SOIL RESOURCES AND MANAGEMENT

KELHAM SOLAR FARM

Report 1909/3

3rd May 2024

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1.0 Introduction

1.1 This report provides information on soil management of land near Kelham, Nottinghamshire proposed as the site of a solar and battery installation. The report is based on a previous detailed soils and Agricultural Land Classification survey undertaken in November 2021 by Land Research Associates Limited (document reference 1909/1).

SITE ENVIRONMENT

1.2 The total site area comprises approximately 66 ha of land, comprising large arable fields, bordered to the south-east by the A617, to the north-east by woodland, and on other sides by adjoining agricultural land. The land has been investigated to determine soil types, to inform a site-specific soil management plan for solar and battery park construction.

1.3 This management plan details measures and working practices to prevent damage to soil resources which may cause adverse effects during and after the lifetime of a solar and battery installation. The report covers:

- Soil resource types
- Machinery access timings (safe working conditions)
- Soil handling methods and work practices
- Remedial measures

2.0 Soils

2.1 A detailed soils investigation was carried out in November 2021. It was based on observations at intersects of a 100 m grid, giving a survey density of one observation per hectare. During the survey, soils were examined by augerings and hand-dug pits.

2.2 The survey found the soils to vary in drainage and composition, as described below. The distribution of soil types is shown by Map 1 in an appendix to this report.

COARSE LOAMY SOILS OVER GRAVEL

2.1 These soils occur across the central and southern parts of the site and comprise sandy loam topsoils and upper subsoils, which often grade to sand and gravel deposits at depth. These soils are naturally affected by shallow groundwater, but significant wetness is unlikely given the intensive agricultural management that controls water levels effectively in these permeable soils.

MEDIUM LOAMS WITH SLIGHT WETNESS

2.2 These soils mostly occupy northern parts of the site and comprise sandy clay loam topsoils and subsoils. The soils are permeable and as with the soils above, serious waterlogging is unlikely for significant periods. However, the higher topsoil clay content means there are likely to be wet periods in winter when the soils are susceptible to compaction and handling damage.

HEAVY WET SOILS

2.3 These soils occur over limited areas in the west and south-east. They comprise fine loamy topsoils that often directly overlie dense clay. The subsoils indicate waterlogging to shallow depth, and it is unlikely that wetness issues will be effectively controlled by agricultural drainage. Care needs to be taken when accessing and handling with machinery, particularly in winter and spring.

3.0 Timing of construction land access

3.1. The local area has low annual rainfall (*c*. 570 mm average) and this means that the soils are at field capacity or above for a relatively short period of the year, typically around four months, from early winter until mid-spring. However, the following soil-specific advice will ensure significant compaction does not occur:

COARSE LOAMY SOILS OVER GRAVEL

3.2. These soils have a low clay content and are of low susceptibility to damage by handling when wet. However, heavy machinery can still cause compaction when soils are very wet following rainfall. These soils can be safely trafficked at all times of year, as long as heavy machinery traffic is avoided during significant rainfall[1] and for the 24 hours following periods of heavy rainfall.

MEDIUM LOAMY SOILS

3.3. These soils have moderately high topsoil clay content, which makes them somewhat susceptible to compaction damage when wet. However, they are unlikely to be seriously waterlogged for long periods other than in late winter and early spring. Damage can be prevented by avoiding soil stripping and trenching during heavy rain and in the 48 hours following significant rainfall (at all times of year), or during any unusually wet winter periods when there is evidence of standing water.

HEAVY WET SOILS

3.4. These soils have high topsoil clay content and therefore are likely to be significant periods in winter and early spring when they are waterlogged and at risk of surface compaction damage, as well as during wet periods at other times of year. The programme of works should take into account these restrictions to ground works and heavy machinery traffic, and schedule activities on these soils according to the likely suitability of ground conditions. In particular, it should be used to limit excavation and heavy traffic in these areas during unsuitable periods as follows:

- Soil stripping/trenching should be avoided where possible before April or after the end of November. It is recommended that land not be accessed with heavy machinery for a minimum of twenty four hours following significant rainfall at

[1] For the purposes of this management plan, significant rainfall is defined as more than 10 mm within a 24 hour period. This figure should be treated as a guide rather than prescriptive

other times, and best avoided for two days as far as possible

- Although the programme of works will reflect the restrictions in access caused by wet ground conditions outlined above, some light works may be necessary outside of the safe working periods in order to meet project scheduling and other environmental restrictions. In order to ensure that these necessary works do not cause significant soil damage, the nature of permissible works should be restricted to the activities described in Table 3.1

Table 3.1: Winter activities

Activity	Mitigation
Delivery of components	Only to work on and from previously installed access tracks and hard standings.

