Great North Road Solar and Biodiversity Park

Environmental Statement

Volume 4 – Technical Appendices

Technical Appendix A17.2 – Outline Soil Management Plan - Part 3 of 4

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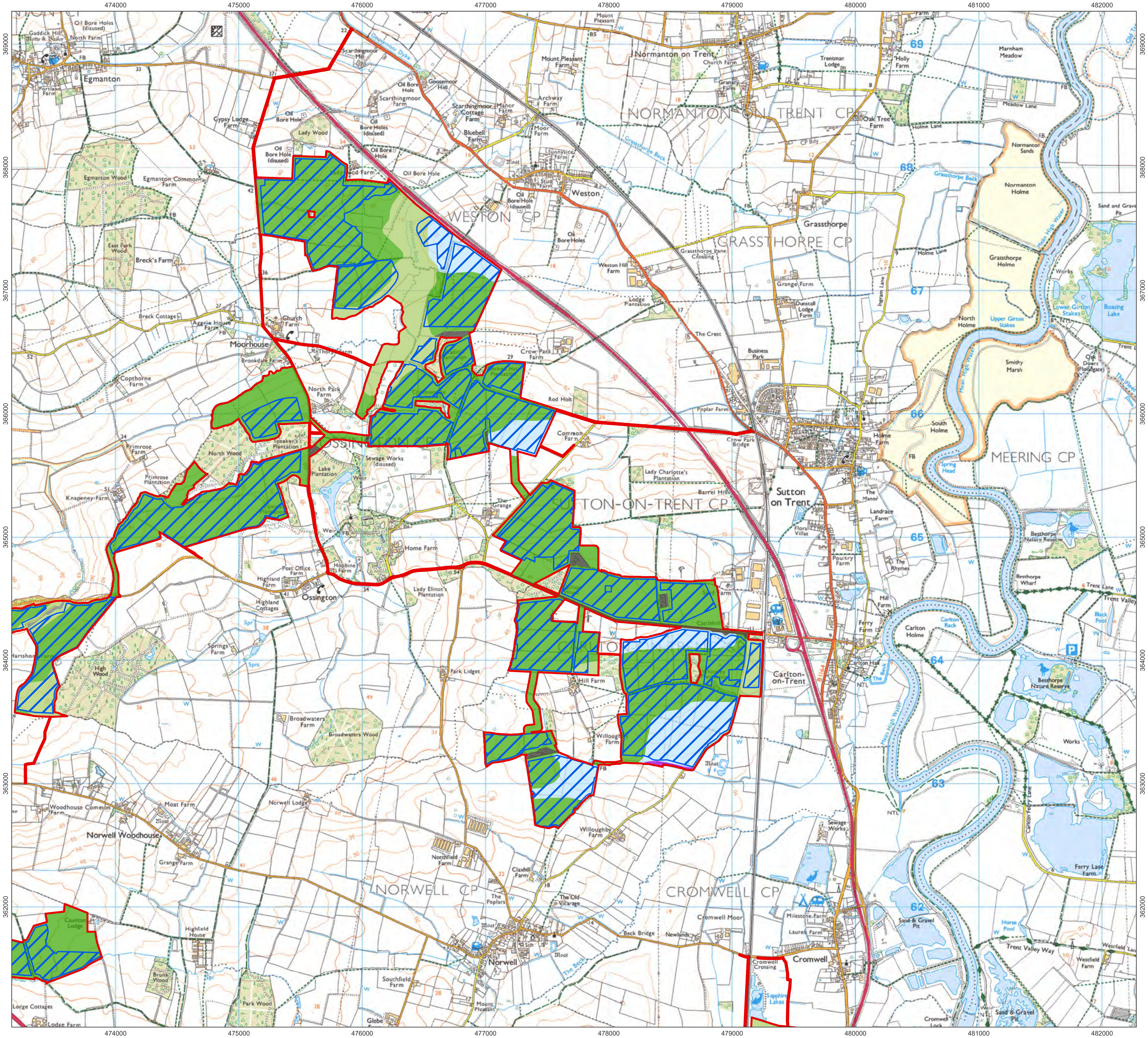
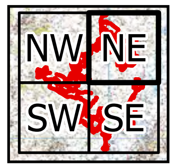
January 2026

Infrastructure Planning (Applications: Prescribed Forms and Procedure)

Regulations 2009, APFP Regulation 5(2)(a)





Order Limits

Works No. 1 Solar PV

Agricultural Land Classification - Survey Results

- Grade 2 - Very Good
- Grade 3a - Good
- Grade 3b - Moderate
- Grade 4 - Poor
- Non Agricultural
- Unsurveyable
- Unsurveyed

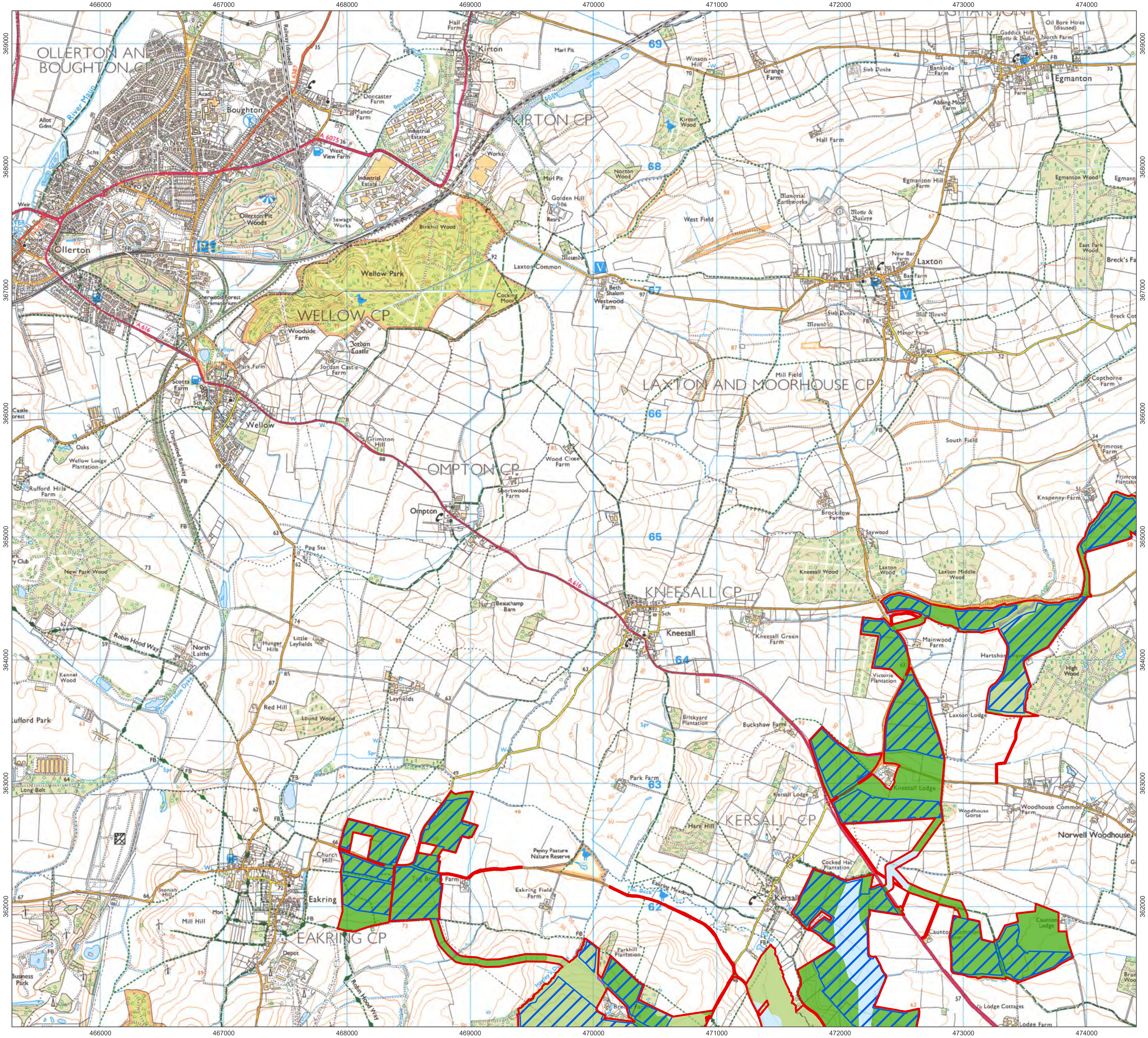
1:30,000 Scale @ A3

0 0.25 0.5 1 km

Ref: 026-ES-17.1 | Date: 23/06/2025

Agricultural Land Classification Figure 17.1 NE

Great North Road Solar and Biodiversity Park Environmental Statement



Order Limits

Works No. 1 Solar PV

Agricultural Land Classification - Survey Results

Grade 2 - Very Good

Grade 3a - Good

Grade 3b - Moderate

Grade 4 - Poor

Non Agricultural

Unsurveyable

Unsurveyed

NW NE SW SE

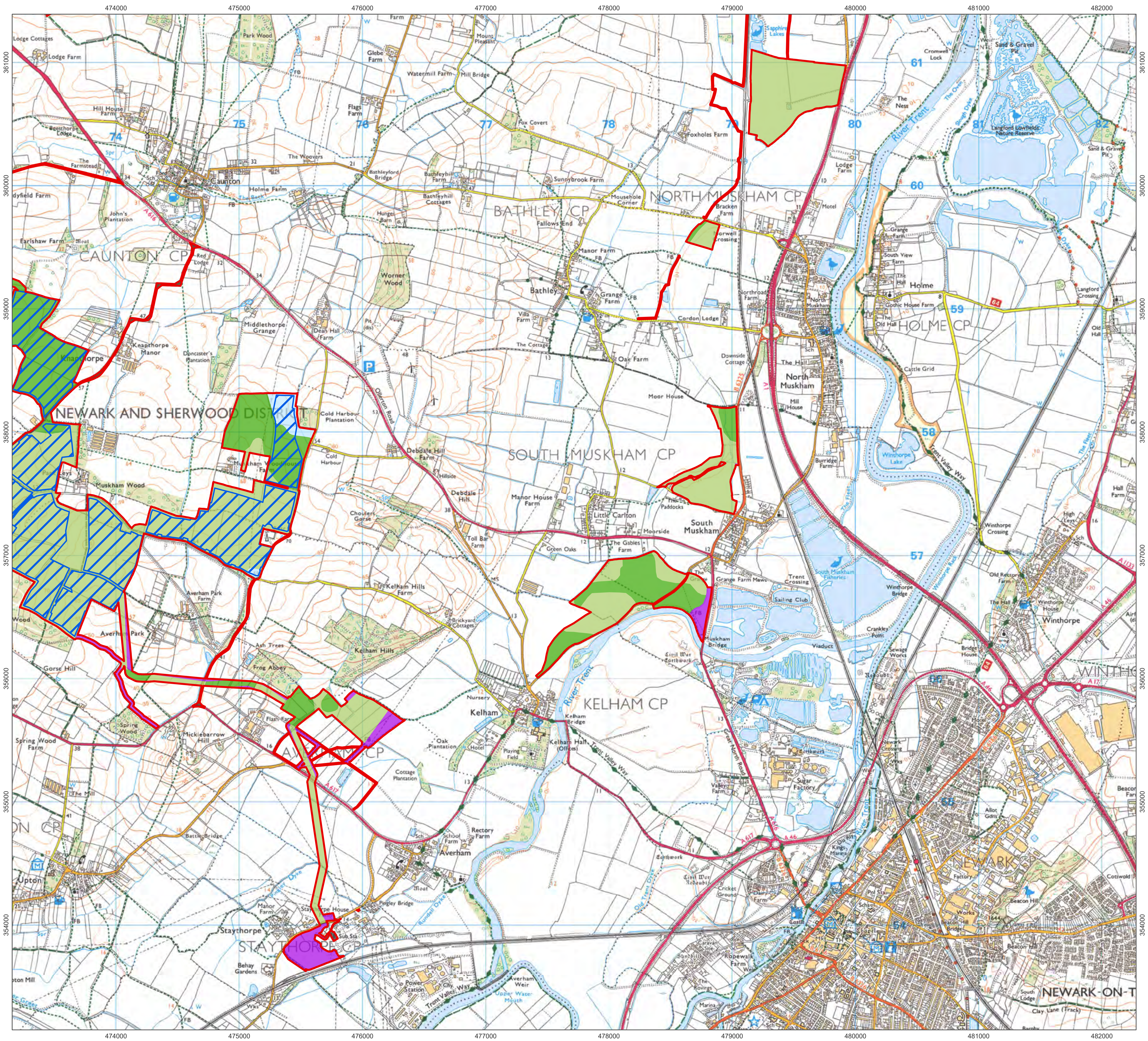
1:30,000 Scale @ A3

0 0.25 0.5 1 km

Ref: 026-ES-17.1 | Date: 23/06/2025

Agricultural Land Classification
Figure 17.1 NW

Great North Road Solar and Biodiversity Park Environmental Statement



Solar & Biodiversity Park

- Order Limits
- Works No. 1 Solar PV

Agricultural Land Classification - Survey Results

- Grade 2 - Very Good
- Grade 3a - Good
- Grade 3b - Moderate
- Grade 4 - Poor
- Non Agricultural
- Unsurveyable
- Unsurveyed

