Ecoenergy International Ltd




Solar Farm on land south of Berrington, Shrewsbury, Shropshire SY5 6HA

Soil Management Plan (Outline)

August 2023

ADAS

ADAS GENERAL NOTES

Project No.: 1051487

Title: Solar Farm on land south of Berrington- Outline Soil Management Plan

Date: 18/08/2023

Office: **ADAS Rosemaund, Preston, Wynne, Hereford, HR1 3PG**

Status: DRAFT AMENDED Final v2

Author	Ruth Metcalfe	**Technical reviewer**	Carla Richmond
Date:	21/08/23	Date:	23/08/2023

EXECUTIVE SUMMARY

The Soil Management Plan (SMP) ensures protection and conservation of the soil resources on the Best and Most Versatile Agricultural Land. The plan sets out management to safeguard the soil resources so that the land is physically capable of reverting to arable production at the end of the life of the solar farm.

The purpose of the (SMP) for the Solar Farm on land to the south of Berrington is:

- to ensure the protection and conservation of soil resources on site
- identify best practice to maintain the physical properties of the soils on site
- provide on-site reference on the management of the soil resource for site operators

Three soil types are identified on the site and where required should be handled and stored separately. On any construction site there is a risk of soil structural damage resulting in soil compaction from the use of machinery and handling soils in unsuitable conditions. Assessment of the soil moisture condition prior to daily site working is key to minimising the risk of soil compaction.

The plan covers on-site soil handling, the assessment of soil moisture content, storage of soil in bunds and trafficking. The plan is applicable throughout the life of the solar farm and should be reviewed prior to the decommissioning phase.

CONTENTS

1 INTRODUCTION

The Solar Farm on land south of Berrington, Shrewsbury, Shropshire is a proposed solar farm which will generate and store renewable energy for supply to the National Grid. The solar farm development will comprise the commissioning, operation and decommissioning phases.

The outline proposal is for an upto 30MW solar farm and associated infrastructure including a construction area, temporary welfare containers, customer substations, inverter stations, a concrete/asphalt access area and a maintenance track. Other infrastructure associated with the proposal includes cabling, fencing and frame mounted solar PV panels.

An Agricultural Land Classification (ALC) survey of the site was undertaken by RSK ADAS (2022). Details of the observations are included in the survey report.

A summary of the findings by grade is given below:

Grade 2 land includes freely draining soils (Wetness Class (WC) I) with a medium sandy loam or sandy clay loam topsoil over subsoils of sandy clay loam and clay at depth. The soils are either well drained or have slightly impeded drainage and mostly belong to WC I. The main limitation to the agricultural use is either soil droughtiness or soil wetness for soil profiles with slightly impeded drainage.

Subgrade 3a land includes soils with a loamy sand topsoil overlying sand. The soils are well drained (WC I) and soil droughtiness limits the soils to Subgrade 3a. Other land classified as Subgrade 3a has either a medium clay loam or sandy clay loam texture overlying clay below a depth of 38cm from the surface and no evidence of gleying above a depth of 40cm. These soils belong to WC III and the main limitation to their agricultural use is soil wetness.

Subgrade 3b land includes soils with a heavy clay loam or sandy clay loam topsoil overlying clay at a depth of 38cm from the surface with evidence of gleying within 40cm of the surface. These soils belong to WC IV and the main limitation to agricultural use is soil wetness.

The survey classified the land within the site boundary as:

Table 1 Agricultural Land Classification Grade - whole site area

Agricultural Land Classification Grade	Total Area (ha)	% of site boundary
1	0	0
2	22.4	54.1
3a	12.4	29.9
3b	4.9	11.8
4	0	0
5	0	0
Non Agricultural Land	0	0
Not surveyed	1.7	4.2
Total	41.4	100

1.1 Purpose of the outline Soil Management Plan (SMP)

The purpose of the Soil Management Plan (SMP) is:

- to ensure the protection and conservation of soil resources on site
- identify best practice to maintain the physical properties of the soils on site
- provide on-site reference on the management of the soil resource for site operators

The SMP follows the principles of best practice[1] [2] to maintain the physical properties of the soil with the aim of the restoring the land to its pre-construction condition at the end of the lifetime of the solar farm.

The principles of best practice to protect soil resources were developed from a research project undertaken in the 1990s, which considered the quality of agricultural land at the post restoration stage for several mineral sites[3]. The study included 34 sites with best and most versatile agricultural land quality and of these about half had maintained their pre-working grade at the start of the 5-year aftercare period and the majority had maintained or improved the grade at the end of the 5-year aftercare period. The study made several recommendations such as soil resource and management planning at an early stage in the planning process, recording details of stored soils and using appropriate machinery in suitable conditions.

