14. SOIL RESOURCE ASSESSMENT

The following Technical Appendices referred to in this Chapter can be found at Appendix 9.

Appendices

Appendix 9.1: Location of Soil Auger Borings, Profile Pits and Topsoil Samples

Appendix 9.2: Distribution of Soil Types

Appendix 9.3: Photo Inventory

Appendix 9.4: Proposed Restoration Plan

Appendix 9.5: Description of Soil Auger Borings

Appendix 9.6: Soil Profile Pit Descriptions

Appendix 9.7: Soil Analysis Results

Appendix 9.8: Flood Risk Sensitivity

Appendix 9.9: Natural England Consultation and Post 1988 ALC Surveys

Appendix 9.10: Footpaths MAGIC 2022

Appendix 9.11: Strategic Land Availability Assessment: Eastleigh Borough Council

Appendix 9.12: Site Phasing Plans

14.1 Introduction

Background

14.1.1 This chapter of the Environmental Statement (ES considers the impact of the Proposal (hereafter referred to as the 'Study Area') on soil resources. It has been prepared by David Royle of Land Drainage Consultancy Ltd.

The Proposal

14.1.2 Chapter 2 of the Environmental Statement describes the Proposal in detail.

Potential Impacts

14.1.3 The primary impacts considered in this chapter are those affecting the soil resource including the risk of soil losses and a potential for deterioration in soil physical, chemical or biological quality that might impact on the subsequent re-use of the soil in site re-instatement.

Scope of Assessment

14.1.4 The scope of this assessment is limited to soil quality and soil resource conservation issues.

Objectives

14.1.5 The objectives of this chapter are to:

- Review and comment on current strategic policy and planning issues in respect of the Proposal.
- Assess the current land use
- Provide a baseline assessment of soil resources across the Study Area.
- Assess the likely significant effects of the Proposal on the soil resource and agricultural land quality.
- Provide recommendations to mitigate likely significant effects of the Proposal through an appropriate soil stripping, storage and re-instatement plan.

14.1.6 The following Figures are included in this Chapter:

- Figure 14.1: Published Soils Information within the Study Area

14.1.7 The following Tables are included in this Chapter:

- Table 14.1: Sensitivity of Receptor
- Table 14.2: Magnitude of Impact on the Soil Resource
- Table 14.3: Significance and Nature of Effects on the Soil Resource
- Table 14.4: Proposed Restoration Land Use
- Table 14.5: Field Testing of Soil Moisture
- Table 14.6: Field Testing of Consistency
- Table 14.7: Topsoil Stripping within the Study Area
- Table 14.8: Subsoil Stripping within the Study Area

14.2 Study Area

14.2.1 The location and extent of the Study Area together with the red line planning boundary is shown on the plans at Appendix 9.1-9.2. The site is described in Chapter 2 of the ES and in the planning statement.

14.2.2 The Study Area extends to 60.04 ha and is centred over OS National Grid Reference (NGR) SU47710770. It is bounded to the North by a railway line, Satchell Lane to the east, Hamble Lane to the west and a residential housing estate and playing field to the south.

14.3 Assessment Methodology

Previous Assessments

14.3.1 A review of DEFRA's MAGIC website, shown at Appendix 9.9, indicates that Natural England conducted a reconnaissance Agricultural Land Classification (ALC) survey across the Study Area in 1995. This mapped land quality in the Study Area, using information from 11 soil auger borings, as excellent quality Grade 1, with a mixture of Grade 2, subgrade 3a and subgrade 3b to the east and northern extents.

Legislation and Planning Policy

National

14.3.2 The National Planning Policy Framework (NPPF) includes policy guidance on 'Conserving and Enhancing the Natural Environment' (Section 15). Paragraphs 170a/b/e are of relevance to this assessment and outline the importance of protecting and enhancing the natural landscape and soils together with considering the economic and other benefits of impacts on the best and most versatile (BMV) agricultural land.

14.3.3 Planning Practice Guidance provides advice on the planning issues associated specifically with the development of mineral sites. This guidance reiterates the Government's commitment to the minerals industry and at para 143 states that in preparing Local Plans, Local planning authorities should…. *'put in place policies to ensure worked land is reclaimed at the earliest opportunity and… that high-quality restoration and aftercare of mineral sites takes place, including for agriculture (safeguarding the long-term potential of best and most versatile Agricultural land and conserving soil resources).*

14.3.4 The local policies relevant to the Study Area are those set out in the 2013 Hampshire Minerals and Waste Local Plan: Policy 8.

'Policy 8: Protection of soils' outline that any development proposed on BMW land agricultural land will be required to return the site to at least its previous agricultural land condition, if not improved, unless it can be demonstrated that alternative after-uses outweigh this need. It goes on to state that

- *"Soils displaced from mineral developments must be adequately protected and maintained throughout the life of the development"*

- *"Supply a restoration plan and suitable mitigation measures or indicate positive impacts where development is proposed"*

- *"Topsoil and subsoil should be carefully removed and stored separately during preparation and working of a site, and particular attention given to protecting important seed banks. The integrity and safety of land and soil should also be protected during working and long-term use of the site once it is restored. Without the appropriate use of soils, successful restoration schemes will be impossible to achieve", and*

- *"Where it is proposed to compensate for the loss of best and most versatile agricultural land by upgrading the agricultural value of land at a different site, it must be robustly demonstrated that "the compensatory land will be upgraded to at least as high an agricultural value as the site which was lost."*

Minerals Policy and Guidance

14.3.5 Overarching international and national policy is supported by UK minerals policy statements and good practice guidance. The following are relevant at the Study Area:

- Institute of Quarrying, 'Good Practice Guide for Handling Soils in Mineral Workings', July 2021
- MPS1, a 'Practice Guide' (Department for Communities and Local Government, 2006,
- 'Guidance for Successful Restoration of Mineral and Waste Sites' (Defra 2004),
- MPG7 'The Reclamation of Mineral Workings' (Department of the Environment, 1996),
- Code of Good Agricultural Practice for the Protection of Soil, MAFF 1998,
- Protecting our Water Soil and Air, Defra, 2009,
- Safeguarding our Soils, A Strategy for England, Defra, 2009,
- 'Code of Practice for the Sustainable Management of Soils on Construction Sites' Defra, 2009,
- Agricultural Land Classification: protecting the best and most versatile land, TIN049, Defra, 2011,
- The Sludge (Use in Agriculture) Regulations (As amended), DoE, 1989, and

- Contaminated Land Exposure Assessment (as amended), Environment Agency, 2010.

Consultations

14.3.6 A planning application has been submitted for the Proposal and a consultation response received, by the Applicant, from Natural England on 3rd March 2022 (Reference 381357). This consultation is shown at Appendix 9.9 and this Chapter seeks to address the concerns raised therein by Natural England.

Desk survey

14.3.7 Prior to field survey a desk study was undertaken and included an examination of:

- Ordnance Survey 1:10,000 mapping,
- Agroclimatic datasets from the UK Met Office (1940-1988),
- Soil Survey 1:250,000, Sheet 3 Midland and Western England,
- Cranfield's LANDIS website,
- ALC data, both provisional and detailed, published on Defra's MAGIC website,
- British Geological Survey (BGS) Website (1:50,000 mapping),
- Aerial photographs reference from Google Earth, and
- Flood risk information from the gov.uk flood risk planning website.

Field survey

14.3.8 Soils across the Study Area were examined using a hand-held Dutch auger and spade to a maximum depth of 1.20m. A total of 59 auger borings were made at approximately 100m centres, at points predetermined using the OS National Grid, within the site which were locally offset due to vegetation/access constraints. Information on topsoil and subsoil depth, texture, stone content and drainage characteristics were collected at each point. A small hand dug profile pit was excavated in each soil type to provide detailed information on soil profile characteristics.

14.3.9 Field observations were made according to the Soil Survey Field Handbook, Technical Monograph No 5, Harpenden, 1974.