3.5. Serious compaction damage is not anticipated as a result of these activities. Should minor damage occur, review and remediation should be conducted as stated in Section 6 of this report.

4.0 General soil management principles

4.1 The main potential impacts of solar and battery installation on long-term agricultural potential include:

- Loss of land to permanent construction features which cannot be removed
- Compaction damage caused by inappropriate construction methods and timing

4.2 All operations are to be undertaken strictly in accordance with the methodology described within this document and the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites, DEFRA (2009).

4.3 Soil quality can be impaired by incorrect handling, separation, storage and replacement. Particular problems arise from:

- Handling soils at inappropriate moisture content
- Inappropriate use of machinery
- Incorrect topsoil stripping depth resulting in dilution with underlying subsoil
- Poor storage separation resulting in mixing
- Excess stockpile height leading to compaction damage, runoff and erosion

4.4 The ease of soil handling is affected by soil type. Heavy soils such as those in parts of this site are difficult to handle when wet without causing structural damage.

SOIL STRIPPING

4.5 All soil handling to be limited to dry conditions, and for *heavy wet soils* limited to the period between April and November where possible.

4.6 Whether soils are at an appropriate moisture content for handling to be checked by a simple 'plasticity test': this involves testing whether a 3 mm thick thread can be rolled in the palm of the hand. If it **cannot**, the material is suitable for handling.

4.7 Stripping should only take place using an excavator as described by Sheet 1 in the MAFF Good Practice Guide for Handling Soils[2].

4.8 Topsoil and subsoil resources should be stripped and stored separately in low bunds

[2] MAFF Good Practice Guide for Handling Soils, (www.defra.gov.uk/farm/environment/land-use/soilguid/)

(less than 4 m in height), avoiding over-compaction.

4.9 Topsoil should be stripped carefully to avoid dilution with subsoil, the average topsoil depth at the site is 300 mm. In most places there is a distinct colour difference between topsoil and subsoil that should aid accurate stripping.

4.10 The following stages should be followed to ensure that suitable conditions exist and that damage to soils is minimised:

- **Machinery operation:** a tracked hydraulic excavator should be used to load topsoil and subsoil. The soils should be stripped, stockpiled, removed from storage (Sheet 3 in the MAFF Good Practice Guide) and replaced by tracked hydraulic excavator using the loose tipping technique (Sheet 4 in MAFF Good Practice Guide), with only gentle firming by tracked vehicles. Stockpiles should be less than 4 m in height
- **Rainfall during operations:** during rainfall and soon after it ceases there will always be surplus of water in the surface layers of soil. If earthmoving continues the surface layer could become compacted, ruts could be formed and any further rain will lie on the surface and tend to drain away far more slowly than previously. Conditions will then tend to deteriorate further during earthmoving with consequential damage to soils. Consequently, soil stripping should be suspended during significant rainfall. After rainfall, the wetness of the soil should be checked (by the earthworks contractor) before recommencing mechanised soil handling.

CONSTRUCTION TRAFFIC MANAGEMENT

4.11 All plant movement/work should be undertaken from access tracks or temporary matting to prevent soil compaction.

5.0 Specific construction activities

SOLAR ARRAY CONSTRUCTION

Roadway/access track construction

5.1. Topsoil should be stripped from tracked construction areas using the excavator/dumper truck method which avoids traffic on stripped surfaces (as described in the Construction Code of Practice for the Sustainable use of Soils on Construction Sites) to a standard depth of 300 mm in accordance with the average findings of the soils and land quality report (1909/1).

