand
LMS - Loamy medium sand
LP - Loamy peats
MCL - Clay loam (medium)
MS - Medium Sand
MSL - Medium sandy loam
MSZL - Medium sandy silt loam
MZ - Marine Light Silts
MZCL - Silty clay loam (medium)
OC - Organic clays
OL - Organic loams
OS - Organic sands
PL - Peaty loams
PS - Peaty sands
SC - Sandy clay
SCL - Sandy clay loam
SP - Sandy peats
ZC - Silty clay
ZL - Silt loam

Stone Type

CH - Chalk or chalk stones
FSST - Soft fine grained sandstones
GH - Gravel with non-porous (hard) stones
GS - Gravel with porous stones (mainly soft stone types listed above)
HR - All hard rocks or stones (i.e. those which cannot be scratched with a finger nail)
MSST - Soft, medium or coarse grained sandstones
SI - Soft 'weathered' igneous or metamorphic rocks or stones
SLST - Soft oolitic or dolomitic limestones
ZR - Soft, argillaceous or silty rocks or stones

Ped. Shape

SG - Single grain
GRA - Granular
SAB - Subangular Blocky
AB - Angular Blocky
PRIS - Prismatic
PLAT - Platy
MASS - Massive
NA - N/A

Subsoil Structure Condition

Not Applicable
Good
Moderate
Poor

Soil or Ped. Strength

Loose
Very friable
Friable
Firm
Very firm
Extremely firm
Extremely hard
N/A

Calcareousness

NON - Non-calcareous (<0.5% $CaCO_3$)
VSC - Very slightly calcareous (0.5 - 1% $CaCO_3$)
SC - Slightly calcareous (1 - 5% $CaCO_3$)
MC - Moderately calcareous (5 - 10% $CaCO_3$)
VC - Very calcareous (>10% $CaCO_3$)

Ped. Size

VF - Very Fine
F - Fine
M - Medium
C - Coarse
VC - Very Coarse
NA - N/A

Degree of Ped. Development

W - Weak
M - Moderate
S - Strong
NA - Not applicable

Wetness Class

WC I
WC II
WC III
WC IV
WC V
WC VI

ALC Grades

1
2
3a
3b
4
5
Non-Ag

Gley

None
Gley
N/A

Appendix 2:
Soil Pit Description

Project	Location	Date	Surveyor(s)	Company
C790	Westhide	18-May-21	RM	Askew Land and Soil

Pit	WC	Grade	Limitation(s)	Notes
1	III	3b		exploratory pti for structure assessment in red soils; SPL within 60cm (low porosity)- fig 7 WCIII

Grid Ref.			Altitude	Nearest	Topography				Flora		Weather and conditions			
Square	East	North		point	Gradient	Aspect	Slope form	Surface	Culivation type	Vegetation types	Temp	Sky	Wind	Precipitation
SO	579	447	62	42	0					Grassland	Mild	Cloudy	Slight	Rain

Horizon	Depth		Matrix			Gleying			Mottles			Stone content					Calc.	Mn C	Ped/soil structure				Horizon boundary		Biopores	SPL
	Top	Bttm	Texture	Colour	Munsell	Gley	Colour	Munsell	Form	Colour	Munsell	%	H	Type	S	Type			Dev.	Size	Structure	Strength	Distinct	Form	>0.5mm	
1	0	35	Silty Clay	Reddish Brown	5YR4/4																					
2	35	50	Silty Clay	Reddish Brown	5YR5/3														MOD	C	AB	Firm	Clear	Smooth	>0.5%	N
3	50	55	Silty Clay	Reddish Brown	5YR5/3														MOD	C	AB	Firm	n/a	n/a	<0.5%	Y

Pit	WC	Grade	Limitation(s)	Notes

Grid Ref.			Altitude	Nearest	Topography				Flora		Weather and conditions			
Square	East	North		point	Gradient	Aspect	Slope form	Surface	Culivation type	Vegetation types	Temp	Sky	Wind	Precipitation

Horizon	Depth		Matrix			Gleying			Mottles			Stone content					Calc.	Mn C	Ped/soil structure				Horizon boundary		Biopores	SPL
	Top	Bttm	Texture	Colour	Munsell	Gley	Colour	Munsell	Form	Colour	Munsell	%	H	Type	S	Type			Dev.	Size	Structure	Strength	Distinct	Form		