NW NE SW SE

1:30,000 Scale @ A3

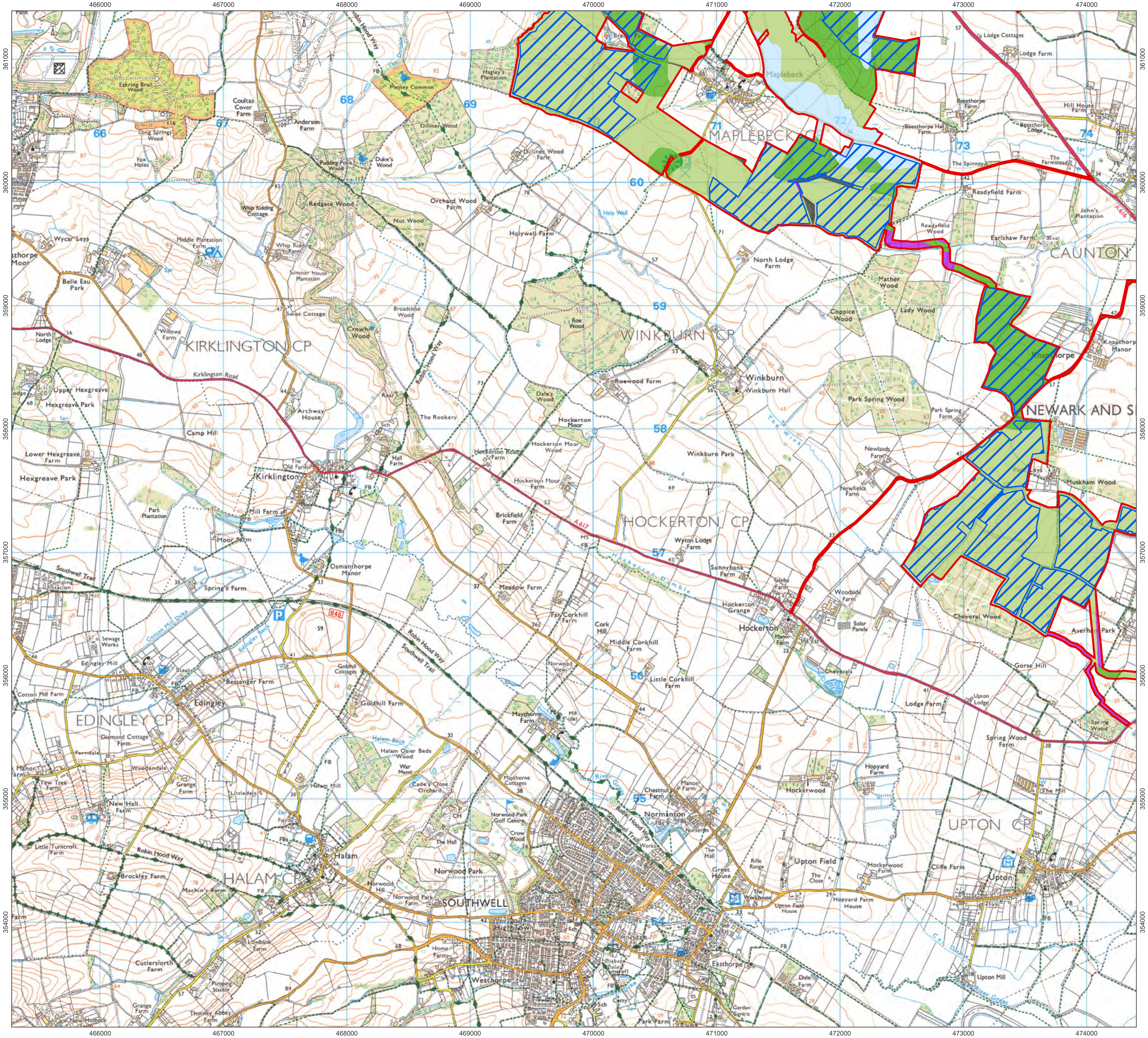
0 0.25 0.5 1 km

Ref: 026-ES-17.1

Date: 23/06/2025

Agricultural Land Classification Figure 17.1 SE

Great North Road Solar and Biodiversity Park Environmental Statement



Solar & Biodiversity Park

- Order Limits
- Works No. 1 Solar PV

Agricultural Land Classification - Survey Results

- Grade 2 - Very Good
- Grade 3a - Good
- Grade 3b - Moderate
- Grade 4 - Poor
- Non Agricultural
- Unsurveyable
- Unsurveyed

NW NE
SW SE

1:30,000 Scale @ A3

0 0.25 0.5 1 km

Ref: 026-ES-17.1	Date: 23/06/2025

Agricultural Land Classification
Figure 17.1 SW

Great North Road Solar and Biodiversity Park Environmental Statement

Appendix SMP3

Extracts from the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (2009)

www.defra.gov.uk

Construction Code of Practice for the Sustainable Use of Soils on Construction Sites

BIS | Department for Business Innovation & Skills

wrap Material change for a better environment

defra Department for Environment Food and Rural Affairs

5.4 Soil stockpiling

Why?

1. Soil often has to be stripped or excavated during the construction process. In order to enable its reuse on site at a later stage, soil needs to be stored in temporary stockpiles to minimise the surface area occupied, and to prevent damage from the weather and other construction activities.

How?

2. The main aim when temporarily storing soil in stockpiles is to maintain soil quality and minimise damage to the soil's physical (structural) condition so that it can be easily reinstated once respread. In addition, stockpiling soil should not cause soil erosion, pollution to watercourses or increase flooding risk to the surrounding area.

3. When soil is stored for longer than a few weeks, the soil in the core of the stockpile becomes anaerobic and certain temporary chemical and biological changes take place. These changes are usually reversed when the soil is respread to normal depths. However, the time it takes for these changes to occur very much depends on the physical condition of the soil.

4. Handling soil to create stockpiles invariably damages the physical condition of the soil to a greater or lesser extent. If stockpiling is done incorrectly the physical condition of the soil can be damaged irreversibly, resulting in a loss of a valuable resource and potentially significant costs to the project. The Soil Resource Survey and Soil Resource Plan should set out any limitations that the soil may possess, with respect to handling, stripping and stockpiling.

5. The size and height of the stockpile will depend on several factors, including the amount of space available, the nature and composition of the soil, the prevailing weather conditions at the time of stripping and any planning conditions associated with the development. Stockpile heights of 3-4m are commonly used for topsoil that can be stripped and stockpiled in a dry state but heights may need to be greater where storage space is limited.

6. Soil moisture and soil consistency (plastic or non-plastic) are major factors when deciding on the size and height of the stockpile, and the method of formation. As a general rule, if the soil is dry (e.g. drier than the plastic limit) when it goes into the stockpile, the vast majority of it should remain dry during storage, and thereby enable dry soil to be excavated and respread at the end of the storage period. Soil in a dry and non-plastic state is less prone to compaction, tends to retain a proportion of its structure, will respread easily and break down into a suitable tilth for landscaping. Any anaerobic soil also usually becomes re-aerated in a matter of days.

7. Soil stockpiled wet or when plastic in consistency is easily compacted by the weight of soil above it and from the machinery handling it. In a compacted state, soil in the core of the stockpile remains wet and anaerobic for the duration of the storage period, is difficult to handle and respread and does not usually break down into a suitable tilth. A period of further drying and cultivation is then required before the soil becomes re-aerated and acceptable for landscaping.

Stockpiling methods

8. There are two principal methods for forming soil stockpiles, based on their soil moisture and consistency.

9. Method 1 should be applied to soil that is in a dry and non-plastic state. The aim is to create a large core of dry soil, and to restrict the amount of water that can get into the stockpile during the storage period. Dry soil that is stored in this manner can remain so for a period of years and it is reuseable within days of respreading.

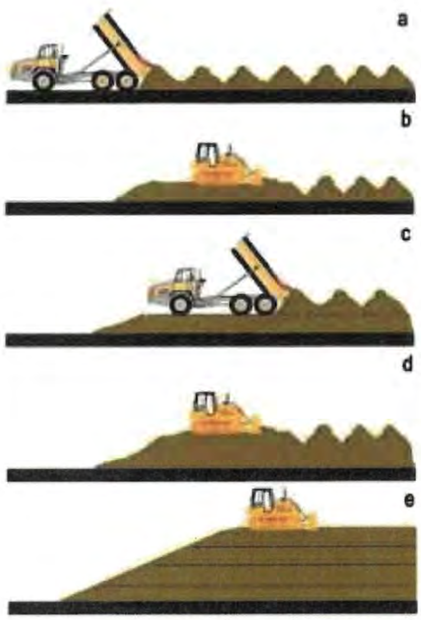
10. Method 2 should be applied if the construction programme or prevailing weather conditions result in soil having to be stockpiled when wet and/or plastic in consistency. This method minimises the amount of compaction, while at the same time maximising the surface area of the stockpile to enable the soil to dry out further. It also allows the soil to be heaped up into a 'Method 1' type stockpile, once it has dried out.

Soil stockpiling

Soil should be stored in an area of the site where it can be left undisturbed and will not interfere with site operations. Ground to be used for storing the topsoil should be cleared of vegetation and any waste arising from the development (e.g. building rubble and fill materials). Topsoil should first be stripped from any land to be used for storing subsoil.

Method 1 – Dry non-plastic soils

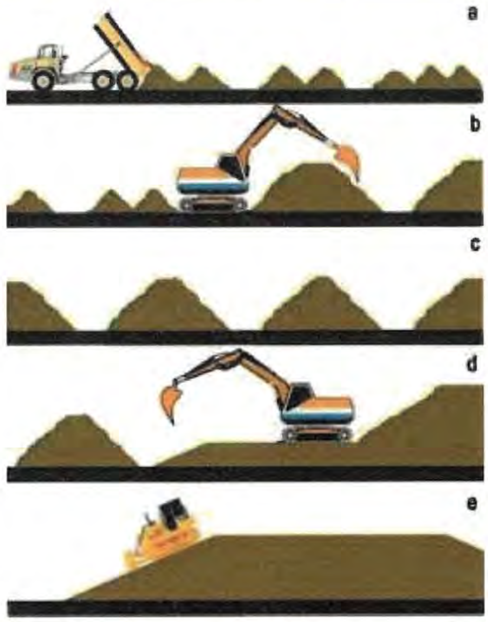
The soil is loose-tipped in heaps from a dump truck (a), starting at the furthest point in the storage area and working back toward the access point. When the entire storage area has been filled with heaps, a tracked machine (excavator or dozer) levels them (b) and firms the surface in order for a second layer of heaps to be tipped. This sequence is repeated (c & d) until the stockpile reaches its planned height. To help shed rainwater and prevent ponding and infiltration a tracked machine compacts and re-grades the sides and top of the stockpile (e) to form a smooth gradient.