5.2. Long-term storage bunds should be sown to a grassland seed mix and kept weed free by cutting, to ensure topsoil is maintained in good condition for restoration.

5.3. Temporary access tracks should be surfaced with imported aggregate, underlain by geotextile matting to ensure the aggregate can be fully removed during decommissioning.

Preparation of hard standings for construction compound

5.4. Topsoil should be stripped from the temporary parking/offloading area using the excavator/dump truck method (as described in the Construction Code of Practice for the Sustainable use of Soils on Construction Sites) to a standard depth of 300 mm. Stripped topsoil should be placed in a temporary stockpile bund up to 4 m high for reuse.

5.5. The area should be surfaced with imported aggregate, underlain by geotextile matting to ensure the aggregate can be fully removed during decommissioning.

Battery storage unit

5.6. The installation would involve topsoil removal and emplacement of a crushed stone base, into which concrete support plinths for the battery modules will be set. Topsoil should be stripped from the battery storage unit (BESS) and substations using the excavator/dump truck method to a standard depth of 300 mm. Stripped topsoil should be placed in a stockpile bund up to 4 m high for potential reuse.

5.7. The area should be underlain with a geotextile matt surfaced with imported aggregate/gravel to ensure all foreign material can be removed during decommissioning.

New substation

5.8. The installed substation equipment will be placed on concrete cast on site. Surrounding compound areas will be formed from crushed gravel. Topsoil should be stripped from the entire area using the excavator/dump truck method to a standard depth of 300 mm. Stripped topsoil should be placed in a stockpile bund up to 4 m high for potential reuse.

5.9. It is considered that this small part of the development could not be viewed as reversible (i.e. it could not be returned to agricultural field use); it is recommended that on decommissioning this area be retained as hard standing, which could be put to practical use for machinery, crop or waste storage.

Archaeological protection areas under panels

5.10. Topsoil from stripped areas of the site to be laid in areas of archaeological importance, to raise the topsoil thickness by 400 mm. Concrete plinths that the panels will sit on should be installed on geogrid matting to prevent adherence of topsoil material to plinth upon decommissioning.

Seeding to grass

5.11. This would typically be undertaken prior to panel installation, ideally in the prior autumn to allow for establishment.

Installation of buried cables (usually limited)

5.12. Cables installed at depth would not interfere with farm operations and could be left in situ. The vast majority of cabling will be above-ground (contained within the panel frame support racking).

Erection of piling/posts for panel frames

5.13. This would typically be undertaken with light piling plant.

Delivery and emplacement of pre-fabricated panels and substations

5.14. This equipment should be delivered via roadways and matting to be unloaded ready for installation.

Erection of security fencing and other security equipment

5.15. Fence post piling and security monitoring equipment to be installed using standard light plant equipment.

SITE DECOMMISSIONING

5.16. The construction methods outlined in the previous sections will ensure that all solar array areas can be effectively restored to agricultural use, with no change in the agricultural capability (ALC grade) of the land. It is proposed that a decommissioning plan should be submitted for local authority/Natural England approval prior to deconstruction work.

6.0 Remediative measures

INTRODUCTION

6.1. Remediation should not be necessary if the management plan detail is adhered to. However, should surface water problems be identified by operators in the seasons following cable installation, it is important that the causes are correctly identified.

SOIL COMPACTION

6.2. Compaction damage following soil reinstatement may be evidenced by standing water at the land surface, or by poor grass growth, resulting either from soil waterlogging or drought stress due to inhibited rooting depth.