14.3.10 Field survey works were completed in April 2022 and remain current for this Chapter.

Soil sampling and analysis

14.3.11 Topsoil samples were collected to a depth of 200mm from the fields within the Study Area in accordance with the sampling procedures outlined in Defra's RB209 (The Nutrient Management Guide, 2022)). Samples were taken from proposed working phases and tested to provide more detail on topsoil texture (particle size distribution and stone content), organic matter levels and pH status, which are important factors in assessing ALC. The samples were also tested for available phosphorus, potassium and magnesium to determine their nutritional status. A screening suite of Potentially Toxic Elements (PTE's) was also completed to include Total Copper (Cu), Nickel (Ni), Zinc (Zn), Cadmium (Cd), Chromium (Cr), Lead (Pb) and Mercury (Hg).

Testing laboratory

14.3.12 Soil samples were analysed at a suitably accredited laboratory (NRM Ltd). NRM Ltd are UKAS accredited for soil, sludge and sediment analyses and participate in numerous proficiency testing schemes including CONTEST (contaminated land soils and leachates), MCERTS, Aquacheck (waters, soils and sludges), FAPAS (nitrate in leafy vegetables) and WEPAL (nutrients in agricultural soils).

Impact assessment

14.3.13 There are no published guidelines or recommended criteria for assessing likely significant effects on soils within the context of an ES. Criteria have therefore been derived using current guidance, professional judgement and experience. These criteria have been adopted in other assessments which have been agreed and accepted as best practice in similar schemes.

14.3.14 The baseline data have been used to assess the likely significant effects of the Proposal using the method described below.

Sensitivity of receptors

14.3.15 Sensitivity criteria for the soil resource within the Study Area are described in Table 14.

Table 14.1: Sensitivity of Receptor	
Receptor	**Sensitivity**
Excellent quality soils	High

Very good and good quality soils	Medium
Low or moderate quality soils	Low
Poor quality land and soils	Negligible

Determining the magnitude of impacts

14.3.16 Criteria used for the magnitude of impacts on the soil resource are shown in Table 14.2. These have been based on a reference value of the loss of 20 ha of excellent, very good and/or good quality soils, derived from Natural England Technical Information Note TIN049. In the absence of recommended published guidance, remaining criteria use professional experience using guidance in codes of good agricultural and construction practice.

Determining the nature of significant effects

14.3.17 Table 14.3 provides a significance matrix for identified impacts in assessing the sensitivity of the soil receptors on site and the magnitude of change relative to the baseline.

Table 14.2: Magnitude of Impact on the Soil Resource

Magnitude	Description
Very High	Permanent loss or irreversible impacts on >20ha of high-quality soil resources caused by handling, storage and re-instatement.
High	Long term (>10 years) temporary reversible impacts on >20ha of high-quality soil resource/quality caused by handling, storage and re-instatement.
Medium	Medium term (5-10 years) temporary reversible impacts on <20ha of soil resource caused by handling, storage and re-instatement.
Low	Short term (<5 years) temporary reversible damage to <20 ha of soil resource/quality caused by handling, storage and re-instatement.
Negligible	Land retained in agricultural production for the duration of site work.

14.3.18 Impacts identified as moderate or major are considered to result in likely significant effects on the receptor.

Table 14.3. Significance and Nature of Effects on the Soil Resource

Sensitivity	Magnitude of impact				
	Very high	High	Medium	Low	Negligible
High	Major	Major	Moderate	Minor	Negligible
Medium	Major	Moderate	Moderate	Minor	Negligible

Low	Moderate	Minor	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible	Negligible

Definitions	
Major:	A large change in land quality and the soil resource is expected to occur which will be of national or regional importance
Moderate:	A medium to large change in land quality and the soil resource with regional significance
Minor:	Small changes in land quality and the soil resource at a local scale
Negligible:	Very small effects on agricultural land quality and the soil resource at a site scale

Impact description

14.3.19 Impacts can be described as beneficial or adverse and, with no discernible change, as neutral.

Mitigation

14.3.20 Mitigation usually takes the form of management controls implemented by the Applicant which are designed to remove or reduce the scale of likely significant effects impacts identified in Table 14.3.

14.4 Baseline Environment

Location

14.4.1 The location and extent of the site is described in detail in the planning statement, at 14.2.2, in Chapter 1 of this ES, and on the plans at Appendices 9.1-9.2.

Land Use

14.4.2 The Proposal will impact a single enclosure extending to 60.04 ha. Natural England's consultation response of 3rd March 2022 recommended that the Study Area requires an Agricultural Land Classification and Soil Resource Assessment to be completed by the Applicant. The consultation outlines that a post 1988 ALC survey was available for the site which was completed at a reconnaissance level by the ADAS Resource Planning Team at ADAS Guildford in 1994 (Reference 1503/244/94) shown at Appendix 9.9. On the basis of this report, Natural England concluded that the land was in agricultural use and likely to be of Best and Most Versatile quality.

14.4.3 Historically, the Study Area formed part of the Hamble Airfield which was established in 1912 https://www.hampshireairfields.co.uk/airfields/ham.html. The Study Area (Area F) became operational in 1926 and is understood to have included grass airstrips used for testing and maintenance of aircraft together with pilot training and dispatch of completed aircraft. The land remained within the curtilage of the airfield until around 1986 after which it was purchased by Persimmon Homes. It is understood that the Study Area has since remained in an unmanaged and extensive use, as described below.

14.4.4 At the time of survey (April 2022), the Study Area consisted of unmanaged scrub/amenity grassland used for recreation, informal public open space and conservation habitat. The Study Area has the following characteristics:

- No evidence of recent agricultural activities such as cultivations, cutting, grazing, fencing, vegetation management or general maintenance normally associated with either grassland or arable use,
- An absence of internal field boundaries
- No formal agricultural field system or enclosures,
- No management of external field boundaries or vegetation,

- A remnant MOD fence in poor repair to all sides with significant public access being made from the urban fringe,
- No evidence of water supplies,
- No watercourses or evidence of modern drainage systems,
- Localised grazing by transient and tethered horses/ponies,
- A labyrinth (several km) of informal footpaths used recreationally for walking and dog exercise (Appendix 9.10),
- Approximately 40 ha to the west of the Study Area was occupied by bramble, gorse, scrub and broadleaved weeds with dense, inaccessible thickets up to 3m in height (shown at Appendix 9.3 and 9.10)
- Remaining land is extensive grass with extremely limited agricultural potential
- pH and nutrient levels that do not reflect agricultural inputs of lime, fertiliser or manure for many year's (Appendix 9.7).

14.4.5 Photographs have been taken (Appendix 9.3) to demonstrate the current land use within the Study Area.

14.4.6 The current owner has not been in receipt of formal basic farm payment, conservation or agri-environment grants since the land was purchased in the 1990's. LDC have contacted the Rural Payment Agency to confirm this, but have not yet received a response.

14.4.7 In their strategic land availability assessment of 2016 (Appendix 9.11), Eastleigh Borough Council concluded that this area of land was non-agricultural.

14.4.8 From the above, LDC conclude that this site has been undergoing reversion from the previous airfield/grassland use to extensive scrub and amenity grassland over a period of at least 25-30 years, and probably longer. To bring this land into agricultural use will require significant intervention in terms of vegetation clearance and management, weed control, land drainage, agricultural inputs of fertiliser/manure, fencing, access and water supply that are economically and logistically impractical. The land is severely constrained in its agricultural potential and LDC conclude that the land within the survey area and, for the above reasons, should be designated as non-agricultural.

14.4.9 Land quality assessments are usually made using the method described in ***"Revised***

Guidelines and Criteria for Grading the Quality of Agricultural Land" (ALC, MAFF 1988). This system grades agricultural land according to physical characteristics that impose long term limitations on agricultural use and cropping flexibility. It also relies on a key assumption that the land being assessed is both agricultural and has been subject to, or is capable, of a good level of agricultural management. This site has not been in in agricultural management for at least 25-30 years, and this period is likely to extend to airfield creation in the early 20th Century. The site has, and continues to be, severely constrained for current and future agricultural use.

14.4.10 Despite the above conclusion with respect to land use, the soils within the Study Area have an intrinsic value and quality which supports Natural England's recommendation that soil resources be fully considered within the ES.