1.2 Use of the SMP

The SMP (Outline) should be reviewed and updated in accordance with the agreed plans and contractors prior to any commissioning works. The Soil Management Plan is part of the Construction Environmental Management Plan submitted to the Local Planning Authority (LPA). Prior to the operational phase of the solar farm the SMP should be reviewed, updated and be included in the Operational Environmental Management Plan. Prior to decommissioning the SMP would be reviewed, updated and included in Decommissioning Environmental Management Plan. Post-decommissioning (i.e. removal of infrastructure associated with the solar farm) an aftercare plan for up to 5 years or until the land is in an appropriate condition should be prepared to include all remedial works needed to return the land to its previous use.

[1] Defra (2009) Construction Code of Practice for the Sustainable Use of Soils on Construction Sites

[2] The Institute of Quarrying (2021) Good Practice Guide for Handling Soils in Mineral Workings. https://www.quarrying.org.soils/soil-guidance

[3] Defra (2000). Evaluation of Mineral Sites restored to Agriculture. Project Code LE0206. http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=3621

2 SOIL RESOURCES

The SMP establishes a baseline of the soil resources prior to the construction phase and enables grouping of soils into soil units which have similar physical characteristics. As part of the Agricultural Land Classification Survey details on soil texture, depth, drainage characteristics and stone content were recorded. There were two main soil types identified in the Agricultural Land Classification report for the site. A third soil type, covering a small area in the central part of the site, is identified in the SMP.

The main soil type is described as medium textured soil with impeded drainage. A second soil type with a light soil texture is found in the western part of the site, where there are slopes and a higher risk of soil erosion than in other parts of the site. The third soil type is found across the centre of the site and is described as a heavy textured soil with impeded drainage. Descriptions of the soil types are in Appendix 1.

The soils can be grouped into soil handling units of similar texture, primarily to avoid mixing of different soil textures during any removal and storage.

3 SOIL UNITS FOR HANDLING

There are three phases - commissioning, operation and decommissioning - within the lifetime of a solar farm, where management of the soil resource is required. To ensure the physical condition and quality of the soil is preserved all soils should only be handled when dry and friable. To reduce damage to the soil structure the soil moisture state should be assessed on site by a suitably qualified person e.g. soil scientist prior to any daily work commencing and after rainfall events.

Soils can differ in their susceptibility to compaction depending on their textural class, degree of structural development and water retention properties. Light textured soils with a clay content of less than 18% such as sandy loam are significantly less susceptible to compaction than a heavy textured soil with a clay content of more than 27% such as a heavy clay loam, which have a low resilience to structural damage.

Three soil handling units are identified across the site, which will require stripping separately if the land is disturbed.

Table 2: Soil resilience to structural damage classification

Soil Handling Unit	Resilience to Structural damage during soil handling in a dry condition	Soil texture class
A (Green)	High	Light textured soils: sandy loam, loamy sand
B (Orange)	Medium	Medium textured soils with <27% clay content: sandy clay loam, medium silty clay loam, medium clay loam
C (Red)	Low	Heavy soils with >27% clay content: heavy clay loam

The following soil handling units have been identified on site with the topsoil texture determining the classification:

Unit A – loamy medium sand and medium sandy loam to a depth of 330mm from the surface over sand and loamy medium sand.

Unit B - medium clay loam, sandy clay loam or medium silty clay loam to a depth of 300mm from the surface with upper subsoils of similar texture over a lower subsoil of heavy silty clay loam or clay.

Unit C - heavy clay loam to a depth of 300mm over a subsoil of clay.

4 SOIL MOISTURE ASSESSMENT

The following points should be considered on each occasion that soil handling and trafficking is proposed:

- topsoil stripping will only occur when the soils are as dry as reasonably practicable (normally below the plastic limit and not normally within 24 hours of significant rainfall (i.e. >10mm in a 24-hour period)
- during light rainfall events local level decisions to proceed or stop should be based on the current wetness state of the soils being handled
- there should be no surface water standing in the area to be stripped
- the ground should be sufficiently dry for traffic to travel across without forming ruts
- soil should not be moved when the ground is covered by snow or is frozen

To determine the suitability of the soil for handling the following in-field soil moisture test should be undertaken to assess the moisture content of the soil prior to working.