Method 2 – Wet plastic soils

The soil is tipped in a line of heaps to form a 'windrow', starting at the furthest point in the storage area and working back toward the access point (a). Any additional windrows are spaced sufficiently apart to allow tracked plant to gain access between them so that the soil can be heaped up to a maximum height of 2m (b).
To avoid compaction, no machinery, even tracked plant, traverses the windrow.

Once the soil has dried out and is non-plastic in consistency (this usually requires several weeks of dry and windy or warm weather), the windrows are combined to form larger stockpiles, using a tracked excavator (d). The surface of the stockpile is then regraded and compacted (e) by a tracked machine (dozer or excavator) to reduce rainwater infiltration.



Stockpile location and stability

11. Stockpiles should not be positioned within the root or crown spread of trees, or adjacent to ditches, watercourses or existing or future excavations. Soil will have a natural angle of repose of up to 40° depending on texture and moisture content but, if stable stockpiles are to be formed, slope angles will normally need to be less than that. For stockpiles that are to be grass seeded and maintained, a maximum side slope of 1 in 2 (25°) is appropriate.

Stockpile protection and maintenance

12. Once the stockpile has been completed the area should be cordoned off with secure fencing to prevent any disturbance or contamination by other construction activities. If the soil is to be stockpiled for more than six months, the surface of the stockpiles should be seeded with a grass/clover mix to minimise soil erosion and to help reduce infestation by nuisance weeds that might spread seed onto adjacent land.

13. Management of weeds that do appear should be undertaken during the summer months, either by spraying to kill them or by mowing or strimming to prevent their seeds being shed.

Clearly defined stockpiling of different soil materials

Long term stockpile of stripped topsoil left with only weed vegetation

Landscape, habitat or garden creation

6.1 Soil placement

Why?

1. The establishment of new landscapes, gardens, or other greenscapes on construction sites often involves the respreading of stockpiled soil or the importation of soil. The manner in which this is carried out has a significant bearing on the soil's function, and particularly its ability to support new trees, shrubs and grass.

2. It is essential to provide a structured, uncompacted and well-aerated soil profile for the successful establishment and subsequent growth of plants and grass. However, where heavy machinery and large volumes of soil are excavated and stored, soil structure can easily be destroyed by over-compaction. This leads to problems of waterlogging and anaerobism, which are detrimental to plants in two main ways. Anaerobic bacteria produce ammonia and methane gases harmful to plant roots, and, without oxygen, plant roots are unable to take up water and nutrients. Restricted rooting increases the risk of trees being affected by wind throw (the uprooting of trees by wind).

3. The consequence of over-compacted soil is not only poor establishment or failure of plantings but also increased surface water runoff and surface ponding that reduces the visual and physical amenity of the landscape or garden and can contribute to localised flooding.

The symptoms of over-compaction of soil on the amenity areas of new housing estates: struggling trees; poor grass growth; and surface ponding after heavy rain.

How?

4. Almost all soil is physically degraded to a greater or lesser extent during soil stockpiling, handling and placement. The potential quality and the ultimate suitability of the soil depends on how well its soil structure is restored during placement.

5. Provided the soil is spread and prepared correctly, damage to soil structure can be kept to a minimum and the soil can usually recover to a healthy state quickly. In order to achieve this, it should be handled only when dry or slightly moist and using suitable machinery in an appropriate way. Multiple handling of soil materials increases the risk of damage to soil structure, so should be minimised.

6. The 'loose tipping' method, using dump trucks and hydraulic excavators to move and spread the topsoil, is the most appropriate method to use.

Loose-tipping method

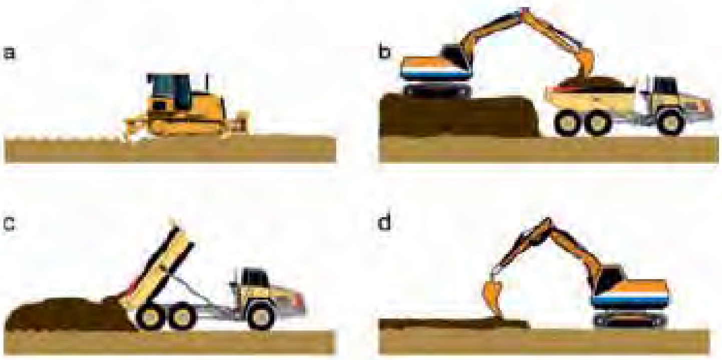
This method entails working to a strip system (the width of the strip determined by the reach of the excavator), and replacing soil sequentially across the soiling area. The receiving ground, whether a basal layer or compacted subsoil is first loosened with a wing-tine ripper.

A hydraulic excavator, fitted with a toothed-bucket to avoid excessive smearing, should be used to load the soil materials from the source area or stockpile into a dump truck which then discharges them onto the receiving surface. An excavator stands next to the newly dropped soil and spreads this to the required thickness. If there is to be more than one soil layer (i.e. if both topsoil and subsoil are being replaced) then the whole length of the strip is restored with subsoil before the process is repeated with topsoil. The topsoil is lifted onto the subsoil without the excavator travelling on the newly placed subsoil. Only when the strip has been completed is the next one started.

If soil is cloddy in structure, the excavator bucket can be used to break up the clods. Large stones can be removed during the operation.

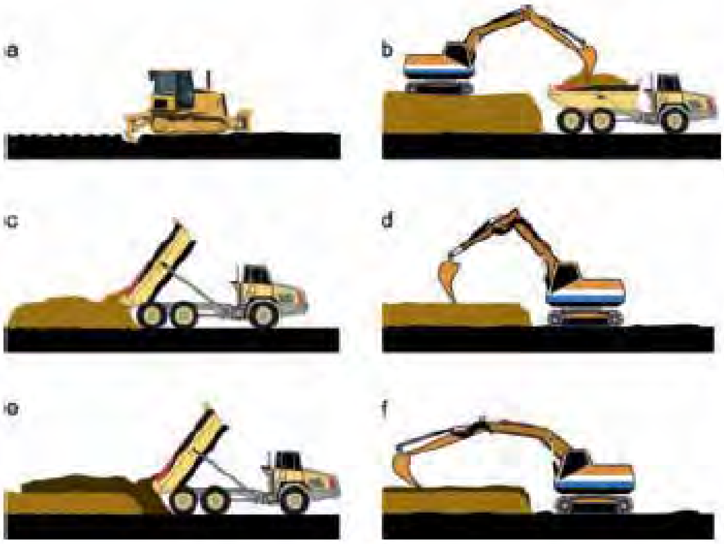
Modified versions of the loose-tipping method, for use when both subsoil and topsoil are to be placed, include spreading the subsoil as described above but then spreading the topsoil layer out using a low ground pressure dozer. Providing that soil conditions are suitably dry and dozer movements are minimised, this can gently consolidate the placed soil without causing over-compaction.

The loose-tipping method (topsoil spreading only)



a) loosening the subsoil of the receiving ground
b) loading of topsoil from stockpile
c) backtipping topsoil onto loosened subsoil
d) levelling topsoil

The loose-tipping method (topsoil <u>and</u> subsoil spreading)



a) loosening the substrate of the receiving ground
b) loading of subsoil from stockpile
c) backtipping subsoil onto loosened substrate
d) levelling subsoil
e) backtipping topsoil
f) spreading topsoil over subsoil using excavator working on substrate

Relief of compaction

7. On most construction sites, the receiving layer will have been compacted by vehicles, foot trafficking or the storage of building materials. Therefore, prior to spreading soil the substrate should be properly decompacted to break up any panning to reduce flood risk and to promote deeper root growth. A small (1-5 tonne) to medium sized (13 tonne) tracked excavator, fitted with a single rigid tine is effective in restricted areas, such as in planting beds and road verges. In more open areas, a tractor-drawn subsoiler is capable of loosening soil that is not too heavily or deeply compacted. In some instances, compressed air injection can be used to decompact the soil profile.

8. Deep compaction can only be effectively relieved using heavy duty ripper equipment, such as the single rigid tine device pictured below. For loosening to be most effective, it should be carried out when the soil is sufficiently dry to the full depth of working, otherwise the tine merely cuts and smears the subsoil rather than lifting, fracturing and loosening it. A toothed excavator bucket is not an appropriate tool for ripping soil.

Top (from left to right): *Ripping by tractor-drawn tines, Large winged-tine ripper, Topsoil rake used on a 3 tonne excavator*
Bottom: *Single ripper tooth used for relieving compaction to a depth of 600 mm*

Topsoil thickness

9. Topsoil placement thickness will depend on the anticipated rooting depth of the plants to be established and the quality of the underlying subsoil. Trees and shrubs require a much greater rooting depth than grasses, though this does not have to be made up entirely of topsoil. Topsoil at least 150mm deep is desirable for lawns and mown amenity grass and can beneficially be placed more deeply (up to 400mm thick) for trees and shrubs. However, topsoil does not normally perform well below a depth of 400mm from the surface, where there is an increase in self-compaction and where the biochemical oxygen demand (BOD) often exceeds the rate of aeration. This often results in the development of anaerobic conditions that are detrimental to plant root functions. Subsoil, which has a lower BOD, should, therefore, always be used to create rooting depths in excess of 400mm.

Topsoil cultivation

10. After respreading topsoil, any large, compacted lumps should be broken down by appropriate cultivation to produce a fine tilth suitable for planting (<50mm maximum aggregate size), turfing and seeding (<10mm maximum aggregate size).

11. Topsoil that has been stored in a stockpile is often compacted and anaerobic. It should therefore be cultivated to its full depth using appropriate tillage equipment to decompact and fully re-aerate. Only when the topsoil has been fully re-aerated will it be satisfactory for planting, turfing or seeding. More than one cultivation may be required to re-aerate the entire thickness of topsoil. Undesirable material (e.g. stones, fill materials and vegetation larger than 50mm in any dimension) brought to the surface during cultivation should be removed by picking or raking.

Adverse weather

12. If sustained heavy rainfall (e.g. >10mm in 24 hours) occurs during soil handling operations, work must be suspended and not restarted until the ground has had at least a full dry day or agreed moisture criteria (such as 'drier than the plastic limit') can be met. Lighter soil can generally be moved at a higher moisture content without damage than a heavy soil.

13. The earlier or later in the year that soil is moved, the greater the risk of causing damage or having work suspended by adverse weather, although the period when soil can be safely handled is longer in the drier eastern parts of the UK than in the west. Where the soil handling technique is such that trafficking over the soil is minimal (e.g. the 'loose tipping method' described above) the period for soil stripping may be extended.

Do

- ✓ Handle and place soil in the driest condition possible.
- ✓ Use tracked equipment wherever possible to reduce compaction.
- ✓ Decompact subsoil before placing topsoil.
- ✓ Fully re-aerate anaerobic topsoil before planting, turfing or seeding.
- ✓ Ensure that the physical condition of the entire soil profile (topsoil and subsoil) will promote sufficient aeration, drainage and root growth.

Don't

- ✗ Place or cultivate soils during or after heavy rainfall or when soils are plastic.
- ✗ Take construction machinery over topsoil or subsoil that has been placed.
- ✗ Place topsoil too deeply – 'more' is not necessarily 'better'.
- ✗ Plant into anaerobic topsoil.