Climate and Relief

14.4.11 This area has a mean annual rainfall of 795mm. The average Accumulated Temperature Above 0°C (ATO) between January and June is 1,532 day°C, which indicates a moderately long and mild growing season. The land is typically at field capacity, (when the land is wet and field drains would be expected to flow), for 162 days (i.e. 5 months) in a normal year

14.4.12 Relief is relatively flat to gently undulated with a slight fall from 22m AOD in the north and west to 11m AOD in the southeast. There are no gradients in excess of 2-3°.

Geology

14.4.13 Solid geology has been mapped by the British Geological Survey (BGS, 1:50,000 maps) as the Marsh Farm and Selsey Sand Formation. These are a sedimentary sand, silt and clay bedrock formed between 41 and 48 million years ago in the Paleogene Period. Bedrock was not encountered within 1.20m depth in any of the auger borings undertaken.

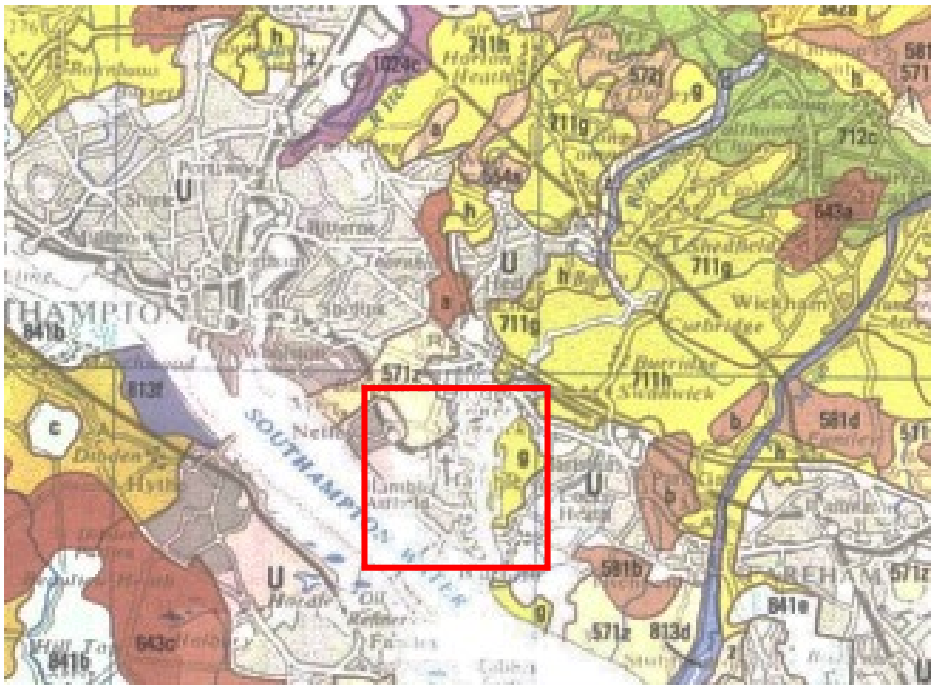
14.4.14 BGS maps show the Study Area has been overlain by superficial deposits of sand and gravel river terrace deposits, formed up to 3 million years ago in the Quaternary Period.

Published Soils Information

14.4.15 Figure 14.1 shows that due to the historic use as an airfield, soils within the Study Area have been mapped as unsurveyed (Soil Survey of England and Wales, Sheet 6, South

East England). To the west of the Study Area, soils are mapped as the Hamble 2 Association. These tend to be deep, well-drained and stoneless silty soils, overlying river terrace or raised sand and gravels, with some locally calcareous subsoils and are often groundwater affected.

Figure 14.1. Published Soils Information within the Study Area



Legend	Soil Association	Typical description
571z	**Hamble 2**	Well-drained deep stoneless, silt derived soils overlaying gravels locally.
U	**Unsurveyed**	Unsurveyed, mainly industrial, urban and non-agricultural areas.

Source: 1:250,000 Soil Survey of England and Wales, Sheet 6: Southeast England

Soil Description

14.4.16 Soils within the Study Area have been mapped by the LDC survey according to the soil classification for England and Wales, fully described by Avery (1980) and Clayden and Hollis (1984). This is a general-purpose classification that group's soils that behave in a similar way in response to normal management practices. A group of soils, or Soil Association, has a limited and defined range of diagnostic properties that differentiate it from other soil types. Detailed descriptions of individual soil types are outlined in 'Soils and Their Use in Northern England' (Harpenden 1984).

14.4.17 The Study Area is occupied by 2 soil types differentiated by their texture, drainage and stone content and influenced by a variable depth to sand and gravel.

14.4.18 There is likely to be a zone of transitionary soils merging from Soil Types 1 and 2 west to east where deep medium textured soils become increasingly stony and shallow Where this transitionary soil is found it should be allocated to either Soil Type 1 or 2 as it's characteristics change.

Soil Type 1: Medium clay loam topsoil overlying medium and heavy clay loam subsoil (39.84 ha, or 66% of the Study Area)

14.4.19 Soil Type 1 was found across the western two-thirds of the Study Area. Soils were representative of the Hamble 2 Soil Association and are mapped in medium brown at Appendix 9.2. A typical profile is described in TP1 (Appendix 9.6).

14.4.20 The topsoil was a brown (7.5YR 4/3) medium clay loam and with a mean depth of 31cm (range 22-40cm). It contained few (1-2%) and occasionally common (3-5%) small, medium and rare large sub angular and sub rounded flints and rare rounded quartzite pebbles. Organic matter was elevated in the surface layers (0-10cm).

14.4.21 A dark yellowish brown (10YR 4/4) and appreciably silty medium clay loam upper subsoil was present below the topsoil between 26-52 cm. Topsoil had been illuviated into cracks and fissures to 40cm and the boundary between the topsoil and subsoil was diffusive, indicating a potential reversion of the lower topsoil to an upper subsoil due to an extended period without agricultural cultivation.

14.4.22 Lower subsoil was brown and reddish yellow (7.5YR 5/4 & 6/6) and comprised of near stoneless heavy clay loam to depth with common to many distinct ochre mottles. This layer was gleyed but not slowly permeable within 80cm (Wetness Classes I and II).

14.4.23 Topsoil structure was moderately to well-developed fine to medium sub angular blocky becoming coarser and angular within the upper subsoil. In the lower subsoil structure was weak and coarse subangular breaking to fine and medium sub angular. Rare manganese mottles were present in the topsoil becoming common at depth.

14.4.24 This soil type is an excellent or very good quality soil resource.

14.4.25 This soil type tended to be occupied by the denser scrub and woodland to the west of the site and has characteristics of free to impeded soil drainage, slightly acidic pH, very

low available phosphorus and profiles which are less droughty. This predisposes the land to colonizing with this type of vegetation.

Soil Type 2: Medium textured stony soils (20.20 ha or 34% of the Study Area)

14.4.26 Soil type 2 was found across the eastern third of the Study Area. Soils were representative of the Hucklesbrook or Sutton 2 Soil Association and are mapped in pale yellow at Appendix 9.2. A typical profile is described in TP2 (Appendix 9.6).

14.4.27 The topsoil was dark greyish brown (10YR 4/2), appreciably silty and a moderately organic medium clay loam with a mean depth of 29cm (range 20-40cm). It contained common to abundant (5-40%) small, medium and large rounded and sub rounded flints, gravels and quartzite pebbles. Stone content tended to increase west to east across the Study Area.

14.4.28 A brown (10YR 4/3) medium clay loam or sandy clay loam subsoil was present below the topsoil, stone content increased with depth to 40-50% with abundant flints and gravels which were frequently impenetrable to hand held tools within 60-80cm.

14.4.29 Topsoil structure was well developed fine to medium sub angular blocky breaking to crumb in the upper layers. Subsoil structure was single grain to apedal at depth. The subsoil was freely drained and contained rare to few manganese and ochre mottles in the upper layers and was not slowly permeable (Wetness Class I).