The method involves rolling a ball of soil into intact threads (3mm diameter), which, if possible, indicate the soils are in a plastic and wet condition[4] [5] [6] (see Table 6). A visual examination of the soil taken initially and then an assessment of the soil consistency (the cohesion and adhesion of the soil) as set out in Tables 3, 4 and 5 should be undertaken.

Table 3 Visual Assessment of Soil Moisture

Soil Condition	Procedure
If the soil is wet, films of water are visible on the surface of the soil particles or aggregates and/or when a soil sample is squeezed by hand and readily deforms into a 'cohesive' ball	NO HANDLING
Soil peds readily break up or crumble when squeezed in the hand	HANDLING OK
If the sample is moist (a slight dampness when squeezed by hand) but the soil colour does not change upon further wetting	HANDLING OK IF UNDERTAKEN BY TRACKED EXCAVATOR AND CONSISTENCY TEST IS PASSED
If the sample is dry and darkens if water is added the soil is brittle	HANDLING OK IF CONSISTENCY TEST IS PASSED

[4] MAFF 1982 Reference Book 441 Techniques for measuring soil physical properties HMSO

[5] Natural England 2021 Planning and aftercare advice for reclaiming land to agricultural use.

[6] The Institute of Quarrying (2021). Good Practice Guide for Handling Soils Supplementary Note 4 Soil Wetness

Table 4 Consistency Test (1)

Attempt to mould a soil sample into a ball by hand:

Soil Condition	Procedure
Impossible because the soil is too hard or dry	HANDLING OK
Impossible because the soil is too loose (dry)	HANDLING OK
Impossible because the soil is too loose and wet	HANDLING NOT OK
Possible	GO to Table 6

Table 5 Consistency Test (2)

Attempt to roll the ball by hand into a thread of 3mm diameter on a flat non-adhesive surface:

Soil Condition	Procedure
Impossible the soil crumbles or disintegrates	HANDLING OK
Possible	NO HANDLING

5 SOIL STRIPPING

In the construction phase soil stripping will be required in limited areas of the site. The Soil Handling Units plan (Appendix 2) shows the units of soil which should be stripped and stored in bunds separately during the commissioning phase. The site will have been sown to a grass/clover ley which should be well established before any soil disturbance takes place. The grass/clover ley will reduce the risk of soil erosion, particularly on the lighter soils in the western part of the site.

The following construction activities will require disturbance of the soil:

- only topsoil stripping will be required in the location of the construction area, temporary welfare containers, customer substations, inverter substations. Where it is proposed that storage containers are placed on 'blocks' stripping of the topsoil will not be required.
- an access track for maintenance, some 4000m in length, extends across the central part of the site from west to east. The topsoil will be stripped from the line of the access track and a geotextile placed on top of the subsoil with compacted crushed stone to form the track.
- the access point at the western boundary of the site is of a concrete/asphalt construction. In this area stripping of the topsoil and subsoil will be required.
- where a trench is excavated for the cabling the topsoil and subsoil should be stripped to the required depth. The topsoil should be placed on one side of the trench and subsoil on the other. Once the cabling is in position the subsoil and then the topsoil should be reinstated as soon as possible in suitable conditions for soil handling. No soil storage is required.

The following points should be in place prior to the stripping of soil:

- the site layout should accommodate designated soil storage areas
- the volume of soil to be stripped and storage requirements calculated
- best practice is to use an excavator and dump truck to strip and move soil
- all machinery should operate and travel on subsoil or defined routes
- matting may be required on defined routes to contain and reduce soil compaction
- vegetation on the areas to be disturbed e.g. compounds, access road etc. should be cut short to less than 100mm as necessary, no more than 2 weeks before stripping
- a record of all soil placed in storage and a plan of the storage bunds should be maintained throughout the life of the solar farm
- the topsoil should be stripped to a depth of approximately 300mm to 330mm depending on the soil handling unit
- the site will be placed under a grass/clover mix prior to the construction phase

6 SOIL STORAGE

Topsoil from different soil units should be stored in separate soil bunds and placed on topsoil of a similar soil unit. A limited amount of subsoil will be stored in a separate soil bund built on subsoil.

Stored soils are expected to be in bunds for the life of solar farm. Any soil that is placed into stockpile is subject to consolidation and compaction as more soil is placed above, up to the maximum height of the bund.