Case Study 4: Decisions not to follow soil specifications cost company £25,000

1. Even where a good specification has been prepared for subsoil and topsoil management, there is seldom quality control of the works to ensure that desired outcomes are achieved.

2. An example is from a small development of 37 houses in Lancashire which necessitated the tipping of subsoil excavated from the development platform onto an adjacent field, which was then to be turned into public open space under a Section 106 agreement. A detailed specification was prepared by the developer's consulting landscape architect and stated that:
   - subsoil to receive topsoil should be thoroughly broken up to a depth of 150 mm and cleared of all roots, stones and debris with any one dimension greater than 75 mm;
   - subsoil should be graded after loosening but not traversed by heavy machinery;
   - topsoil should conform to 'BS3882:1994 fertile agricultural soils of uniform composition throughout, of light or medium texture with stones not exceeding 50 mm in any one dimension'.

3. Despite the detailed soil specification, including recommended quality control stages, neither the landscape architects nor other suitably qualified professionals were retained to supervise the contractors and check that the specifications were followed. Site clearance soil was used rather than fertile agricultural soil, the local planning authority was dissatisfied, refused to adopt the open space and legal action ensued. Investigation showed that the substrate was very compact and probably hadn't been loosened or stone picked, the topsoil had an excessive inclusion

One of many items of debris encountered in the imported topsoil during remedial works

Appendix SMP4

BSSS Working with Soil Guidance Note

Guidance Document 3

Working with Soil Guidance Note on Benefitting from Soil Management in Development and Construction

YEARS 1947–2022

The British Society of Soil Science (BSSS) exists to promote the study, public understanding and application of soil science. This guidance note is written for development planning and control professionals, site owners and developers to help promote the protection of soils and the important functions they support within the planning system and the development of individual sites.

Soils in the Planning System

Soils are protected in development to varying degrees by UK national planning policies. However, specific 'calls to action' regarding soils are generally lacking, and therefore explicit requirements of developers relating to soils are relatively rare in the planning approval process. The result is that the nature of the soils on a site is often poorly understood before construction starts. This stems from a failure to appreciate the variability of soils within the landscape and what effect this has on their specific hydrology, habitat potential and sensitivity to damage in particular. The inappropriate use and management of soil resources is often responsible for costly programme delays, the failure of planting schemes and higher incidence of surface runoff. This can mean non-compliance with planning conditions related to biodiversity net gain, tree protection, landscape enhancement and storm water management for example. There is therefore a strong argument for considering the nature and management of existing soil resources on a site at the design stage of a development, in accordance with planning policy relating to other sustainability priorities.

Recommendations

With the above in mind, **BSSS recommends** that planning consents for the development of green field sites are conditional on **the production and implementation of a comprehensive and site-specific Soil Resource Survey and Soil Management Plan,** the results of which are a consideration at the design stage of a development.

The Soil Resource Survey and Soil Management Plan should:

1. **be based on a detailed field survey of the soils of the proposed development site to bedrock or a depth of 1.2m.**
2. **be conducted by a professional soil scientist with the competencies set out in BSSS Working with Soil Professional Competency in Soil Science Documents 1 (Foundation skills in field soil investigation, description and interpretation), 4 (Soil science in soil handling and restoration), 5 (Soil science in land evaluation and planning) and 8 (Soil science in landscape design and construction) as appropriate.**

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www.soils.org.uk

3. **comprise a map at a suitable scale showing the distribution of each soil type present on the site and a detailed report describing the suitability and volume of each soil resource present for specific after-uses (as per the proposed development).**
4. **Site/soil specific management advice on stripping, stockpiling and restoration to ensure soils are protected.**
5. **Where semi-natural vegetation is to be established within a development, soils should be sampled and analysed for the major nutrients and advice should be given on the depth of topsoil to be reinstated and the suitability of each soils for different plant communities.**

Mitigation against Flooding

Natural soils store large volumes of rainfall during storm events, which has a significant mitigating effect on flooding. Planning applicants are required to demonstrate that a built development will not increase risk of surface flooding, and any increase in runoff rates from built surfaces compared to baseline soils needs to be offset through sustainable urban drainage systems (SUDS). However, it is frequently assumed that baseline runoff from *non-built* surfaces (gardens, landscape areas and public green space) within the development are unaffected by construction. Compaction caused by soil handling activities and construction traffic can cause profound reductions in soil infiltration rates, but this extra surface runoff is seldom considered in SUDS design. The result can be that post-development surface flood risk is much higher than anticipated.

BSSS recommends that Soil Management Plans include considerations of the runoff from natural and re-instated soils post development.

Creation and Support of Habitats

Increasingly, planning permission for built development is conditional on the provision of specific landscape planting schemes and/or the inclusion of habitat creation (e.g. species-rich meadow grassland). However, while planning conditions regularly include detailed planting specifications, it is rarely recognised that the success of this planting is highly dependent on appropriate soil being used as a planting medium. Soil resources on large development sites are often variable: some may be heavy (clayey), hard to handle and difficult to reuse in landscaping, while others are loamy or sandy, well-structured and easy to handle. Soils may also be acid or alkaline with a high lime content. Some have been used for intensive agriculture and are very high in nutrients and weed burden, while others are low in nutrients and well suited to use in habitat creation. If soil resources are not properly assessed at an early stage of the planning process, and appropriately re-used, there is a high probability that targeted landscaping and habitat creation will fail (and therefore planning conditions associated with landscape and ecology will not be satisfied), increasing project costs and delaying development completion.

BSSS recommends that the underlying soil conditions should be taken into account in the choice and establishment of semi-natural vegetation.

Soil Biodiversity

Soils that have remained undisturbed for lengthy periods of time develop rich and diverse below-ground flora and fauna. Old parkland soils provide good examples of this and support equally rich above ground insect, bird and bat communities. Soil fauna form the foundation of diverse food chains. Needless to say, such soils are increasingly rare and BSSS believes that every opportunity should be taken to protect and preserve them.

BSSS recommends that where biologically-rich soils fall within a proposed development, they should be protected from any disturbance as far as is possible and be assigned to a future use as urban greenspace.

Further Reading

The Construction Code of Practice for the Sustainable Use of Soils on Construction Sites[1] provides examples of good practice and highlights the need for detailed Soil Resource Assessment as part of a Soil Management Plan for the construction phase of built development.

January 2022 – version 3

[1]https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/716510/pb13298-code-of-practice-090910.pdf

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Appendix SMP5
Institute of Quarrying Field Tests for Soils Suitability

IQ
The Institute
of Quarrying

Good Practice Guide for Handling Soils in Mineral Workings

Supplementary Note 4
Soil Wetness

Soil wetness is a major determinant of land use, and environmental and ecosystem services in the UK. It is also a factor in the occurrence of significant compaction arising from handling soils with earth-moving machines and the practices used (Duncan & Bransden, 1986).

Relative soil wetness can range from the waterlogged to moist (mesic) or dry (xeric) depending on rainfall distribution and depth to a water-table and duration of waterlogging. In the UK, soil wetness is largely seasonal with higher evapo-transpiration rates potentially exceeding rainfall in the summer resulting in the soil profile becoming drier where there is vegetation. Whilst soil wetness is largely weather system and equinox (climate) driven, it varies with geographical and altitudinal locations, and importantly the physical characteristics of the soil profile, such as texture structure, porosity, and depth to the water-table and topography including flood risk (MAFF, 1988). The Soil Wetness Class is based on the expected average duration of waterlogging at different depths in the soil throughout the year (days per year), and can be determined by reference to soil characteristics and local climate (MAFF, 1988). The likely inherent wetness and resilience status of a soil should be indicated in the SRMP (see **Part 1, Table 2 & Supplementary Note 1**), reflecting potential risks for soil handling such as low permeability, permanently high groundwater, or a wet upland climate.

Wet soils can also be a result of other circumstances. For example, the interception of water courses, drainage ditches and field land drains. Where these occur, the provisions are to be made in the SRMP to protect the soils being handled and the operational area.

Soils, when in a wet condition generally have a lower strength and have less resistance to compression and smearing than when dry. Lower strength when soils are wet also affects the bearing capacity of soils and their ability to support the safe and efficient operation of machines than when in a dry state.

In terms of resilience and susceptibility to soil wetness, the clay content of the soil largely determines the change from a solid to a plastic state (the water content at which this occurs is called the 'plastic limit' (MAFF, 1982)). This is the point at which an increasing soil wetness has reduced the cohesion and strength of the soil and its resistance to compression and smearing.

Whilst coarse textured sandy soils are not inherently plastic when wet, they are still prone to compaction when in a wet condition. Hence, handling all soils when wet will have adverse effects on plant root growth and profile permeability, which may be of significance for the intended land use and the provision of services reliant on soil drainage and plant root growth. It may be less so in other circumstances where wet soil profiles, perched water tables and ponding are the reclamation objectives, though drainage control, for example to control flooding, may still be important in these contexts.

In cases of permanently wet soils, such as riverine sites, upland or deep organic soils where there is a persistent high water-table throughout the seasons within the depth of soil to be stripped and/or the soil profile remains too wet, a strategic decision has to be made to be able to proceed with the development of the mineral resource. This may mean alternative and less favourable soil handling practices have to be agreed with the planning authority.

Predicting & Determination of Soil Wetness
There are well established methods to predict and determine soil wetness of undisturbed and restored soil profiles (Reeve, 1994). The challenge has been the prediction of the best time for soil stripping. Models based on soil moisture deficits and field capacity dates for a range of soil textures can provide indicative regional summaries (**Table 4.1**) that can help with planning operations at broad scale but cannot be relied upon in practice for deciding operationally whether to proceed on the ground given the actual variation in weather events from year to year and within years.

	Climatic Zones		
Soil Clay Content	**1**	**2**	**3**
Soil Depth <30cm			
<10%	Mid Apr - Early Oct	Late Mar – Early Nov	Late Mar – Early Dec
10 -27%	Late May - Early Oct	Early May – Early Nov	Early Apr – Early Dec
Soil Depth 30-60cm			
<10%	Late Apr - Early Oct	Mid Apr – Early Nov	Early Apr – Early Dec
10-27%	Late May - Early Oct	Early May – Early Nov	Early Apr – Early Dec
>27%	Late June – Early Oct	Early June – Early Nov	Late May – Early Dec
Soil Depth >60cm			
<10%	Late Apr - Early Oct	Mid Apr – Early Nov	Early Apr – Early Dec
10-18%	Late May - Early Oct	Early May – Early Nov	Early Apr – Early Dec
18-27%	Late June – Early Oct	Early June – Early Nov	Late May – Early Dec
>27	Mid July – Mid Sept	Early July – Mid Oct	Late June – Mid Oct

Table 4.1: Indicative on-average months when vegetated mineral soils might be in a sufficiently dry condition according to geographic location, depth of soil and clay content

The timing of most soil handling operations takes place between April and September. Although in western (Zone 1) and central (Zone 2) areas it typically can be a later start in May with an earlier termination in August. Whilst the return to climatically 'excess rainfall' is later in the eastern counties (Zone 3) and can be as late as November/early December, there is a need to maintain transpiring vegetation to keep the soils being handled in a dry as possible condition and to establish new vegetation covers as soon as possible (on replaced soils and storage mounds). Hence, soil handling operations generally need to be completed no later than the end of September (Natural England, 2021), unless appropriate provisions can be assured.

Where data is available, more realistic local and real-time predictions can be made, however, because weather patterns and events differ between and within years, and soils can be vary locally in their condition. Experience has shown that the most practical approach for operations is to inspect the site and soils in question near to/ at the time when soil handling is to take place. Professional soil surveyors can advise on the best time for soil handling (stripping, storage & replacement) and carry out site assessments of soil wetness condition prior to the start of operations.