14.4.30 This soil type is a good to moderate quality soil resource. It is occupied principally by rough grassland interspersed with less frequent scrub and volunteer trees.

Soil analysis results (Appendix 9.7)

Topsoil pH

14.4.31 The optimum pH for mineral soils in arable use is 6.50 and for grassland 6.00. The pH of the topsoil across the Study Area was generally slightly low to near neutral (5.50-6.20). Given the proposed restoration land use there are currently no requirements for lime.

Available Phosphorus, Potassium and Magnesium

14.4.32 The nutrient status across the site was consistent and reasonably uniform. Levels of available phosphorus (Index 0) were very deficient in all areas. Available potassium

was slightly deficient to satisfactory (Index 1 and -2) whilst magnesium was satisfactory (Index 2). The electrical conductivity of the soil was consistently low (1,900-2,000 µS/cm) with no issues of salinity associated with the maritime location.

14.4.33 The pH and nutrient status results are typical of topsoil under long term, low intensity grass or amenity use with minimal fertiliser inputs.

Potentially Toxic Elements (PTE's)

14.4.34 PTE's were found to be consistently low across the site and well within the typical levels found in UK soils.

Particle Size Distribution and Organic Matter Content

14.4.35 Topsoil texture was a uniform and appreciably silty medium clay loam throughout containing between 19-42% sand, 39-57% silt and 19-24% clay. The organic matter status of 4.50-5.70% was satisfactory for medium textured topsoil in all areas.

Agricultural Land Classification (ALC)

14.4.36 The site has been classified by LDC as non-agricultural.

14.5 Impact Assessment (Unmitigated)

Method

14.5.1 Baseline data in section 14.4 has been referenced with Tables 14.1-14.3 for soil receptors with likely significant effects (unmitigated) considered below.

14.5.2 The total area of soils affected within the Study Area is 60.04 ha.

14.5.3 More than 20 ha of the Study Area contains excellent, good or moderate quality soils.

14.5.4 There will be no permanent loss of soil resource in the Study Area.

14.5.5 The sensitivity (Table 14.1) of the soils is high.

14.5.6 Handling soils can lead to long term damage which can take more than 10 years to fully mitigate and up to 60 ha of soils might be affected. The magnitude (Table 14.2) of the Proposal is high.

14.5.7 The significance (Table 14.3) is that the Proposal has the potential for a major adverse likely significant effect on the soils within the Study Area.

14.6 Mitigation

14.6.1 Appropriate management and mitigation of the likely significant effects on the soil resource will facilitate a more rapid recovery of the land restored in the longer term.

Design/Embedded Mitigation

14.6.2 Policy recommends that significant effects from mineral site development be directed towards lower quality soils and that irreversible effects on higher quality soils be avoided wherever possible. If impacts are unavoidable then policy recommends that soil recovery and re-instatement is maximised and working practices replace them to retain their intrinsic quality. The site contains more than 20ha of excellent, very good or good quality soils and avoidance, in this instance, is not possible.

14.6.3 Given that likely significant effects on higher quality soils are unavoidable, it will be important to ensure that soils are managed and re-instated to an appropriate soil handing strategy. A site restoration plan is shown at Appendix 9.4 and proposed phasing and restoration plans at Appendix 9.12. A breakdown of the restoration land uses for the restored areas is shown in Table 14.4.

Table 14.4. Hamble Airfield: Proposed Restoration Land Use

Land use	Area (ha)	Soils required
Grassland	48.16	Yes
Scrub and Heathland	6.37	Yes
Woodland	3.64	Yes
Lakes	0.55	No
Other wetland	1.32	No
Total Area Requiring Soils	**58.17**	
Total Study Area	**60.04**	**-**

14.6.4 The restoration design provides for the re-instatement of 58.17 ha of land requiring suitable soil profiles for re-instatement, this represents approximately 97% of the Study Area. The remaining areas will be restored to lakes, wetlands and riparian margins. The design therefore provides a high level of mitigation for soil recovery and re-use within the site boundary.

14.6.4 The site phasing (Appendix 9.12) shows that the site will be worked in 6 phases of a similar size, beginning in the northwest and progressing anticlockwise from northwest to northweast. This will provide an opportunity to progressively restore the proposed extraction phases as the mineral working phases advance. This will enable soils to be stripped from the next phase and to be replaced directly into the previous phase, thereby reducing the potential impacts of soil storage and double handling.

Soil Handling

General

14.6.5 The movement, storage and reinstatement of soils inevitably results in at least a temporary degradation of soil characteristics. Of particular concern at this site will be the potential for soil losses, compaction, drainage, stone content and mixing of different textural layers. Failure to control these risks could result in permanently degraded soils and a requirement for difficult and costly operations to rectify longer term implications for crop growth. Careful management of soils handling and restoration practice will help to facilitate soil structural recovery, improve soil drainage and maximise the potential for re-instated soils to support healthy plant growth over the medium and longer term.

14.6.6 This site has a high annual average rainfall of 795mm and the land is typically at Field Capacity for 162 days (44%) in a normal year. Soil stripping and re-instatement will therefore be restricted to the drier periods of the year, notionally April-October. Soils should only be moved under the driest practicable conditions and this must take account of prevailing weather conditions. This will ensure that soil smearing and compaction are minimised and enable soils resources to be recovered and replaced both accurately and in their entirety.

14.6.7 The soils are medium textured throughout the site. The soil types will have relatively high bearing strengths when dry but correspondingly this will be low if they are wet, particularly in soil type 1. When wet, soils will be prone to compaction, structural instability, rutting and smearing. If extraction is proposed overwinter, it will remain feasible to work the site for mineral provided that soil stripping and re-instatement have been phased to drier periods of the year and that proposed trafficking is restricted to either haul roads, hardstandings or overburden once soils are removed.

14.6.8 More than two thirds of the site has very good quality soils and soil handling techniques

will need to reflect this quality. To ensure the best practicable re-instatement of all soils their handling will follow the enclosed recommendations. The Soil Handling Strategy below follows the recommendations of Institute of Quarrying, 'Good Practice Guide for Handling Soils in Mineral Workings', July 2021. Soils will be handled using 360 excavator, dump truck and low ground pressure bulldozers. This equipment will be used in accordance with the Institute of Quarrying *Good Practice Guide For Handling Soils*, Sheets A to D, G and O as follows.

- Sheet A Soil stripping with excavators and dump trucks.
- Sheet B Building soil storage mounds with excavators and dump trucks.
- Sheet C Excavation of soil storage mounds with excavators and dump trucks.
- Sheet D Soil replacement with excavators and dump trucks.
- Sheet G Building soil storage mounds with bulldozers and dump trucks.
- Sheet O Soil de-compaction with bulldozer drawn tines.

Monitoring of site and soil conditions

14.6.9 Monitoring of prevailing weather and ground conditions will be clearly understood by all personnel and conveyed to them by a programme of toolbox talks prior to commencement of site work.

Weather

14.6.10 Local weather forecasts will be monitored closely, a minimum of once daily in dry conditions and twice daily during unpredictable weather. Long range forecasts, the EA's flood risk alerts and surface water flood risk maps, showing the impact from rainfall, will be consulted.

14.6.11 In certain weather conditions, the handling of topsoil and subsoil will be effectively managed to prevent damage. Topsoil and subsoil conditions will be assessed by applying the following criteria:

- During drizzle and/or intermittent light rain, handling can continue unless the soils are at or nearing their lower plastic limit (LPL),
- If there is heavy rain forecast(e.g. heavy showers, slow moving depressions),

handling must stop if soils are nearing or likely to reach their LPL,

- If there is sustained heavy rainfall of more than 10 mm in 24 hours, soil handling will be suspended and not restarted until the ground has had at least a full day to dry, or an agreed soil moisture limit can be met as agreed with the project team, and
- Soil shall not be handled or trafficked over/driven on immediately after a heavy rainfall (or snow/hail) in a waterlogged condition, or when there are standing pools of water on the soil surface.

Soil conditions and field assessment

14.6.12 Soils should not be handled when in a plastic state, this is when moisture content exceeds their lower plastic limit and, as a general rule will be as dry as reasonably practicable when handled.