The following points should be considered when planning soil storage to keep soil aerated, reduce erosion, runoff and ponding:

- the soil bund should be no higher than 3m for topsoil and 5m for subsoil
- the side slopes should be between 25° and 45°
- the bund should be shaped to shed water
- the bund should be located on dry level ground
- the bund should not disrupt any natural surface drainage
- the bund should be seeded with a suitable grass mix
- the bund should be treated for weeds
- grass on the bund should be cut at least twice a year

A record should be kept of soil placed into storage. Each bund should be identified by a marker post with the soil volume and soil unit recorded. The GPS location should be recorded for each storage bund and a plan maintained throughout the life of the solar farm.

7 TRAFFICKING

On any construction site there exists the risk of soil compaction from the use of heavy machinery and traversing land in unsuitable ground conditions. Soil compaction happens when soil is compressed. The soil structure is damaged when the soil is either traversed or handled when soil moisture conditions are unsuitable. This results in damage to the soil structure and a loss of soil porosity (the gaps through which water and air move in the soil).

It is essential to minimise the risk through appropriate site management of operations during the commissioning, operational and decommissioning phases. This will ensure that the risk of damage to the soil structure is managed and that the land is physically capable of reverting to arable production after decommissioning.

Much of the site is classified as having a medium resilience to structural soil damage and hence there exists the risk of soil compaction on the site. The western part of the site has a light textured soil with a high resilience to structural soil damage. An area of heavy clay loam soils in the central part of the site has low resilience to structural soil damage.

The management of trafficking on-site and traversing the land when the soil is in a suitable dry condition is key to managing the risk of soil compaction.

Where land is to be returned to agricultural use at the end of the solar farm life it is important that the risk of soil compaction and its management is considered as part of the pre-construction planning.

As a guide to planning operations it should be noted that the Field Capacity Day figure for the site is about 149 days (Appendix 3).

The term Field Capacity is a measure of the duration of climatic wetness when soils hold the maximum amount of water. In a normal year the soils are likely to return to Field Capacity in late November and remain at Field Capacity until late March. As a general guide planning of the construction works should take this into consideration and either avoid or undertake minimal traversing across the site and soil handling during the period late November to late March. An on-site inspection of the soil condition prior to any soil handling or trafficking is essential. Reference should be made to Section 4 ‘Soil Moisture Assessment’ in this report and a diary kept of daily conditions.

To manage risk the following best practice should be followed:

- use machinery, such as dump trucks fitted with tracks or low ground pressure tyres, to spread the weight of the machinery across the ground.
- all traffic should keep to defined routes across the site to contain the risk of soil compaction.
- all operations for stripping soil should be undertaken on subsoil.

8 DECOMMISSIONING

The Soil Management Plan will be reviewed and form part of the decommissioning phase. The purpose of the plan will be to:

- to ensure the protection and conservation of soil resources
- undertake best practice to maintain the physical properties of the soils
- provide on-site reference on the management of the soil resource for site operators undertaking the decommissioning works

In addition to the best practice guidance in sections 3, 4 and 7of this plan, the following points are relevant to the management of soil resources at the decommissioning phase:

- when solar farm infrastructure such as compounds, inverters etc and any ground coverings are removed the subsoil condition should be examined by digging a trial pit
- across the site trial pits should be dug to assess the soil profile for any compaction. If compaction is identified a programme of remediation works should be devised and undertaken
- where appropriate the subsoils may be loosened ideally with a subsoiler set up to the appropriate depth and spacing to alleviate compaction or with an excavator ripper attachment
- should there be deep compaction (>450mm depth) in the soil profile the use of specialist equipment should be considered
- the surface of the subsoil should be cleared of any debris and large stones
- grass on the soil bunds will be sprayed off 10 days before soil reinstatement
- examine the conditions of the soil under the bunds and take remedial action such as loosening if required
- where there have been compounds or fuelling points the subsoil should be sampled and a UKAS and MCERTS (or equivalent) laboratory analysis undertaken for metals, oils and Polycyclic Aromatic Hydrocarbons (PAHs)
- the decommissioning phase and reinstatement of soil should be monitored by a suitably qualified competent person. Records of operations should be kept with photographic evidence
- soil conditions for pile pull out should be dry and friable (to be reviewed as part of the decommissioning plan)
- any void left after pile pull out should be examined and may require in-filling with similar soil
- the condition of field drainage should be assessed and reviewed for any remedial action

9 SUMMARY

The purpose of the Soil Management Plan (SMP) is to ensure protection and conservation of the soil resources on the Best and Most Versatile Agricultural Land. The aim is to ensure that the land is physically capable of reverting to arable production at the end of the life of the solar farm.