A Practical Method for Determining Soil Wetness Limitation

During the soil handling season (see Table 4.1 above), prior to the start or recommencement of soil handling soils should be tested to confirm they are in suitably dry condition (**Table 4.2**). The 'testing' during operations can be done by suitably trained site staff and reviewed periodically by the professional soil surveyors.

The method is simply the ability to roll intact threads (3mm diameter) of soil indicating the soils are in a plastic and wet condition (MAFF, 1982; Natural England, 2021). Representative samples are to be taken through the soil profile and across the area to be stripped. It is the best available indicator of soils being too wet to be handled and operations should be delayed until a thread cannot be formed. For coarse textured soils which do not roll into threads, a professional's view as to soil wetness and the risk of compaction may have to be taken.

Table 4.2: Field Tests for Suitably Dry Soils

Soil tests are to be undertaken in the field. Samples shall be taken from at least five locations in the soil handling area and at each soil horizon to the full depth of the profile to be recovered/replaced. The tests shall include visual examination of the soil and physical assessment of the soil consistency.

i) Examination

- If the soil is wet, films of water are visible on the surface of soil particles or aggregates (e.g. clods or peds) and/or when a clod or ped is squeezed in the hand it readily deforms into a cohesive 'ball' means **no soil handling to take place.**
- If the samples is moist (i.e. there is a sligh dampness when squeezed in the hand) but it does not significantly change colour (darken) on further wetting, and clods break up/crumble readily when squeezed in the hand rather than forming into a ball means **soil handling can take place.**
- If the sample is dry, it looks dry and changes colour (darkens) if water is added, and it is brittle means **soil handling can take place.**

ii) Consistency
First test
Attempt to mould soil sample into a ball by hand:

- Impossible because soil is too dry and hard or too loose and dry means **soil handling can take place.**
- Impossible becuase the soil is too loose and wet means no soil handling to take place.
- Possible - Go to second text.

Second test
Attempt to roll ball into a 3mm diameter thread by hand:

- Impossible because soil crumbles or collapses means soil handling can take place.
- Possible means no soil handling can take place.

N.B.: It is possible to roll most coarse loamy and sandy soils into a thread even when they are wet. For these soils, the Examination Test alone is to be used.

A Rainfall Protocol to Suspend & Restart Soil Handling Operations
Local weather forecasts of possible rainfall events during operations and the occurrence of surface lying water have been used to advise on a day-to-day basis if operations should stop (Natural England, 2021). Single events such as >5mm/day in spring and autumn months, and >10mm/day in the summer have been suggested as more precise triggers for determining soil handling operations (Reeve, 1994). However, in practice the following generic guidelines are often used:

- In light drizzle soil handling may continue for up to four hours unless the soils are already at/near to their moisture limit.
- In light rain soil handling must cease after 15 minutes.
- In heavy rain and intense showers, handling shall cease immediately.

In all of the above it is assumed that soils were in a dry condition. These are only general rules, and it is at the local level decisions to proceed or stop should be based on the actual wetness state of the soils being handled. After the above rain event has ceased, the soil tests in **Table 4.2** above should be applied to determine whether handling may re-start, provided that the ground is free from ponding and ground conditions are safe to do so.There can be extreme instances where soil horizons have become very dry and are difficult to handle resulting in dust and windblown losses. In these conditions the operation should be suspended. The artificial wetting of extremely dry soils is not usually a practice recommended but has been successful in some cases.

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Appendix SMP6

Building on Soil Sustainability

Cornwall Council and Others

(September 2022)

Building on soil sustainability: Principles for soils in planning and construction

Soils in Planning and Construction Task Force

Sept **2022**

CORNWALL COUNCIL
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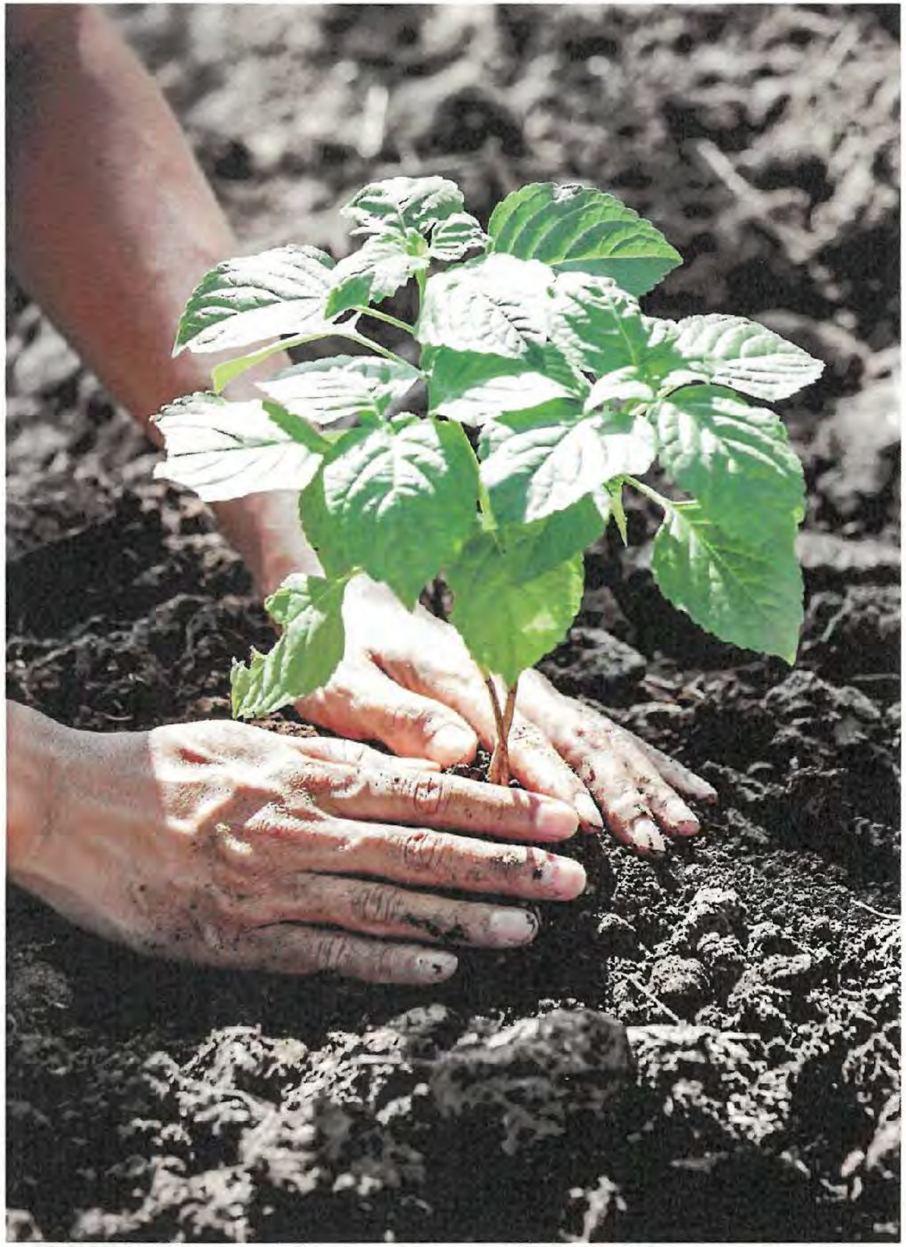
FARRER HUXLEY

jtp

LANCASTER CITY COUNCIL
Promoting City, Coast & Countryside

Lancaster University



Foreword

This report is short, simple, important, revealing, and ultimately, just simple common sense. Soil is something we don't understand, see, or value. This must change.

I think we all know that soil is a source of nutrients for growing plants and crops. I think we know that healthy soil is important, and that with a bit of added compost, it will deliver real benefits for our roses! But when it's on a construction site it simply becomes unwanted muck to be removed so building work can commence.

You'll be shocked by the horrifying truth of the level of ignorance there is toward soil. Every single teaspoon of soil contains around one billion bacteria; every cubic metre of healthy soil captures between 12kg and 35kg of carbon. In the construction sector we destroy and throw it into landfill at a rate of nearly 30 million tonnes each year, worth nearly £3 billion!

This report lays bare just how important soil is, and how much we undervalue the dirty brown stuff. It highlights the extent of soil waste in construction and the costs of failing to recognise soil as an asset worthy of preservation and use – including the huge carbon release and loss of biodiversity when we disturb or compact it.

The report starts by highlighting the multiple and complex benefits of soil, its health, and its capacity to harbour mycorrhizal activity essential for life on earth. It highlights how soil is abused in construction, setting out the guidance and legislation that we rarely follow, and concluding just how misunderstood soil is. Finally, it proposes guidance for the key sectors that need to collectively deliver realistic and achievable change.

This is a practical and timely report, which I invite you to read and disseminate. In highlighting the key issues that compromise responsible soil management and setting out how to address them, the report empowers the policies that do exist and provides the imperative for us to unite and advance cross-sector action.

Finally, I urge non-construction audiences to read this report – because we are all contributors. Paving over our garden areas and turning them into outdoor living rooms or car parking bays contributes significantly to both soil loss and associated localised flooding.

We can all do our bit to preserve and enhance soil at home, and this report provides the basis for the construction sector to reverse present practice and see soil for what it is: a fragile, fundamental, and valuable asset for the planet and for us all.

Noel Farrer PPLI FLI
Vice President of the Landscape Institute
(Image © Clare Elliott)

Landscape Institute
Inspiring great places

Executive Summary

Soil provides a multitude of important functions and ecosystem services for society, including climate change mitigation and adaptation opportunities and supporting biodiversity. Yet, at present, soil is routinely undervalued, damaged and disposed of during construction and urban development. It is crucial that we not only stem the damage done to these vital ecosystems, but also actively consider how better planning and management of soil can result in environmentally and socially beneficial development. This report, collaboratively formed in consultation with a wide range of scientists, policy and industry representatives, aims to raise awareness of the importance of soil. It provides a set of guiding principles to help improve how soil is planned for and managed during construction and urban development.

What can you do?

Use these guiding principles for soils in construction:

1. **Plan, design and construct for soil functions** – including soil carbon storage and reducing CO2 emissions, water infiltration and flood mitigation, soil biodiversity, and optimal support for above ground vegetation and trees
2. **Engage** local communities and stakeholders on soil issues and development during the consultation process
3. **Reuse or share soil** – maximise use of soil on site and share excess soil to ensure there is no loss to landfill
4. **Maximise permeability** – minimise soil sealed area and maximise permeable paving to allow water to infiltrate and soil to respire; manage draining on-site using SuDS rather than off-site
5. **Minimise compaction** – plan haul routes and materials storage and designate Soil Protection Zones (SPZs) where soil is protected from traffic, stripping and stockpiling
6. **Stockpile correctly** – minimise the duration of stockpiling and size of stockpiles, ensure this is undertaken according to soil texture, moisture and weather conditions, and ensure topsoil and subsoil are separated and do not become mixed or contaminated
7. **Minimise erosion** – prevent sediment loss by use of vegetation cover, seeding, mulching, silt fences or rolls, or geotextiles, particularly on slopes and stockpiles
8. **Learn through training** – engage with soil professionals to continually develop best practice

Local Authorities – use a standard planning clause for soil that includes consideration of soil functions, requirement of a soil survey and soil management plan, and a method statement for soil prior to commencement of works. Encourage the use of Soil Protection Zones (SPZs) to minimise vehicle compaction in areas for future green spaces and private gardens.

Clients and Developers – include the importance of soils in tender briefs. Bring in a soil specialist early and encourage their collaboration with other disciplines (ecology, landscape architecture, arboriculture and engineering). Undertake a soil survey as part of the EIA and use this to write a soil management plan, going beyond engineering or contamination surveys. Consider levels and earthworks early in the process to maximise cost benefits of reusing soils.