14.6.13 Handling soils are in a plastic state may, exceptionally, be necessary, for instance in areas of high groundwater or permanent waterlogging. Where this is the case works will continue to follow best practice accepting that soil moisture conditions may not be at an optimum and dewatering or drainage might be required.

14.6.14 The assessment of soil suitability for handling will use a staged method as outlined in Table 14.5 and Table 14.6 to determine whether soils are suitable for handling. Stage 1 (Table 14.5) forms a field moisture test and Stage 2 (Table 14.6) a consistency test based on an assessment of lower plastic limit.

14.6.15 A field soil moisture test will first be carried out as per Table 14.5.

Table 14.5. Field testing of soil moisture

Assessment/Test	Suitability for handling
If soil sample is wet, films of water are visible on the surfaces of grains and aggregates; or If soil sample readily deforms into a cohesive 'ball' when squeezed.	Soils should not be handled.
Soil peds break up/crumble readily when squeezed in the hand. Sample does not form a cohesive ball.	Soils can be handled.
If the sample is moist, there is a slight dampness when squeezed between the fingers, but it does not significantly change colour (darken) on further wetting.	No handling by dozers but may be handled by excavators **if** the consistency test is passed.

Sample is dry and brittle. Sample looks dry and changes colour (darkens) on wetting	Soils can be handled if the consistency test is passed.
Test to be completed daily during soil stripping operations and the results recorded.	

14.6.16 Where required, and as per Table 14.5, samples will be tested for consistency as in Table 14.6.

Table 14.6. Field testing of soil consistency	
STEP A. CONSISTENCY Attempt to roll sample into a ball by hand	**Suitability for handling**
It is impossible because the soil is too hard (dry)	Soils can be handled
It is impossible because the soil is too loose (dry)	Soils can be handled
It is impossible because the soil is too loose (wet)	Soils should not be handled
It is possible to roll the sample into a ball by hand	See Step B
STEP B. Lower plastic limit (LPL) Attempt to roll sample into a thread of 3 mm diameter by 75mm length on a flat non-adhesive surface (e.g. ceramic or glass tile) using light pressure from the flat of a hand, avoiding drying the sample with the hand	
It is impossible as the soil crumbles or disintegrates.	Soils can be handled
It is possible to roll a 3 mm diameter thread.	Soils should not be handled
Test to be completed daily during soil stripping operations and the results recorded.	

Site Preparation

14.6.17 It will be important to ensure that the full extent of the extraction phases are planned from the earliest possible date. The phasing plans (Appendix 9.12) indicate the proposed working method and soil movements have been considered in advance by the Applicant.

14.6.18 All areas proposed for mineral extraction will be fenced with a suitably robust design prior to work commencing. Fencing for temporary works will be commensurate with the risk of accessibility or accidental trespass.

14.6.19 The site is likely to contain agricultural drainage systems and evidence from old maps indicates changes to field boundaries in Fields 1 and 4. Drainage water conveyed by

these systems will be provided with a suitable outfall before soil stripping. Intrusive drainage investigations and design mitigation will be completed in advance of soil stripping. Pre-development drainage will also include planning for the location and size of any siltation control lagoons and/or soakaways.

14.6.20 Account has been made for suitable and sufficient areas for soil storage without the requirement to stockpile to excessive heights or to double handle soils once stripped and stored. This allows soil layers to be stored separately, with dry footings and in areas where the risk of additional movement or double handling is minimised. The working plan, as described in the planning statement, together with the draft phasing plans (Appendix 9.12) allow for progressive stripping and reinstatement, i.e. where soils are stripped from their original location and put directly to bed in their final location on a previous and completed phase. Not all of the Study Area can be progressively worked and the longer-term phases associated with phase 1, i.e. plant yard, processing area and topsoil stores will necessitate temporary soil stripping and storage in advance so that progressive restoration can follow.

14.6.21 All crops in excess of 15cm (6 inches) in height are to be removed prior to topsoil stripping. This will ensure accuracy of stripping depth and help to prevent the formation of anaerobic conditions in the stored soils.

14.6.22 Most of Study Area is severely overgrown with tall, dense shrub vegetation, volunteer trees, bramble, gorse, broom and scrub. The nature and extent of vegetation cover at this site will necessitate a carefully planned cutting, spraying and clearance regime in advance of soil stripping. This program will include proposals for clearance and re-use of vegetation within the site and will consider the use of seed and soil inoculum for restored areas and potentially the composting of residual and surplus vegetation within the site, subject to appropriate environmental permissions. Clearance and ground preparation work is to be managed to prevent the risk of structural damage by appropriate stop periods aligned to prevailing weather and ground conditions.

Topsoil Stripping

14.6.23 Topsoil will be stripped using backacter and dumper and loose tipping techniques employed, which are in line with industry standards for achieving the best re-instatement outcome for restored land. Topsoil stripping will be undertaken from a subsoil base layer and the use of dumpers will be required to move soils to designated stockpiles. Working to phased manageable areas will be completed to avoid excessive

topsoil trafficking. Dumpers will only traverse dedicated haulage routes trafficking subsoil and/or overburden only.

14.6.24 Topsoil is to be stripped under the driest practicable conditions and only when it is below its plastic limit. This will ensure that soil smearing and compaction are minimised and will enable soils resources to be recovered both accurately and in their entirety.

14.6.25 Topsoil is defined as the layer of darker, usually more organic material, occurring at this site to a depth of 20-40cm. It can be clearly defined from less organic, more variably coloured subsoil. Topsoil texture and colour are reasonably uniform on this site but the depth varies slightly. In the event of doubt as to the depth and nature of topsoil, confirmation on stripping depths will be confirmed on site. The depth of topsoil at each auger boring position is shown at Appendix 9.5.

14.6.26 Topsoil will be stripped from the whole of the site except for those areas which are to be used for topsoil storage mounds or are to remain completely undisturbed. This will include as a priority the site access; plant yard, mineral processing and storage areas; subsoil and overburden storage areas; internal haulage routes and turning areas.

14.6.27 All topsoil stripping is to be undertaken under the supervision of a competent banksman/engineer and take account of any archaeological requirements.

14.6.28 Topsoil boundaries can be irregular which can result in difficulties when stripping with heavy machinery. The removal of all the topsoil resource and slight contamination of the topsoil (up to 5% (or 1-2cm)) with subsoil will be acceptable, as opposed to leaving topsoil in situ.

14.6.29 All trafficking following topsoil stripping will be on subsoil only and to designated haul routes.

14.6.30 The topsoil in each of the soil types identified is sufficiently different, particularly in terms of stone content to be stripped and stored separately.

14.6.31 Topsoil pH and nutrient status is sufficiently similar in each of the stripping phases to not warrant separate stripping for the land use types proposed. pH and nutrient status are suitable for the extensive grassland uses proposed in the restoration scheme and do not warrant separation on this basis.

14.6.32 The location of topsoil and subsoil storage mounds are shown on the phasing plans (Appendix 9.12). Individual topsoil stripping units are described below.

Topsoil unit T1

14.6.33 Topsoil unit T1 is a stoneless or very slightly stony topsoil medium clay loam to be stripped from soil type 1 to a depth of 31cm and stored or used progressively in reinstatement.

Topsoil unit T2

14.6.34 Topsoil unit T2 is a light to medium textured, moderately to very stony sandy or medium clay loam to be stripped from soil type 2 to a depth of 29cm and stored or used progressively in reinstatement.

14.6.35 A summary of the depth and volume of topsoil arisings are shown in Table 14.7. These volumes are indicative and based on the total area of land likely to be affected. Volumes are likely to change as further detail on the Study Area layout and phasing evolves.

Table 14.7. Topsoil Stripping within the Study Area

Soil Type	Topsoil unit	Texture	Depth (cm)			Area[1]	Volume[2]
			Min	Max	Mean	m^2	m^3
1	T1	Medium clay loam. Slightly stony	22	40	31	398,400	123,500
2	T2	Medium clay loam. Very stony	20	40	29	202,000	58,500
Total						600,400	182,000

1. area affected by mineral extraction
2. Estimated volume based on entire strip of the area of the Study Area to nearest $500m^3$

Subsoil Stripping

14.6.36 Subsoils will be stripped from areas to be worked for mineral extraction, but not from the topsoil and subsoil storage areas or access roads. Subsoil will only be stripped when it is below its plastic limit as per tables 14.5-14.6.