There will be stripping and storage of topsoil in limited areas. The only subsoil stripping in addition to the topsoil will occur at the access on the western side of the site.

There are three soil units identified on the site, which indicate the level of resilience to soil structural damage. Where required soils in each unit should be stored in separate bunds. As part of managing the risk of soil compaction an assessment of the soil moisture condition on a daily basis is required to ensure that the soil is either handled or traversed in a suitable condition. The soil moisture assessment is required in the commissioning, operational and decommissioning phases of the solar farm, whenever the land is being traversed or soil is being moved to and from storage bunds.

The Soil Management Plan should be reviewed prior to the start of the decommissioning phase.

APPENDIX 1 SOIL UNIT DESCRIPTIONS

Soil Handling Unit A (green)

These soils have either a loamy sand or sandy loam topsoil overlying a well-drained and weakly structured loamy medium sand or medium sand upper subsoil and medium sand lower subsoil. The topsoil and upper subsoil are very slightly stony (0-5%), with small, rounded stones. The lower subsoil is stoneless.

The light textured soils have a high resilience to structural damage during soil handling.

Soils in Unit A are found in the western part of the site, where the land is undulating. There is a risk of water-induced erosion on the weakly structured soils, which will require careful management to minimise the risk of erosion. Planning of site operations should be undertaken to minimise the land having bare soil or sparse crop cover.

An example soil profile is described below:

0-35 cm	Reddish brown (5YR4/4) loamy medium sand; very slightly stony (0-5%), with a few small, rounded stones; weakly developed fine granular structure; very friable; common fine fibrous roots.
35-50 cm	Dark red (2.5YR 3/6) medium sand; stoneless; loose structure; very friable; very few fine fibrous roots;
50-120 cm	Dark red (2.5YR 3/6) medium sand; stoneless; loose structure; very friable.

These soils are well drained and belong to Wetness Class I.

Soil Handling Unit B (orange)

This soil unit covers much of the site and the topsoil has a medium resilience to structural damage during soil handling. The clay subsoil in this unit has a low resilience to structural damage, so assessment of the soil moisture must be undertaken prior to any trafficking or disturbance of the subsoil.

These soils have a fine loamy topsoil overlying gleyed, poorly structured, slowly permeable clayey upper subsoil and lower subsoil. The topsoil is very slightly (0-5%) stony, with a few small, rounded stones. The upper and lower subsoil is very slightly (0-5%) stony.

An example soil profile is described below:

0-38 cm	Brown (7.5YR4/4) sandy clay loam; very slightly stony (0-5%) with small, rounded stone; weakly developed medium subangular blocky structure; friable; common fibrous roots;
38-50 cm	Reddish brown (5YR5/3) clay with common faint strong brown (7.5YR 5/8) mottles and light reddish brown ped faces (5YR6/3); stoneless; weakly developed coarse angular blocky structure; firm; few roots fine; <0.5% macropores;
50-80+ cm	Reddish brown (5YR5/3) clay with common faint strong brown (7.5YR 5/8) mottles; stoneless; weakly developed coarse angular blocky structure; firm; few roots fine; <0.5% macropores; (augered below 50cm).

These soils have impeded drainage and belong to either Wetness II, III or IV depending on the depth to the slowly permeable layer in the profile. They have a low capacity to absorb excess winter rainfall.

Soil Handling Unit C (red)