Design Teams – consider soil early on in a collaborative way and design based on soil functions and soil survey information. Maximise synergies across disciplines (landscape architecture, architecture, ecology, engineering) to create better schemes for soils, tree protection, habitats, biodiversity net gain, open spaces and private gardens.

Contractors – include soils in ECSR targets and raise with clients, undertake toolbox talks on good practice for soil management, and undertake soil handling according to methods in the latest Defra guidance: Construction Code of Practice for the Sustainable Use of Soils on Construction Sites.

Introduction

Soil provides a multitude of important functions and ecosystem services for society, including playing an important role in climate regulation and supporting biodiversity – two of the biggest existential threats to society. Yet, soil is routinely undervalued, damaged and disposed of during construction. The rising need for more homes and infrastructure to support growing populations and economies are putting increasing pressure on soils. It is vital that we better manage this non-renewable resource during construction so it can continue to provide its many crucial functions, and help us in our fight against climate change and biodiversity loss.

Currently in the United Kingdom, soils on construction sites fall within a gap in policy and legislation and large amounts of soil is being lost and damaged as a result. The key guidance document, the Defra Construction Code of Practice for the Sustainable Use of Soils on Construction Sites is not often followed, and good practice is rarely seen. Whilst the total cost of the soil lost and damaged during construction to society is currently unknown, the initial evidence gathered together here indicates that in any terms the cost is large, and likewise, the scale of responsibility and opportunity for improving practice and delivering positive change is substantial.

This report aims to raise awareness of the importance of soil and why it needs to be better managed during construction. It has been developed by a cross-sector team of scientists and practitioners in consultation with a wide range of representatives from planning and construction industries. In developing and sharing this document, we hope to provide a valuable case for taking soils seriously in planning and construction, and a set of high-level useful principles for practice. The report is for anyone working in planning, development, design and construction, and focuses on the UK context. It provides a set of guiding principles to improve how soil is planned for and managed, and there are dedicated sections with specific actions for each industry to support project teams to manage soils more sustainably.

Why is soil important?

Soil is a mixture of minerals, organic matter, living animals and micro-organisms, water and gas. It takes hundreds, thousands or even tens of thousands of years for soil to form – this means **it is a non renewable resource** and it is vital we look after it.

Soil provides many important functions and, as such, it is a valuable resource that we rely on for life on Earth. Soil provides nutrients for plants and crops to grow, it holds water and prevents flooding, it's an important store of carbon, is a cornerstone of biodiversity and habitats, and it filters pollution and contaminants from water.

Soil is a living system. **One teaspoon of topsoil contains around one billion bacteria**[1]. In urban parks, soil biodiversity can be very high. For example, in Central Park in New York, the breadth of soil microbes was similar to that found across the world in arctic, tropical and desert soils[2]. These soil micro organisms, along with soil insects and worms, decompose organic matter and recycle it into nutrients. In parks, gardens and new developments, these nutrients **support the growth of trees and green infrastructure**. Soil animals also burrow through the soil and help maintain the soil structure, creating pore spaces where oxygen is stored and water can infiltrate. Water movement and storage in the soil is key to mitigating flooding, so looking after soil helps to prevent waterlogging and reduce flood risk.

Soil also plays an important role in mitigating climate change. It is the largest store of carbon on land, storing nearly twice as much carbon as all the plants and atmosphere combined[3]. **When soil is disturbed, carbon is emitted to the atmosphere as CO2 – this means we need to manage soils carefully so that carbon remains stored in the soil.**

Why does soil in planning and construction matter?

Whilst only a small fraction of our total global soil resource is built upon (around 1% of habitable land supports human settlements and infrastructure[4]) towns and cities are the fastest growing use of land and a major driver of soil change. Whilst this is only a small land area, the scale of soil degradation that currently occurs in this small fraction of land is astounding. We are only just beginning to learn about the scale and costs of soil degradation from construction, but from the initial insights presented in what follows, it is clear to see that the current approach to soils in planning and construction presents a major threat to national prosperity.

It is also important to note that these soils also matter because of their proximity to where the majority of people live and work. Soil's ability to function, for example by infiltrating water and reducing flood risk or supporting high quality green spaces, has direct effects on our daily lives. The opportunity is there to better plan and build for soil functioning and create positive benefits for communities and economies being developed.

[1] Needelman (2013) What Are Soils? Nature Education Knowledge, 4(3)(2).

[2] Ramirez et al. (2014) Biogeographic patterns in below-ground diversity in New York City's Central Park are similar to those observed globally.
Proceedings of the royal society B. biological sciences, 281(1795).

[3] Ontl and Schulte (2012) Soil Carbon Storage. Nature Education Knowledge, 3(10)(35).

[4] https://ourworldindata.org/land-use

29.5 million tonnes of soil from construction sites was sent to landfill in 2018: ten times that lost due to soil erosion across the whole of England and Wales

Once compacted, soil structure is damaged and the soil can no longer function – the best approach is to prevent compaction in the first place

Soil loss from construction sites

Topsoils can become mixed with subsoils, and both can be mixed with construction rubble or stones. If these soils no longer meet specifications following mixing or damage during construction, they will be disposed of to landfill. Soils need to be designated as a resource rather than a waste material and should be retained or reused on site as much as possible.

In 2018, **29.5 million tonnes** of soil from construction sites were disposed of in landfill in the UK[5]. Only 0.6 % of this was hazardous, which means a huge amount of this vital resource is being lost during construction. **This is 10 times greater than the 2.9 million tonnes of soil lost due to soil erosion each year in England and Wales**[6]. This soil has value and its loss constitutes a substantial material impact for schemes. The economic value at its most basic level is large. Topsoil has a sale value of between £80 – 100 a tonne bag, and even if only 10% of the soil lost to landfill was usable topsoil, this would equate to approximately £300m per year. However, when the broader functional value of this soil is considered, the cost of soil loss to landfill alone to the UK could be estimated to be in the order of £1.5bn per year.

In addition to soil lost to landfill, **soil erosion on construction sites can be 100 times greater than on agricultural soils** due to the removal of vegetation, disturbance of soil and alteration of topography through stockpiling[7,8].

Take action: Designate soil materials early through a soil survey, soil management plan and a materials management plan using the **CL:AIRE Definition of Waste Code of Practice** (DoW CoP)[9]. *The Routemap for Zero Avoidable Waste in Construction*[10] may also be useful. These actions, when combined with good erosion control, will help prevent the loss of valuable soil from construction sites. This will significantly enhance the sustainability credentials of projects and generate cost benefits if soil reuse can be maximised and earthworks minimised.

Soil compaction

Soil compaction occurs due to trafficking of heavy vehicles, laydown of materials and poor soil stockpiling. This can occur in both topsoils and subsoils on construction sites. When soil is compacted the structure is damaged and the pore spaces are lost, meaning water and oxygen can no longer get into the soil, plants will not grow, and micro-organisms will not survive.

Compaction can reduce water infiltration by 70-99%, and heavily compacted soil starts to resemble the infiltration characteristics of an impervious surface[11]. This leads to poor drainage, waterlogged sites and issues with flooding. Compacted soils also cause problems for plant establishment and growth due to a restricted rooting area, particularly for woody plants and trees[12]. Restoration of soil structure is very difficult, takes many years, and is dependent on soil texture and the damage caused[13]. Remediation of compacted soil adds costs and time to a project and will not immediately return the soil to its former state. Recovery will only occur with time and a lack of disturbance.

Take action: The best approach is to prevent soil compaction in the first place rather than mitigate afterwards. Soils that are protected from vehicle traffic and are stockpiled appropriately will be less likely to suffer from compaction and will continue to function as healthy soils.

[5] Defra (2021) ENV23 - UK statistics on waste data

[6] Graves et al. (2015) The total costs of soil degradation in England and Wales. Ecological Economics, 119, 399-413

[7] Hani Ismail and Yee (2012) MUSLE Evaluation of Soil Loss on a Construction Site by Using Gauging Weirs. Advanced Materials Research, 446-449, 2718-2721.

[8] Weil and Brady (2017) The nature and properties of soils. 15th edition.

[9] CL:AIRE (2011) The Definition of Waste Development Industry Code of Practice.

[10] Green Construction Board (2021) The Routemap for Zero Avoidable Waste in Construction

[11] Gregory et al. (2006) Effect of urban soil compaction on infiltration rate. Journal of Soil and Water Conservation, 61(3), 117.

[12] Day and Bassuk (1994) A Review of the effects of soil compaction and amelioration treatments on landscape trees. Journal of Arboriculture, 20(1), 9-17.

[13] Horn et al. (2021) Consequences of gas pipeline hauling on changes in soil properties over 3 years. Soil and Tillage Research, 211, 105002.

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Soil carbon storage

Typical construction soil management, where topsoil is stockpiled and then replaced onto compacted subsoil, leads to losses of carbon as CO_2 emissions from the soil[14]. Earthworks disrupt soil aggregates, and the carbon stored in these aggregates and attached to soil minerals becomes more accessible to soil micro-organisms[14,15,16]. This makes the carbon more vulnerable to decomposition and it can then be lost as CO_2.

Soil carbon stocks vary greatly depending on soil type, texture, climate, land use and management, and vegetation cover. In the UK, the top 1 metre of soil has been estimated to contain an average of 18 kg carbon per m2 soil (or 180 tonnes per hectare); in semi-natural habitats this is 32 kg per m2 soil, in woodlands it is 25 kg per m2 soil; and in arable land it is 12 kg m2 soil[17].

In 2013, **soil carbon losses due to development were estimated at 6.1 million tonnes of CO_2**; this is greater than losses of greenhouse gases from other big emitting industries such as concrete production (6 million tonnes CO_2 equivalent) and the chemical industry (5.2 million tonnes CO_2 equivalent)[18].

Take action: To keep carbon in the soil there needs to be minimal disturbance, and ideally 'Soil Protection Zones' (SPZs) should be left completely undisturbed to maintain soil carbon storage. These SPZs could be combined with tree root protection areas and areas set aside for biodiversity net gain, where appropriate. Where movement and stockpiling is necessary, this should be done appropriately for the soil texture, water content and weather conditions.

Soil biodiversity

Soil animals and micro-organisms are affected by soil stockpiling, compaction, damage to soil structure and contamination. Most harm to soil biodiversity occurs due to the creation of anaerobic conditions, where soil oxygen is depleted due to compaction during stockpiling or vehicle movement. Anaerobic conditions can develop soon after stockpiling and persist at depths below 1 metre in large stockpiles, though smaller stockpiles can also become anaerobic over time[19]. Anaerobic stockpiles can lead to a reduction in mycorrhizal fungi and earthworm populations[20] and a reduction in the diversity of mycorrhizal species[21]. Compaction can also alter the community structure of soil invertebrates[22].

Take action: To maintain healthy soil life and biodiversity, reduce disturbances to soil structure and chemistry (i.e. avoid physical disturbance and contamination), and ensure that soil is kept oxygenated and is not compacted. This will allow soil insects, worms, bacteria and fungi to continue their ecological processes, helping to recycle nutrients support vegetation growth and store carbon in the soil.

[14] Chen et al (2013) Changes in soil carbon pools and microbial biomass from urban land development and subsequent post-development soil rehabilitation. Soil Biology and Biochemistry, 66, 38-44.

[15] Wick et al. (2009) Soil aggregation and organic carbon in short-term stockpiles. Soil Use and Management, 25(3), 311-319.

[16] Wilson and Karakouzian (2012) Assessing Soil CO2 at Project Sites in the Desert Southwest United States. SEBUA-12 ICHMT International Symposium on Sustainable Energy in Buildings and Urban Areas, Turkey, 323-328.

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[20] Abdul-Kareem and Mcrae (1984) The effects on topsoil of long-term storage in stockpiles. Plant and Soil, 76(1), 357-363.