14.6.37 Subsoils are to be stripped using a backacter working from a previously stripped basal

layer and moved using dumper. Works will be completed in manageable areas as per the phasing plans (Appendix 9.12) and machinery will only traverse dedicated haulage routes trafficking subsoil/overburden only.

14.6.38 Subsoil is to be stripped from the Study Area to a depth of 90cm or thereabouts to provide an overall restoration profile of 120cm which is adequate for re-instatement and in line with that recommended by Defra for mineral extraction sites (COGAP Soil, 1998). Subsoil profiles differ between the two soil types and are to be stripped separately.

14.6.39 Careful monitoring of subsoil characteristics is recommended at all stages of soil stripping. Significant variability in texture or stone content with depth will necessitate separate storage of different materials as they are encountered.

14.6.40 Soil Type 1 has an upper subsoil that will be stripped separately from lower subsoil. Soil Type 2 has a uniform subsoil to be stripped as one unit. Individual subsoil stripping units are described below.

Subsoil Unit S1 (Soil Type 1)

14.6.41 Subsoil unit S1 consists of 25cm of near stoneless to very slightly stony medium clay loam upper subsoil to be stripped as a single layer to an average depth of 56 cm (range 40-80cm) below ground level and stored or used progressively as unit S1.

14.6.42 The depth to heavier textured lower subsoil is variable and the aim will be to maximise the recovery of better quality lighter textured upper subsoil rather than adhering to specific depths. Careful monitoring of subsoil characteristics is recommended at all stages of soil stripping to expedite separation.

14.6.43 There will be a transitionary zone between the two soil types where deeper medium textured stoneless subsoils are present. Where encountered, these will be stripped to their full depth and stored with this unit.

Subsoil Unit S2 (Soil Type 1)

14.6.44 Subsoil unit S2 consists of 64 cm of near stoneless heavy clay loam, which will be stripped and stored separately from S1 to a depth 1.20m below ground level.

Subsoil Unit S3 (Soil Type 2)

14.6.45 Subsoil unit S2 consists of approximately 90cm of abundantly stony sandy or medium clay loam which will be stripped and stored separately from S1. This material is a lower quality soil forming substrate.

Overburden (Soil Type 1)

14.6.46 Intrusive ground investigations have been reported in other Chapters of the ES (Vol 1, Appendix 4 and Vol 2, Appendix 2.5). These reports indicate that medium and heavy textured overburden will be made available during the extractive phases form below 1.20m. This is present to an average depth of 3.20m and, where found, can be used as a replacement and alternative subsoil to unit S3 which is likely to retain value as a mineral reserve. These investigations indicate that there will be a sufficient quantity of overburden to facilitate this substitution.

14.6.47 Subsoil is to be stripped and stored/re-instated according to the units and approximate volumes shown in Table 14.8.

Table 14.8. Subsoil Stripping within the Study Area

Soil Type	Subsoil unit	Subsoil Texture	Depth (cm)	Area[1] m^2	Volume[2] m^3
1	S1	Medium clay loam	31-56	398,400	100,000
1	S2	Heavy clay loam	56-120	398,400	255,000
2	S3	Medium clay loam (stony)	29-120	202,000	183,000
Total				**600,400**	**538,000**
1	Overburden	Sandy clay and clay *In lieu of S3*	320	398,000	1.27 M

[1] area affected by mineral extraction
[2] Estimated volume based on entire strip of area to nearest 500m^3
Overburden assumes mean depth of 3.20m as detailed in Vol 1, Appendix 4 of ES

Soil Storage

14.6.48 Stripped topsoil is to be stored on topsoil to maximum depth of 3.00m in the storage areas shown in the phasing plans (Appendix 9.12). Units T1 and T2 will be stored separately to avoid mixing.

14.6.49 Stripped subsoil layers will be stored separately in the designated subsoil storage area shown in the phasing plans (Appendix 9.12).

14.6.50 Storage mounds will be sited to take account of the proximity of ditches/watercourses and other features such as hedges/fences, overhead powerlines and the risk of potential flooding. The location of the heaps in relation to the construction and haul routes, together with levels both outside and within the extraction area, will be planned to avoid excessive diversion of surface water flows to low areas and avoid the necessity to double handle soils due to requirements to re-locate storage heaps. Soil mounds will be recorded in plan format with a description of their origin and composition.

14.6.51 The duration of soils storage will be minimised wherever practicable and opportunities for progressive restoration maximised as per the planning statement and in line with the phasing plans (Appendix 9.12).

14.6.52 Topsoil and subsoil are to be stored separately to avoid cross contamination and mixing of different soils materials.

14.6.53 Topsoil mounds will be kept as shallow as practicable to allow maximum aeration of the stored soils. The outer batters of mounds will have gradients which minimise the risk of slumping and also on requirements for site screening. If topsoil storage is proposed next to subsoil the outer flanks of the mounds will be appropriately shaped to avoid soil mixing and/or a geotextile separator used between differing materials.

14.6.54 Topsoil storage mounds in situ for more than 12 months are to be seeded with an appropriate amenity or conservation grass seed mix. This will assist with weed control, reduce soil erosion and increase stability, speed up drying of the topsoil, maximise aeration of the stored soils and improve the aesthetics of the site.

14.6.55 Topsoil mounds are to be kept free of pernicious perennial weeds through an appropriate cutting and/or herbicide spraying programme. This work is to be carried out by a BASIS registered contractor.

14.6.56 Subsoil mounds will not exceed 5 metres in height and be appropriately battered on the outer flanks to avoid the risk of slumping and soil erosion. Subsoil mounds remaining in situ for more than 12 months are to be seeded with a low vigour drought resistant amenity or conservation seed mix with weed management during the storage period. A

small amount of nitrogen fertiliser may be applied to facilitate grass establishment on subsoil mounds in particular.

Soil Protection

14.6.57 Temporary hardstandings and stone access roads constructed on subsoil will make use of an appropriate geogrid and/or geotextile membrane to act as a strengthener/separator. This will avoid potential contamination of soils with stone or aggregate, which are otherwise stoneless or slightly stony. Depending on subsoil moisture content it may be beneficial to lightly roll the subsoil to provide a firm and level sub-base on which to construct hard standings.

14.6.58 Fuelling points, waste skips and material storage areas will be appropriately sited and located in an area stripped of soils. Fuel tanks will make use of an appropriate membrane at filling points to prevent contamination of the underlying strata.

Soil Erosion and Siltation

14.6.59 The Study Area contains soils which, in an undisturbed condition, are relatively permeable and able to drain excess rainfall vertically. There is potential for subsoil trafficking during working which will lead to compaction and reduced permeability of the soil surface. Surface water drainage features such as grips or siltation lagoons in lower lying areas or at key discharge points will be provided in the proposed scheme of work.

Soil Re-instatement

General

14.6.60 The soil types on the site, combined with excess winter rainfall, mean that soil re-instatement is to be restricted to the drier periods of the year, notionally April-October.

14.6.61 More than 95% of the site area is to be returned to grassland and conservation use and it will be possible to re-instate all of the high quality soils impacted in Soil Type 1 with the remainder using good or lower quality soils from Soil Type 2. Surplus topsoil and subsoil won from the footprint of wetlands will be repurposed within the site, in particular to offset an anticipated shortfall in subsoil unit S3.

14.6.62 The proposed profiles for re-instatement will be replaced in the reverse order of the stripping recommendations and will be set out in advance with consideration of the

quality and quantity of S3 and availability of suitable site won overburden from below 1.20m depth.

14.6.63 Priority will be given to retaining topsoil unit T2 for use in the re-instatement of dry acid grassland in the north of the site, where operationally possible.