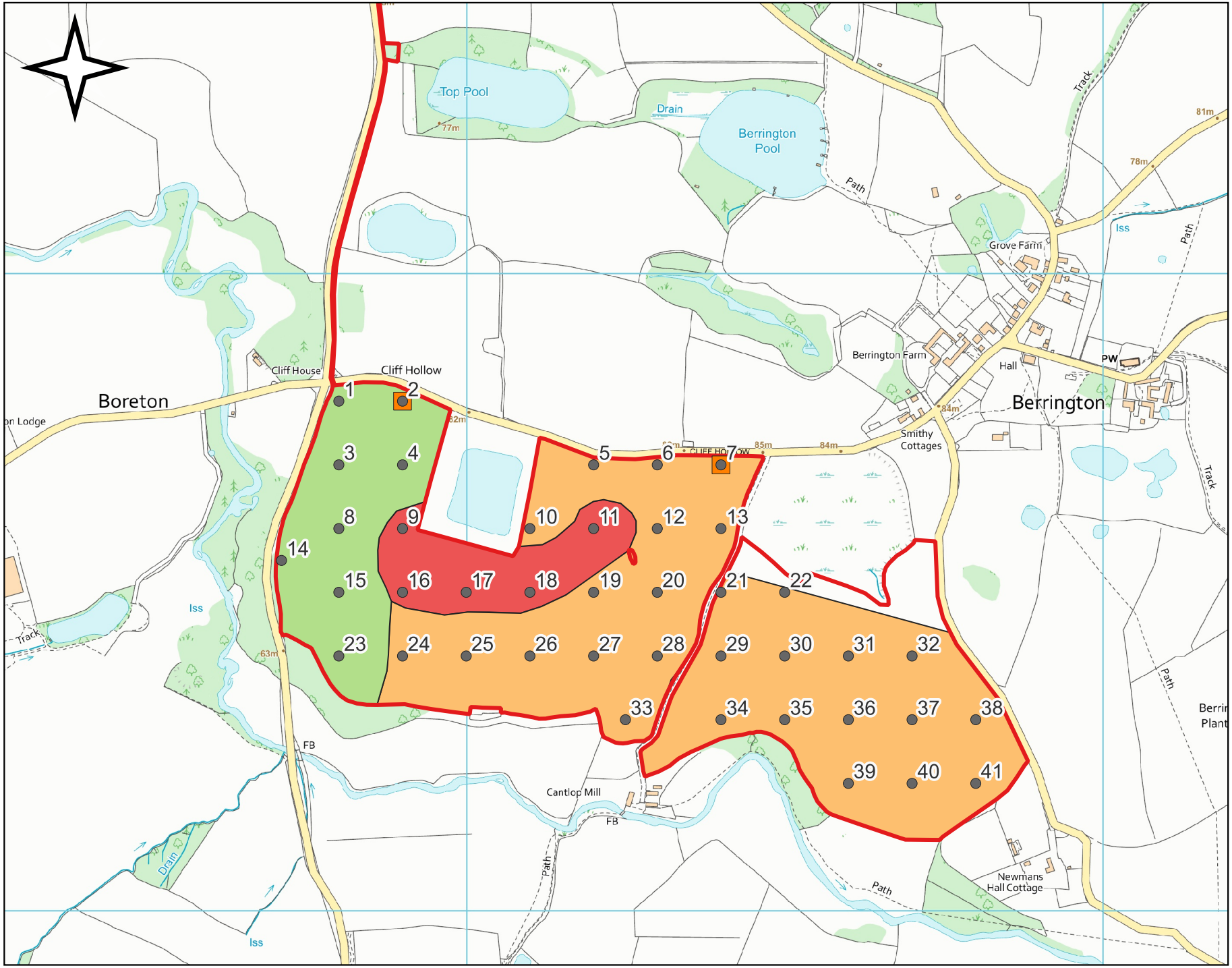
This soil unit covers a limited part of the site. The topsoil has a heavy clay loam texture and low resilience to structural damage during soil handling.

A typical profile in this soil unit is described as:

0-38 cm	Reddish brown (5YR4/4) heavy clay loam; very slightly stony (0-5%) with small, rounded stone
38-50 cm	Dark reddish brown (5YR3/4) clay with common faint strong brown (7.5YR 5/8) mottles stoneless; weakly developed coarse angular blocky structure; firm; few roots fine; <0.5% macropores;
50-100+ cm	Dark reddish brown (5YR3/4) clay with common faint strong brown (7.5YR 5/8) mottles

APPENDIX 2 SOIL HANDLING UNITS PLAN

(See following page)



Contains OS data © Crown Copyright, OS VectorMap™ Local Raster, Updated: February 2022

Title

Appendix 2
Soil Handling Units Plan

Project

Land South of Cliff Hollow, Shrewsbury, Shropshire, SY5 6HA - SRMP

Client

ecOnergy
Powering renewables.

- Augers
- Pits
- Survey Area
- Unit A
- Unit B
- Unit C

Date: 08 / 06 / 2022

ADAS

www.adas.uk

APPENDIX 3 AGRO-CLIMATIC VARIABLES

Table A: Agro-climatic variables

(Grid reference SJ523 065 altitude 88m)

Average Annual Rainfall (AAR)	688 mm
January-June Accumulated Temperature (AT0)	1394 day °C
Field Capacity Days (FCD)	149
Field Capacity Period	late November-late March
Moisture Deficit Wheat (MDW)	98 mm
Moisture Deficit Potatoes (MWP)	87 mm
Climate (upper grade limit)	1