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Soil sealing

Urban development seals the soil with impermeable surfaces such as road asphalt, paving and concrete. In England, an average of 15,800 hectares (158 square km) of undeveloped land was developed each year between 2013-2018[23]. This is a large increase from an average of 4,500 hectares per year in the 2000s[24], with a percentage increase of over 250 %. As soils are increasingly sealed over there is less water and gas exchange between the soil and atmosphere, and this prevents the soil providing its many functions[25].

Sealing also leads to increased surface run-off, risk of flooding, and pollution to surface water from roads. In urban areas, the proportion of front gardens in England that are paved over increased from 28% in 2001 to 48% in 2011[26] further exacerbating the problem of sealed surfaces in urban areas and putting pressure on urban drainage systems.

Take action: To reduce surface run-off and waterlogging on sites, green spaces and permeable paving should be maximised to enable water to infiltrate. SuDS and water management should be dealt with on-site.

Soil contamination

Contamination in soil can occur during construction through the misuse and spillage of materials or chemicals on site. Notable examples of this are the pollution of soil with hydrocarbons during storage of fuel, and asbestos fibres through the demolition or reuse of rubble materials. Historically, waste materials and rubble were used as fill and there may be legacy contamination in some urban soils and construction sites. Once soil is contaminated or earthworks expose older contaminated soils, rainfall and groundwater can move the contaminated soils and sediments across the site and to adjacent areas spreading the problem further.

Soil that is considered to be lightly contaminated may be reused for some purposes if it does not pose a risk. However, the uncertainty of environmental risk related to soil reuse can lead to resistance, and often new materials are sought as a preference[27].

Take action: Ensure all risk assessments and method statements are adhered to for materials and chemicals on site to prevent spillage and contamination. Be aware of the location of materials laydown and rubble storage in relation to soil stockpiling, water courses and the future landscape design to minimise contamination to both soil and water. Undertake toolbox talks on the importance of soils, good soil management techniques and prevention of contamination.

[23] Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government (2023) 2017 to 2018 land use based change tables Live Tables.

[24] Environment Agency (2019) The state of the environment: soil.

25 FAO (2022) Urbanisation and soil sealing. Soil Letters no 5. Intergovernmental Technical Panel on Soils.

[26] Harley and Jenkins (2014) Research to ascertain the proportion of block paving sales in England that are permeable. Report for the Adaptation Sub-Committee of the Committee on Climate Change.

[27] Hale et al. (2021) The Reuse of Excavated Soils from Construction and Demolition Projects: Limitations and Possibilities. Sustainability 13(11), 6083.

Current state of UK policy and guidance or soils in construction

There are a number of relevant existing policies, reports and guidance documents that address soils in construction, as summarised in Table 1. These policies and documents contain a great deal of useful advice. However, the current state of soils in planning and construction is evidence that, to date, these have not gone far enough or have not been effectively implemented.

Defra Construction Code of Practice for the Sustainable Use of Soils on Construction Sites

The Defra Code of Practice (2009) sets out the importance of soil functions and the issues that arise through poor management of soils on construction sites. The key messages in the Code of Practice are the need for a **soil resource survey** which can feed into a materials management plan, and a **soil resource plan**, which sets out how soil will be stripped, hauled and stockpiled.

The guidance sets out methods for soil handling including topsoil and subsoil stripping, stockpiling, reinstatement, and remediation of compaction. **This guidance is due to be updated in 2022/2023 – the most up-to-date version of the guidance should be used when making soil management plans and construction method statements.**

Working with Soil Guidance Note on Benefitting from Soil Management in Development and Construction – British Society of Soil Science (2022)

This BSSS (2022) guidance note sets out recommendations for **soil resource surveys** and **soil management plans**. It states that a soil resource survey should be conducted by a professional soil scientist with the appropriate competencies as set out in BSSS *Working with Soil Professional Competency in Soil Science* Documents. It also highlights some key recommendations around surface flooding, planting in relation to soil conditions, and soil biodiversity.

British Standards

The following British Standards are relevant when working with soils in construction:

- **BS 3882:2015 Specification for topsoil** – this specifies requirements for natural or manufactured topsoil brought in to a site rather than topsoils remaining in situ.
- **BS 5837:2012 Trees in relation to design, demolition and construction** – provides recommendations relating to tree care and Root Protection Areas. It recommends that there should no excavation, no changes of soil level and no compaction within the root protection area.
- **BS 8683:2021 Process for designing and implementing Biodiversity Net Gain** – sets out a process for implementing biodiversity net gain to ensure that development and land management leaves biodiversity in a measurably better state than before.
- **PAS 100:2018 Specification for composted materials** – provides a compost quality standard for the organics recycling sector.

National Planning Policy

The National Planning Policy Framework (NPPF) for England (DLUHC, 2021) recognises the need for local planning policies that relate to the protection and enhancement of soils. Through the NPPF, mitigation and remediation of despoiled, degraded, contaminated and unstable land, where appropriate, is recommended. In relation to green field sites, the NPPF advocates that the best agricultural land is preserved from development and poorer quality agricultural land be used preferentially.

Soils in Environmental Impact Assessment

Depending on the type of development and statutory importance of the site, soils may be considered in Environmental Impact Assessment (EIA). The recent IEMA guidance: A New Perspective on Land and Soil in Environmental Impact Assessment (2022), provides a comprehensive methodology to assess the effects of developments on soil functions. Soil specialists in EIA teams should use it to assess the significance of development impacts on selected soil properties and the consequent changes in soil functions.

Local Planning Guidance

Soil in local planning is routinely dealt with through Agricultural Land Classification (ALC), however ALC data alone is not sufficient for assessment of a development site, as confirmed by Natural England[28]. Specific soil policies in local plan documents are not common, though two examples of local soil guidance and policy follow.

Worcestershire County Council set out the importance of soil and the implications of poor management during development in a technical research paper[29]. West Lothian Council provide a more recent example of local policy and guidance adopted in 2021. They set out a policy requirement for developers to provide a soil sustainability plan and to use their planning guidance document: *Soil Management & After Use of Soils on Development Sites*[30], which will be applied when making planning decisions. The aim of the guidance is to reduce flooding, water logging and failed landscaping due to poor soil handling.

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Table 1 – UK Policy and Guidance

Strategies, Plans & Legislation

Document Type	Date	How is soil considered?
Safeguarding our Soils: A strategy for England (Defra)	2009	The vision of the strategy is that by 2030 all England's soils will be managed sustainably and degradation threats tackled successfully. This includes soils in urban areas being valued during development and construction practices that ensure that vital soil functions are maintained.
25 Year Plan to improve the Environment (Defra)	2018	The plan identifies actions to protect and improve soils with a focus on agricultural soils. The risks to soils from construction and subsequent loss of soil functions are not addressed in the plan.
The Environment Act (UK Parliament)	2021	The Act does not set specific soil targets. However, a Soil Health Action Plan for England (SHAPE) is expected to be produced which will provide soil targets.
The Scottish Soil Framework	2009	The aim of the Framework is to promote the sustainable management and protection of soils in relation to the economic, social and environmental needs of Scotland. It does this by identifying 13 soil outcomes.
EU Soil Strategy for 2030: Reaping the benefits of healthy soils for people, food, nature and climate (European Commission)	2021	The strategy provides a framework to protect and restore soils. It sets out a vision and objectives to achieve healthy soils by 2050, with actions by 2030; and announces a Soil Health Law to ensure a high level of protection.

National Planning Policy

Document Type	Date	How is soil considered?
National Planning Policy Framework (NPPF)	Updated 2021	The NPPF focuses on valued landscapes and sites of biodiversity, geological value or soils with a statutory status or identified quality. Soils are not valued or given statutory status unless they are peat soils or considered through Agricultural Land Classification (ALC).

National Planning Guidance

Document Type	Date	How is soil considered?
Code of practice for the sustainable use of soils on construction sites (Defra)	2009 – update in 2022	This voluntary code sets out the importance of soil functions, gives guidance on best practice, and highlights issues that arise through poor management of soils on construction sites. Key messages are the need for a soil resource survey which can feed into a materials management plan, and a soil resource plan, which sets out how soil will be stripped, hauled and stockpiled.
Planning Practice Guidance for the Natural Environment	2019	This guidance suggests planning can safeguard soils by referring to the Defra Code of practice.
Guide to assessing development proposals on agricultural land (Natural England)	Updated 2021	This sets out how the NPPF and 25 Year Environment Plan aim to protect agricultural land and soils, with a focus on using ALC to inform planning decisions.
A New Perspective on Land and Soil in Environmental Impact Assessment (IEMA)	2022	This provides guidance for soils and land in Environmental Impact Assessment. It provides an approach to assess the impacts of a development proposal on soil properties and soil functions and sets out how soils should be considered more substantially in EIA.
SEPA Position Statement on Planning and Soils	/	Sets out SEPA's role in relation to land use planning and the Scottish Soil Framework.

Local Planning Guidance

Document Type	Date	How is soil considered?
Technical research paper: Planning for Soils in Worcestershire (Worcestershire County Council)	2011	Highlights the importance of soil and the implications of not managing it well through development.
Planning Guidance: Soil Management & After Use of Soils on Development Sites (West Lothian Council)	2021	The local development plan sets out a policy requirement for developments to have a Soil Sustainability Plan and to use this planning guidance. The guidance aims to reduce flooding on development sites and failed landscaping due to unsuitable soil handling.

Other Resources

Document Type	Date	How is soil considered?
The Definition of Waste: Development Industry Code of Practice (CL:AIRE)	2011	This voluntary code describes good practice for assessing whether excavated materials are classified as waste or not, and determine whether treated material can be re-used.
Policy Position Statement: Protecting and Enhancing Soils (CIWEM)	2019	Highlights the multi-functional and non-renewable nature of soils. It calls for actions to reflect this, including increased legislation to protect soils, implementation of the 25 Year Environment Plan and improvements to the evidence base for policy decisions about soils.
Position Statement: Sustainable Urban Soils Health Initiative (SUSHI) (Sustainable Soils Alliance)	2020	The position statement sets out where policy and guidance is lacking, where current issues are arising, and makes the case for an update to the Defra Code of practice.
Guidance Note: Benefiting from soil management in development and construction (British Society of Soil Science)	2022	This note makes recommendations based on soil resource surveys and soil management plans. It also highlights key recommendations around surface flooding, planting in relation to soil conditions, and soil biodiversity.
Soils and Stones Report (Society for the Environment)	2021	This report recognises soil as a valuable resource and material, and aims to prevent it ending up in landfill by promoting its re-use in construction projects.

Three barriers to improving integration of soil sustainability into planning and construction

Consultation with policy, industry and academic experts presented three major barriers to better treatment of soils in planning and construction.

1 Soil is not understood or valued – earthworks are seen as something to be completed to get to the 'real work', and soil is seen as 'muck' to be removed. Project teams (including clients, designers and contractors) are often unaware of the importance of soils and how to design with soils in mind. Soil specialists are often brought into a project too late, leaving little opportunity to make useful plans for soil management and prevent soil damage.

2 Soil data availability – site-scale soil data is not always available and desk-based studies or ALC data is not sufficient to understand the soil resource, in particular for soil carbon storage. A full soil survey should always be done for EIA or during early stages of the project and the soil data shared throughout the design and construction stages.

3 Time and space constraints – project timelines can mean that topsoil stripping and stockpiling go ahead even in poor weather. Once the soil is damaged in this way it cannot be restored easily. Space limitations can also lead to poor stockpiling, where topsoils and subsoils become mixed. This means soil will be replaced incorrectly and will cause damage to the soil ecosystem, biodiversity and soil structure.

What would help?

Think about soil early on – this applies to all those involved in a project: developers, EIA consultants, masterplanners, designers and contractors.

Understand the soil resource on site – a soil survey (see appendix 1) will tell you what type of soil you have and help you understand the functions it provides. This must go beyond geotechnical or contamination properties and should include soil texture, water holding, nutrients and carbon storage capabilities.