Appendix 3:
Topsoil Particle Size Analysis

ANALYTICAL REPORT

Report Number	**53885-21**	**N717**	**ROB ASKEW**
Date Received	**26-MAY-2021**		**RW ASKEW**
Date Reported	**03-JUN-2021**		**THE OLD STABLES**
Project	**SOIL**		**UPEXE**
Reference	**C790**		**EXETER**
Order Number			**DEVON EX5 5ND**

Client C790

Laboratory Reference		**SOIL515844**	**SOIL515845**								
Sample Reference		**C790 4**	**C790 56**								
Determinand	**Unit**	**SOIL**	**SOIL**								
Sand 2.00-0.063mm	% w/w	8	34								
Silt 0.063-0.002mm	% w/w	32	46								
Clay <0.002mm	% w/w	60	20								
Textural Class **		C	MCL								

Notes

Analysis Notes
The sample submitted was of adequate size to complete all analysis requested.
The results as reported relate only to the item(s) submitted for testing.
The results are presented on a dry matter basis unless otherwise stipulated.

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** Please see the attached document for the definition of textural classes.

Reported by
Myles Nicholson

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ADAS (UK) Textural Class Abbreviations

The texture classes are denoted by the following abbreviations:

Class	Code
Sand	S
Loamy sand	LS
Sandy loam	SL
Sandy Silt loam	SZL
Silt loam	ZL
Sandy clay loam	SCL
Clay loam	CL
Silt clay loam	ZCL
Clay	C
Silty clay	ZC
Sandy clay	SC

For the *sand, loamy sand, sandy loam* and *sandy silt loam* classes the predominant size of sand fraction may be indicated by the use of prefixes, thus:

vf Very Fine (more than 2/3's of sand less than 0.106 mm)
f Fine (more than 2/3's of sand less than 0.212 mm)
c Coarse (more than 1/3 of sand greater than 0.6 mm)
m Medium (less than 2/3's fine sand and less than 1/3 coarse sand).

The subdivisions of *clay loam* and *silty clay loam classes* according to clay content are indicated as follows:

M medium (less than 27% clay)
H heavy (27-35% clay)

Organic soils i.e. those with an organic matter greater than 10% will be preceded with a letter O.

Peaty soils i.e. those with an organic matter greater than 20% will be preceded with a letter P.

Appendix 4:
Soil Health

Soil Health

[1]Soil Health

Soil health can be defined as a soil's ability to function and sustain plants, animals and humans as part of the ecosystem. There are five main factors that impact the health of the soil and can have a large influence over its capability and resilience to function, they are:

1. Soil structure
2. Soil chemistry
3. Organic matter content
4. Soil biology
5. Water infiltration, retention and movement through the profile

A healthy soil will have a good combination of all these factors, whilst an unhealthy soil will have a problem with at least one of these. A healthy soil has plenty of air spaces (voids) within it, maintaining aerobic (oxygenated) conditions. A healthy soil will provide a buffer to extremes in temperature (as it allows movement of gases between the soil and the air above) and rainfall (as the soil is well drained). This helps to reduce the impact of extreme weather events.

When a soil has limited air spaces, anaerobic conditions (i.e. oxygen depleted) dominate, leading to waterlogging and stagnation of roots and the proliferation of anaerobic microbes and denitrification (i.e. the loss of nitrogen from the system). A healthy soil will filter water slowly, retaining the nutrients and plant protection products (PPP) applied to the crop. If rainfall moves through the soil profile too quickly, or if it is prevented from entering the soil through compaction or soil sealing, surface runoff increases, taking soil, nutrients and PPP with it. This also increases the risk of flooding.

Summary: A healthy soil has a well-developed soil structure, where soil particles are aggregated into soil peds (structural units) separated by pores or voids. This allows the free movement of water (precipitation) through the soil and facilitates gaseous exchange between the plant roots and the air. These soils are well aerated (oxygenated), which encourages healthy plant (crop) growth and an abundance of soil fauna and aerobic microbes. These soils often have high amounts of soil organic matter (SOM), associated with an accumulation of plant and animal matter, and thus are a good store of soil organic carbon (SOC).