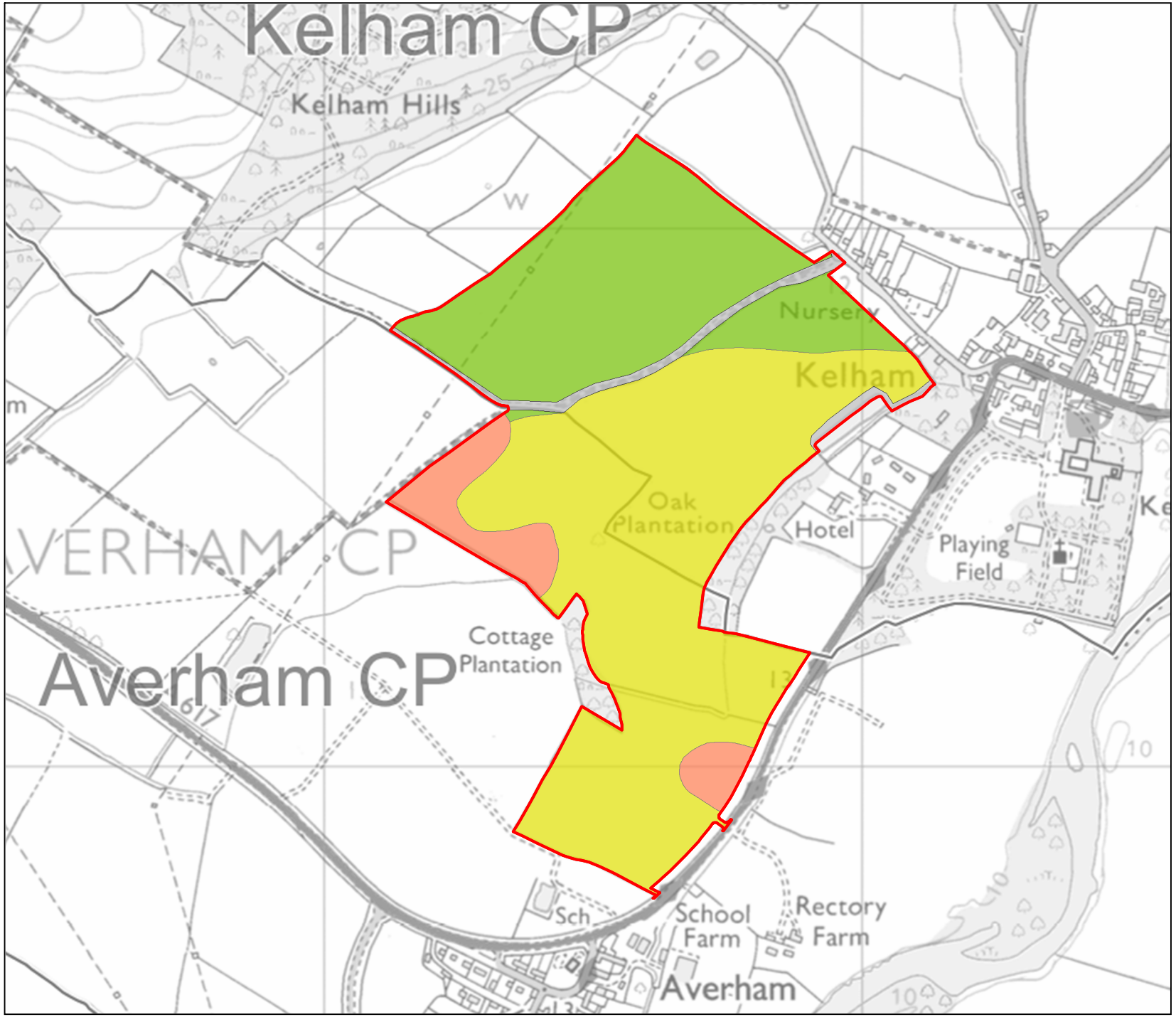
6.3. Existence of over-compacted layers should be initially assessed by inspection of shallow pits. This is particularly important in establishing cause with reference to damage to drainage systems as described below.

6.4. Topsoil compaction can be removed relatively easily by cultivation (ploughing) and reseeding. This should be done under dry conditions in spring or early autumn.

6.5. Where compacted subsoil layers are observed, they should be loosened/ripped using commercial subsoiling equipment. Grassland subsoilers (which minimise vegetation disturbance) are also commercially available.

APPENDIX

SOIL TYPES MAP



KEY

- Coarse loamy soils over gravel (Access year round or 24 after heavy rainfall)
- Medium loamy soils (Dry access year round or 48 hours after rainfall)
- Heavy wet soils (Access April - November and 48 hours after heavy rainfall)
- No soil resources
- Site boundary

Site:

Kelham

Map title:

MAP 1
Soil types

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Date: 27/03/2024

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