Site Clearance and Overburden Preparation

14.6.64 Hardstandings and footings will be grubbed out and removed from site. Rutting and compaction of overburden will be levelled into an even surface following site clearance. Soils which are wet are to be avoided accordingly until such a time that they are suitable for trafficking and/or an appropriate weather window exists.

14.6.65 Overburden will be brought to within 1.2m of final level prior to soils placement. Levels will take account of potential bulkage during soil re-instatement.

14.6.66 Land with potential for agriculture will be reinstated with slopes of less than 7°.

14.6.67 Where required, soil mounds will be sprayed with an appropriate herbicide at least two weeks prior to soils replacement.

Subsoil Placement

14.6.68 Excavated or stored subsoils/overburden are to be replaced as per the restoration (Appendix 9.4) and phasing plans (Appendix 9.12) using a loose tipping methodology.

14.6.69 Soil profiles will be re-instated in the reverse order of stripping with loosening of individual layers undertaken prior to placement of the overlying horizon.

14.6.70 Surplus subsoil from lakes and wetland areas will be used to offset losses of S3 and will be retained for re-instatement. The selection and preferential use of compacted clay overburden will form low permeability lining for wetlands and ponds.

Subsoil Loosening

14.6.71 Subsoil subject to trafficking and compaction is to be loosened using a winged tine assembly to a maximum depth of 500mm operating at a tine spacing of one and a half times the depth of working (i.e. 750mm). The exact depth of loosening will be determined by soil moisture status, depth of compaction, degree of trafficking during mineral extraction and re-instatement and the presence of shallow services/drains at

restoration stage. The operation will be undertaken, where practicable, from one access and to one exit point with sufficient turning space so as not to re-compact the ripped subsoil.

14.6.72 The moisture content of the subsoil during the ripping operation is crucial to its success. If the soil is excessively wet and the subsoil is plastic in consistency, then there will be a very limited beneficial effect. If the subsoil is too dry, then the operation will cause excessive ground heave and surface disruption. Due to the site-specific nature of this operation, the exact procedure will be decided at restoration stage. Following ripping, trafficking of ripped and stonepicked subsoil will not be allowed.

Subsoil Stonepicking

14.6.73 Where appropriate, and following loosening, the subsoil will be stonepicked. Large stones and very large stones, greater 150mm in any dimension, unrepresentative of those occurring naturally in the upper layers of the subsoil will be removed.

Subsoil Grading

14.6.74 In the event of an uneven subsoil surface following stonepicking the subsoil surface will be lightly graded, but not over-consolidated, to provide an even surface for topsoil placement.

Topsoil Re-instatement

14.6.75 A working method for topsoil re-instatement will be adopted to minimise trafficking of the ripped subsoil. This will be achieved, for example, by restoring 15-20m wide retreating panels of topsoil using 360° excavator, dumper and low ground pressure dozer.

14.6.76 Topsoil will be spread evenly to correspond with existing levels at the edges of the working areas. A written and photographic record of re-instated topsoil depth will be made in all enclosures.

14.6.77 Surplus topsoil accrued from lakes or wetlands will be re-purposed on site wherever possible. Surplus topsoil will be used to augment the depth of topsoil in restored grassland or woodland areas. A deeper topsoil profile will provide longer term improvements for crop growth but to avoid future issues with anaerobism no more than 400mm of topsoil will be replaced.

14.6.78 Topsoil Unit T2 is to be used to form the dry acid grassland to the north of the site.

14.6.79 Where appropriate, some minor stone picking of the topsoil >100mm in any dimension, may be necessary, particularly on any ground that may be subsequently mowed.

14.6.80 If the land cannot be vegetated immediately, or if weather conditions are unpredictable, the surface may be consolidated or sealed by back blading or lightly tracking to reduce rainwater ingress into the newly laid and loosened soils.

14.6.81 There is a considerable benefit to soil recovery from immediate crop establishment, or at the very least a vegetative nurse crop if timing dictates, on re-instated soils which will to accelerate structural recovery and reduce the potential for erosion and further damage or loss.

14.6.82 Soil stripping, storage and re-instatement will damage the structure of the soils and reduce their natural hydraulic conductivity. Restoration will be to a combination of low intensity grassland and acidic dry grassland. Depending on the proposed intensity of use, the medium to heavier textured subsoils on site will require the installation of some surface water features and swales to encourage drainage and soil structural recovery.

Secondary Loosening

14.6.83 Following topsoil replacement secondary loosening operation will be carried out on all restored soils. A winged tine subsoiler will be used to loosen below the topsoil (400-500mm) and at an oblique angle to the underdrains. This will relieve residual subsoil compaction caused by soil placement and provide interconnectivity between the topsoil, loosened subsoil and permeable fill over the drains. The precise depth, tine spacing and subsoiler configuration will be decided at restoration stage.

<u>Vegetation Establishment and Aftercare</u>

14.6.84 Rapid establishment of vegetation in the restored areas will be encouraged to help bind soils and start the process of soil structural regeneration through plant rooting. Bare soils will be avoided for any extended periods especially over-winter when the risk of structural damage and erosion is potentially more severe.

14.6.85 Following reinstatement, land with potential for agricultural use and conservation grassland will need to be managed sensitively for several years. Soils are likely to remain wetter for longer in spring and wet up earlier in autumn leading to a reduction in

the working window for mechanical cultivations, land access and grazing by livestock.

14.6.86 Arable crops could potentially be grown on the re-instated land with agricultural potential and provide benefits in the first season after re-instatement to allow subsoiling and drainage together with cultivations to provide a level surface. Thereafter, the land is likely to benefit from a period in grass, as per the proposed restoration plan, to promote soil structural development and maximise organic matter returns to the soil.

14.6.87 An aftercare program will be formulated to an agreed landscaping and maintenance plan for all restored areas. Cropping with low intensity grassland is proposed with minimal fertiliser. The need for further subsoiling will need to be assessed during the aftercare period.

Additional Mitigation, Compensation and Enhancement Measures

14.6.88 The Proposal has the potential to affect 59.92 ha of non-agricultural land but with soils that have intrinsic properties that reflect those of Best and Most Versatile Land. ALC has not been considered in the impact assessment and it is inappropriate to consider whether land quality might either improve, decline or remain neutral post re-instatement.

14.6.89 In economic terms, the land within the Study Area is severely constrained for agricultural use. The Proposal provides an opportunity to invest returns from the mineral extraction process into the land and soils to improve their potential, which would otherwise not be feasible in a normal farming context. Agricultural benefits will accrue from clearance of vegetation; re-introducing field boundaries and returning 97% of impacted land and soils to similar profiles in a formalised scheme of low intensity agricultural management. Ultimately this would improve the value of this land, making it more attractive for potential uptake by a farmer/tenant on completion.

14.6.90 It is important that the mitigation of likely significant effects is secured, implemented and monitored. In this instance, this will be achieved through a combination of legislative compliance, planning conditions aligned to site working practices and oversight by trained personnel employed by the Applicant.

14.6.91 The techniques used in soil handling and the need for land drainage post re-instatement are well understood and have been employed by the Applicant and their contractors on similar projects for many years throughout the UK.

14.6.92 It is anticipated that planning permission will include conditions to ensure that appropriate mitigation is secured and implemented. This is usual in schemes of this type and conditions typically relate to the development of a pre-agreed Construction and Environmental Management plan incorporating a soil management plan, proposals for land drainage mitigation, aftercare and monitoring.

14.6.93 The Applicant will employ suitably qualified personnel to design, manage and monitor site works, including soil handling, storage and re-instatement together with drainage installation (where required).

14.6.94 Technical support to the Applicant will be provided by advising landscape architects and specialist land reclamation consultants as required.

14.7 Assessment Summary and Likely Significant Residual Impacts

14.7.1 Extraction of the mineral resource necessitates the removal and replacement of soils leading to changes in their physical characteristics. The Proposal outlines that soils will be handled, stripped, temporarily stored and re-instated to an appropriate and agreed soil handling strategy which maximises progressive restoration, limits storage and double handling and an aftercare management scheme. The techniques for the successful re-instatement of land are understood and have been practised for many years by the Applicant, and others, on similar sites elsewhere in the UK.