[2]Soil Organic Matter (SOM)

Soil carbon is predominantly derived from carbon fixed by plants. This enters the soil as litter or dung, root tissue turnover, root exudates and carbon allocated to mutualistic fungi. Carbon is mixed into the soil and transformed by biological processes, but some is also carried down the profile by downward movement of rainwater. Where these biological processes are retarded, and mixing does not occur, soils can develop organic layers on their surface, and in waterlogged conditions these become deep peat deposits. Soils on limestone and chalk may also contain inorganic carbon as carbonate compounds. Some ammonia oxidising bacteria also fix carbon.

In all habitats, most carbon is stored in soils in the form of soil organic matter (SOM), and peaty soils in particular, are major stores of carbon (Natural England, 2012). Globally, soils contain more organic carbon than the vegetation and atmosphere combined (Swift, 2001). Ten billion tonnes of organic carbon are estimated to be stored in United Kingdom (UK) soils, with over half stored in peat. Soils in England and Wales store 2.4 billion tonnes of carbon of which 58% is in the top 30 cm of soil

(Department for Environment and Rural Affairs (Defra), 2011). Soil carbon is stored in fresh and decomposing litter and as longer-lasting material stored in soil particles, in a complex with clays or in anaerobic waterlogged conditions. England's deep and shallow peaty soils are estimated to contain over 580 million tonnes of carbon (Natural England, 2010), but in surface layers, denser mineral soils contain more carbon than peaty soils (Emmett et al, 2010). In peat, anaerobic conditions caused by waterlogging prevent the breakdown of phenols, which build up and inhibit other decomposition enzymes, while plants producing tannins also inhibit enzyme activity (Defra, 2010A). In lowland fens where waterlogging is due to groundwater, peat can be formed from a wide range of plants that are found in waterlogged conditions. In bogs, where water supply is derived from precipitation only, peat is predominantly formed from Sphagnum mosses and Cotton-grass (Eriophorum spp.), with minor components of other plants reflecting past drier conditions or periods (Natural England, 2013).

Cultivation of soils promotes the release of stored soil carbon by mineralisation of soil organic matter to carbon dioxide (CO^2) (Lal, 2004). The conversion of grassland to arable cropland was the largest contributor to soil carbon losses from land use change in the UK between 1990 and 2000 (Ostle et al, 2009). Carbon in the subsoil (below 15 cm for grassland or 30 cm plough layer for arable) is more stable and less influenced by surface processes (Defra, 2011A).

On mineral soils, Environmental Stewardship is estimated to have reduced England's agricultural greenhouse gas (GHG) emissions by around 11% a year (Defra, 2007), mainly through increases in soil organic carbon delivered by options such as buffer strips that take land out of cultivation.

The greatest benefits in terms of increase in soil carbon can be realised through land use change from intensive arable to grasslands (Conant et al, 2001), woodlands or some biofuels (Defra, 2003). Avoiding disturbance of undisturbed soils, and changing land use to grassland, heathland, woodland or wetland is likely to deliver carbon storage benefits (Natural England, 2012A), including on organo-mineral soils (Defra, 2011B). Conversion from arable to grassland may, however, be offset to some extent by methane emissions associated with livestock production.

There is ongoing research into how grasslands can be managed to increase carbon storage. Defra Project BD5003 (Ward et al, 2006) found that older, and particularly semi-improved grasslands are important carbon stores compared to intensively managed, improved grasslands.

Soil organic matter is a key indicator of many desirable soil functions. It helps to maintain soil structure, provides and stores nutrients, supports biological activity, increases water retention and stores carbon (Gobin et al, 2011). Early results from Natural England's project BD5001 (Natural England, 2016) indicate that grassland soils in good structural condition tend to have more organic matter than soils in moderate or poor condition. Soils with more organic matter tend to be more resistant and resilient to damage, with this effect interacting with soil texture and biological properties (Defra, 2010C).

The best opportunities to increase carbon storage come from planting perennial crops, returning crop residues to the soil and application of organic manures (Defra, 2014).

In the short to medium term (up to 10 years) zero tillage does not result in increased levels of soil carbon compared to conventional tillage (Defra, 2014), but global data suggests that zero tillage results in more total soil carbon storage when applied for 12 years or more (Steinbach and Alvarez, 2006).

Summary: The greatest benefits in terms of increase in soil organic matter (SOM), and hence soil organic carbon (SOC), can be realised through land use change from intensive arable to grasslands. Likewise, SOM and SOC are increased when cultivation of the land for crops (tillage) is stopped and the land is uncultivated (zero tillage). Global evidence suggests that zero tillage results in more total soil *carbon storage when applied for 12 years or more. Therefore, there is evidence that conversion of land from arable to grassland which is uncultivated over the long-term (>12 years), such as that under solar PV arrays, increases SOC and SOM.*

[3]**Biodiversity in the Soil**

Biological function of soils can be enhanced by simple approaches that can be integrated into real farm systems, including adapting organic matter management, cultivation approaches and cropping, with likely benefits to both farming and the environment (Natural England, 2012B).

Soils are habitats for millions of species, ranging from bacteria, fungi, protozoa, and microscopic invertebrates to mites, springtails, ants, worms and plants. It is estimated that more than 1 in 4 of all living species in earth is a strictly soil-dwelling organism (Decaens et al, 2006).

A single gram of soil can contain a billion bacterial cells from up to 10,000 species (Torsvik et al, 1990, 2002).

Soil biota are strongly influenced by land management. Modern farming has sought to replace many soil biota functions with less sustainable technological solutions, which lead to loss of soil biodiversity (Stockdale et al, 2006; Defra 2010c). For example, changes in land management practice and land use can have large effects on soil biodiversity over relatively short-time scales. Reducing the intensity of management, introducing no-tillage management and converting arable land to pasture usually has substantial beneficial effects (Spurgeon et al, 2013).

Microbial diversity in the UK reflects soil conditions, especially pH, but also vegetation, climatic and other environmental factors. Distinct specialist communities occur in more extreme soils with low diversity (Griffiths et al, 2012).

Current levels of understanding of soil biodiversity is low. Out of approximately 11 million species of soil organisms, an estimated 1.5% have been named and classified (Turbé et al, 2010) and most ecological roles are understood only at a general level.

Summary: Soils are habitats for millions of species, ranging from bacteria, fungi, protozoa, and microscopic invertebrates to mites, springtails, ants, worms and plants. Soil biota are strongly influenced by land management. Modern farming has led to the loss of soil biodiversity. Changes in land management practice and land use can have large effects on soil biodiversity over relatively short-time scales. Reducing the intensity of management, introducing no-tillage management, and converting arable land to pasture, such as grassland under solar PV arrays, has substantial beneficial effects.

[4]**Soil Structure**

Soil structure is defined by the way individual particles of sand, silt, and clay are assembled. Single particles when assembled appear as larger particles, called aggregates or peds. Soil structure is most usefully described in terms of grade (degree of aggregation), class (average size) and type of aggregates (form), or shape. The degree of aggregation ranges from structureless, through weak and moderate structure to strong structure. The shape of soil aggregates/peds is often describes as platy, prismatic/columnar, angular/subangular, or granular/crumb structure (Farming and Agriculture Organisation, FAO).

Soil structure refers to the way that soils are bound together. In a well-structured soil, water and air can move freely through cracks and pores. But a poor soil structure prevents water and air movement, and increases the risk of runoff (Defra, 2008). Soil structure can be improved by increasing soil organic matter (SOM) (Cranfield University, 2001).

The Game and Wildlife Conservation Trust's Allerton Project (Game and Wildlife Conservation Trust, 2020) has been involved in investigating the sustainable intensification of agriculture through different experiments. Some research has focused on moving away from conventional agricultural practice, with greater emphasis on no-tillage ('no-till'). One of the fields at the Allerton Project has not been ploughed for the last 14 years and the soil structure is visibly different compared to other soils on the farm. No-till systems can help improve soil fertility, create changes to the structure and properties of the soil due to the stability of the environment, and enhance soil biology. Over time the no-till field has had the highest yields compared to the conventional field equivalent on the farm.

Summary: In a well-structured soil, water and air can move freely through cracks and pores. But a poor soil structure prevents water and air movement, and increases the risk of runoff. Soil structure is improved when the land is uncultivated over time (no tillage), and when soil organic matter content (SOM) is increased through the accumulation of plant material, such has roots, in the soil. The aerobic (oxygenated) decomposition of SOM helps to bind soil particles together into aggregates (peds). Therefore, the conversion of land which is tilled for arable to long-term grassland (no tillage), such as that under solar PV arrays, improves soil structure over time.

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