14.7.2 Approximately 1.87 ha of Soil Type 2 will be permanently removed to accommodate wetlands and ponds in the east of the site and full soil profiles will be provided across the remaining areas of conservation grassland and woodland.

14.7.3 More than 20 ha of the site is occupied by excellent, very good or good quality soils. The site sensitivity (Table 14.1) remains unchanged and is high.

14.7.4 Handling soils appropriately can reduce longer term damage and may take 5-10 years to fully mitigate. With appropriate phasing and progressive re-instatement, the Proposal will lead to the temporary loss of <20 ha of soil resources that can be returned to use within 5 years. The residual magnitude (Table 14.2) of likely significant effects on the soil resource is low.

14.7.5 The residual significance (Table 14.3) is that the Proposal has the potential for a minor adverse effect on the soil resources in the Study Area.

14.8 14.8 Conclusions

Soils

14.8.1 The baseline survey has identified two soil types in the Study Area with characteristics that necessitate careful handling.

14.8.2 The restoration design provides for the re-instatement of 58.17 ha of land requiring suitable soil profiles for re-instatement which represents approximately 97% of the Study Area. The remaining 1.87 ha of impacted land will be restored to lakes, wetlands and riparian margins. It is concluded that the design provides a high level of mitigation for soil recovery and re-use within the site boundary.

14.8.3 Sand and gravel extraction will lead to the loss of 1.87 ha of soil resources to accommodate wetlands. The design proposes to mitigate likely significant effects by repurposing topsoil and subsoil from the wetland areas into restored land within the site.

14.8.4 It will be extremely important to ensure that soil stripping, storage and re-instatement is undertaken during drier periods of the year, usually between April and October and to an agreed plan. Compliance with legislation, guidance and the adoption of monitoring, good practice guidance and techniques during construction will mitigate many of the issues associated with large sale soils handling, storage and re-instatement. The mitigation can be further secured by planning conditions relating to soil handling and re-instatement, which is usual for a Proposal of this type.

14.8.5 Site re-instatement will include a phased program of soils movements that maximise conservation and use of the better-quality soil resources for restoration to agricultural and/or conservation use.

14.8.6 The site will be returned to a productive use with as land with agricultural potential, conservation and wetland use within a five-year aftercare period post extraction and this will require the creation of soil profiles to sustain the land use types proposed.

14.8.7 With appropriate soils handling and restoration, the likely significant effects on the soil resource can be viewed as minor adverse in the longer term and should be balanced against the wider socio-economic and environmental benefits of the Proposal.

Agricultural Land Classification

14.8.8 The Agricultural Land Classification assessment concludes that the land within the Study Area is non-agricultural. However, it remains important to recognise that the soils within the site have intrinsic qualities typical of excellent through to moderate quality land. Accordingly, the mitigation proposed reflects this potential in the longer term.

14.8.9 Impacted soils will be returned to an equivalent quality to the existing and interventions proposed will return this land to a resource that could be managed to a standard suitable for agriculture in the longer term.

Policy

14.8.10 Policy affords the excellent and good quality soils land at this site protection during the Proposal, necessitating a high standard of soil handling and re-instatement Mineral extraction and land restoration in the Proposal seek to minimise irreversible losses of good quality soils and implement a high level of mitigation. Whilst the policy objective of avoidance of impacting good quality soils will not be achieved, the mitigation proposed is in keeping with policy objectives for mineral extraction impacting land in the UK.

Cropping and Aftercare

14.8.11 The installation of a post working drainage system will be important in mitigating the likely significant effects from soil handling and re-instatement, recreating the landscape and preventing soil loss and damage through erosion.

14.8.12 Rapid establishment of a vegetative cover in the restored areas is proposed in order to stabilise the soils and begin the process of soil structural regeneration through plant rooting.

14.8.13 An aftercare management plan is anticipated to be conditioned and implemented in agreement with the LPA for the land use types proposed. This will ensure that the land is managed in a sympathetic manner leading to suitable soil profiles and healthy plant growth in the longer term.

14.9 References

Publications and guidance

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14.10 Glossary of terms

Term	Definition
ALC	Agricultural Land Classification.
AAR	Average Annual Rainfall based on the 1961-1988 Agroclimatic Dataset
ATO	Accumulated Temperature Above 0° C between January and June. Report as day° C
ALC Grade 1	Land with no or very minor limitations to agricultural use. A very wide range of agricultural and horticultural crops can be grown and commonly includes top fruit, soft fruit, salad crops and winter harvested vegetables. Yields are high and less variable than on land of lower quality.
ALC Grade 2	Land with minor limitations which affect crop yield, cultivations or harvesting. A wide range of agricultural and horticultural crops can usually be grown but on some land in the grade there may be reduced flexibility due to difficulties with the production of the more demanding crops such as winter harvested vegetables and arable root crops. The level of yield is generally high but may be lower or more variable than Grade 1.
ALC Subgrade 3a	Land with moderate limitations which affect the choice of crops, timing and type of cultivation, harvesting or the level of yield. Land capable of consistently producing moderate to high yields of a narrow range of arable crops, especially cereals, or moderate yields of a wide range of crops including cereals, grass, oilseeds and roots.
ALC Subgrade 3b	Land with moderate limitations which affect the choice of crops, timing and type of cultivation, harvesting or the level of yield. Land capable of producing moderate yields of a narrow range of crops, principally cereals and grass or lower yields of a wider range of crops or high yields of grass which can be grazed or harvested over most of the year
ALC Grade 4	Land with severe limitations which significantly restrict the range of crops and/or level of yields. It is mainly suited to grass with occasional arable crops (e.g. cereals and forage crops) the yields of which are variable. In moist climates, yields of grass may be moderate to high but there may be difficulties in utilisation. The grade also includes very droughty arable land.
ALC Grade 5	Land with very severe limitations which restrict use to permanent pasture or rough grazing, except for occasional pioneer forage crops.
AOD	Above Ordnance Datum expressed in m above mean sea level from OS mapping
Arable	Land growing crops subject to seasonal ploughing or cultivations typically at this site being wheat, barley, oilseed rape, maize and/or potatoes.
Auger	A 1.2m metal rod used to recover soil cores manually from the ground.
BMV	Best and Most Versatile Agricultural Land falling in ALC Grades 1, 2 and subgrade 3a.

Drought/droughtiness	The susceptibility of land to drying out and the degree to which soil moisture may be in deficit during the year.

Term	Definition
FCD	Field Capacity Days - a meteorological parameter which estimates the duration of the period when the soil moisture deficit is zero. Soils usually return to field capacity (zero deficit) during the autumn or early winter and the field capacity period, measured in days, ends in the spring when evapotranspiration exceeds rainfall and a moisture deficit begins to accumulate.
Gleying	Specific soil colours usually produced in response to periods of waterlogging or imperfect drainage.
Horizon	A layer within the soil that can usually be clearly defined due to colour, organic matter, texture, stone content or drainage characteristics.
Limitation	A factor affecting the ability to effectively farm or manage the land at the site and which imposes a restriction on its flexibility to grow certain crops.
NGR	Ordnance Survey National Grid Reference.
Profile	The column of soil usually between a depth of 0-120cm that is examined in the field assessment.
Soil Association	A group of soils, usually named after a geographical area in which they are found, that are similar in terms of their characteristics and how they behave in response to management.
Soil series	An individual sub unit of the Soil Association.
Soil structure	The size, shape and degree of development of individual soil units, known as peds, within the soil profile.
Subsoil	The layers of the soil profile below the topsoil and to a depth of 1.20m.
Texture	The relative proportions of sand, silt and clay in a layer of soil. This can be determined either by an experienced soil surveyor in the field by hand or by laboratory analysis of a representative soil sample to determine particle size distribution.
Topsoil	The darker, humose material usually at the surface of the land found to a depth of 20-40cm and subject to agricultural husbandry.
Wetness Class	The drainage status of a soil profile ranging from I-V derived from an assessment of climate, soil profile characteristics including colour, texture, structure, porosity and the presence of mottling and gleying