Design for soil retention and reuse – consider levels and construction methods from the outset – aim to minimise cut and fill, locate road access on areas of lower soil quality, prioritise greater topsoil depth in gardens and open spaces, work with the existing soils and landscape.

Write a soil management plan (see appendix 2) – use the soil survey to plan how best to use the soil resource, including how and when to move, store, and respread the soil, and how to avoid contamination. Proper planning and management of the soil on site means it can be reused, reducing the need to buy in new topsoil and leading to cost savings. Functioning soil at project completion with minimum compaction or disposal should be the outcome.

Soil Protection Zones (SPZs) – fence off areas in a similar way to tree Root Protection Areas (as per BS 5837) to prevent disruption to soil in those areas – this will enable soil to continue to function and retain soil biodiversity, soil carbon storage and water storage capability in those areas.

Include soil in accreditation schemes – soil, its biodiversity, and carbon storage properties should be taken account of in sustainability, nature and carbon accreditation schemes and targets.

Education and training – this would be useful for contractors moving and storing soil on site, planners making planning decisions, and landscape architects writing soil specifications.

Integrate soil with existing regulations – biodiversity net gain could provide an opportunity to protect soil through protection of older trees and habitats.

Monitoring of soil at completion – the aim is to have a functioning soil following project completion, with minimum compaction and good soil structure which will benefit water infiltration, soil biodiversity, plant growth and carbon sequestration. Monitoring the soil after it is respread or topsoil is brought in, and subsequent compaction is avoided, would ensure soil is able to provide these functions.

Guiding Principles for Soils in Planning & Construction

1. Plan, design and construct for soil functions – including soil carbon storage and reducing CO2 emissions, water infiltration and flood mitigation, soil biodiversity, and optimal support for above ground vegetation and trees
2. Engage local communities and stakeholders on soil issues and development during the consultation process
3. Reuse or share soil – maximise use of soil on site and share excess soil to ensure there is no loss to landfill
4. Maximise permeability – minimise soil sealed area and maximise permeable paving to allow water to infiltrate and soil to respire; manage draining on-site using SuDS rather than off-site
5. Minimise compaction – plan haul routes and materials storage and designate Soil Protection Zones (SPZs) where soil is protected from traffic, stripping and stockpiling
6. Stockpile correctly – minimise the duration of stockpiling and size of stockpiles, ensure this is undertaken according to soil texture, moisture and weather conditions, and ensure topsoil and subsoil are separated and do not become mixed or contaminated
7. Minimise erosion – and prevent sediment loss by use of vegetation cover, seeding, mulching, silt fences or rolls, or geotextiles, particularly on slopes and stockpiles
8. Learn through training – engage with soil professionals to continually develop best practice

What you can do

Local Authorities

- Include a specific soil policy in new local development plan documents – highlight the importance of soil functions and ensure soil is valued and protected in construction.
- Use a standard planning condition for soil that includes – consideration of soil functions, requirement of a soil survey and soil management plan, and a method statement for soil prior to commencement of works. It should also require evidence of good practice for soil management in construction, and monitoring of the soil following project completion. See West Lothian Council planning guidance for an example (see resources below)
- The construction method statement should include soil as a resource – ensure the order of work and project timings take account of soil management and that measures will be taken to minimise damage. Methods should be informed by the latest Defra Construction Code of Practice for the Sustainable Use of Soils on Construction Sites
- Use Soil Protection Zones (SPZs) to minimise vehicle compaction in areas for future green spaces and private gardens
- Ask for details on how a scheme has considered and optimised synergies for soils, trees and biodiversity
- Request sustainable drainage (SuDS) and that permeable paving is maximised to enable soil to function, allowing water to infiltrate and enable flood mitigation.

What to look for in a soil survey

- Ensure that site-based data is included that is based on soil sampling from the site and laboratory analysis
- Look at the soil texture, water content, pH, carbon content and any contamination – this will tell you about the soil's permeability, biology and chemistry and will give an indication of its functioning (see Appendix 1: What should a soil survey contain?)
- Look for evidence of liaison with the project ecologist, landscape architect and arboricultural consultant to ensure the soil survey provides data they require to inform their work.

What to look for in the soil management plan

- The soil management plan should be based on information in the soil survey.
- It should set out plans for soil protection, soil handling, soil use and any soil remediation needed (see Appendix 2: What should a soil management plan contain?)

Resources:

- Example of planning guidance for soils in construction – West Lothian Council – Planning Guidance: Soil Management & After Use of Soils on Development Sites (adopted 2021).
- Defra – Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (2009) – due to be updated

Clients and Developers

- Include the importance of soil functions in tender briefs to consultants and contractors
- Bring a soil specialist in early before the scheme is set and ensure their liaison with the ecologist, arboricultural consultant and landscape architect at early project stages to achieve collaborative working and maximising synergies
- Consider levels and earthworks quantities early in the process and involve Quantity Surveyors to maximise cost benefits of retaining and re-using soils, feeding into the overall project viability analysis
- Undertake a soil survey for EIA and use the IEMA guidance for land and soil in EIA. Use the soil survey to write a soil management plan and construction method statement, going beyond engineering or contamination surveys (see Appendix 1: What should a soil survey contain? And Appendix 2: What should a soil management plan contain?).
- Use the latest Defra Construction Code of Practice for the Sustainable Use of Soils on Construction Sites to inform the soil management plan and appropriate method for soil stockpiling.
- Make EIA soil data available to all consultants and contractors for all project stages
- Provide the design team with levels data from the outset and ask them to design to minimize cut and fill
- Write a materials management plan before work starts on site – retain the valuable soil resource and reuse it appropriately
- Plan for the use of excess soils across the site share with another site if it can't be reused
- Consider carbon calculations for projects that take account of soil carbon, and use such data to feed into project viability and sustainability credentials. Monitoring of soils following project completion can provide evidence of good soil management and the maintenance of soil carbon stores
- Plan for rubble management – ensure it is not disposed of in gardens and green space areas
- Promote the understanding and importance of soil to contractors e.g. through training, and demand careful management of soil from contractors on site.

Benefits to clients and developers

- Shows you are taking environmental and climate change issues seriously – this could reduce planning uncertainty
- High standard private gardens and green spaces are a selling point for future home owners
- Involving a soil specialist early will help you get it right first time – this leads to reduced project time
- Careful management of existing soil resources will lead to less landfill tax and smaller topsoil import costs
- Lower transport and fuel costs – less need to move soil to and from the site
- Fewer complaints and claims, for example, from home owners when private garden soils fail, are waterlogged, the structure is damaged, large amounts of rubble is found etc.
- Help with ECSR targets

Resources

- Defra – Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (2009) – due to be updated
- CL:AIRE – DoW CoP – The Definition of Waste: Development Industry Code of Practice (2011)
- IEMA guidance – A New Perspective on Land and Soil in Environmental Impact Assessment (2022)
- Green Construction Board & Construction Leadership Council – The Routemap for Zero Avoidable Waste in Construction (2021)
- British Society of Soil Science - Working with Soil Guidance Note on Benefitting from Soil Management in Development and Construction (2022)
- Farm Carbon Toolkit – Monitoring Soil Carbon: a Practical Field, Farm and Lab Guide (2021) – though this is based on agricultural soil it provides a useful resource to understand monitoring for soil carbon.

Design Teams

- Consider soil early on in a collaborative way – design based on soil functions and soil survey information
- Key disciplines to collaborate and advise on soil functions: soil specialist, ecology, arboriculture and landscape architecture.
- Key disciplines to design with soil in mind: landscape architects, architects and engineers. The lead designer must coordinate collaboration.
- Maximise synergies to create better schemes for soils, tree protection, habitats, biodiversity net gain, open spaces and private gardens
- Use these collaborations to inform the masterplan – plan to reuse the existing soil resource
- Design with levels in mind from the outset – explore options to minimise cut and fill, consider construction solutions, such as foundations, early to inform design solutions, ensure greater topsoil depths in private gardens and green spaces
- Maximise permeable paving in the design
- Soil specification – provide sufficient detail to allow soil to be stockpiled carefully, reused appropriately, and soil condition to be able to function to support the design

Benefits to Design Teams

- Better and more sustainable masterplans that take advantage of the existing soil resource
- Show greater value for money to clients
- Greater sustainability credentials of schemes
- ECSR benefits

Resources

- Landscape Institute – Technical Information Note: Soils and Soil-forming Material (2017)
- Landscape Institute – Technical Information Note: Carbon and Landscapes (2018)
- Defra – Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (2009) – due to be updated
- British Society of Soil Science – Working with Soil Guidance Note on Benefitting from Soil Management in Development and Construction (2022)

Contractors

- Include soils in ECSR targets and raise with clients
- Undertake toolbox talks on the importance of soils and good practice for soil management
- Work to the soil management plan, construction method statement and planning recommendations
- Refer to the latest Defra Construction Code of Practice for the Sustainable Use of Soils on Construction Sites to inform methods for soil stockpiling
- Keep topsoil and subsoil stockpiles separate and label clearly
- Undertake stockpiling appropriately according to soil texture and weather conditions
- Consider soil compaction when planning haul routes and materials laydown – minimise subsoil compaction rather than remediating afterwards
- Stick to planned haul routes and minimise soil compaction or damage in Root Protection Areas or Soil Protection Zones
- Work to rubble management plans – ensure it is not disposed of in private garden and green space areas

Benefits to contractors

- Good soil management from the start will enable better functioning soils at completion – less risk, and less cost for remediation or replacement afterwards
- Help with ECSR targets

Resources

- Defra – Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (2009) – due to be updated
- CL:AIRE – DoW CoP – The Definition of Waste: Development Industry Code of Practice (2011)

Soils in Planning and Construction Task Force

Who we are

The Soils in Planning and Construction Task Force is made up of professionals from across soil science, local authorities, urban design and landscape architecture. The task force have come together to drive better management of soils through the planning and construction stages of development projects. Their aim is to protect and improve our vital soil resources, enabling soils in the built environment to function and provide crucial ecosystem services that support thriving places to live and work.

Task Force members

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- Professor Jess Davies, Lancaster University
- Roisin O'Riordan, Lancaster University
- Paul Hatch, Principal Planning Officer, Lancaster City Council
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The report authors were Roisin O'Riordan, John Quinton and Jess Davies at Lancaster University, with support from all Task Force members.

www.lancaster.ac.uk/soilstaskforce

Network of Experts

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- Helen Brookes – Atelier Helen Brooks, RIBA Cornwall
- Jess Frivnak – RIBA
- Jessica Lewis – St James Group / St William Homes, Berkeley Group
- Joanne Kwan – CIRIA
- Julia Thrift – TCPA and Green Infrastructure Partnership
- Luke Engleback – Studio Engleback
- Martin Ballard – Willmott Dixon, Soil & Stones Group at SocEnv
- Nicholas Invernizzi – St James Group / St William Homes, Berkeley Group
- Olivia Dear – Countryside Properties
- Rob Askew – Askew Land and Soil
- Robert MacDiarmid – Countryside Properties
- Robin Nicholson – Cullinan Studio, Chair of Cambridgeshire Quality Panel
- Sue James, Trees & Design Action Group

Glossary

- **Organic matter** – is the organic material that comes from dead plant matter, including roots, leaves and stems, and dead organisms in the soil that all contribute organic compounds to the soil as they decompose.
- **Permeability** – is a measure of the ability of soil to allow water to infiltrate and pass through it.
- **Soil biology** – this encompasses all the insects, worms, fungi, bacteria and all micro-organisms that live in the soil and are important for key soil processes.
- **Soil carbon** – this is the carbon stored in soils globally. It includes soil organic matter and inorganic carbon as carbonate minerals.
- **Soil functions** – these are the important processes and services that soil provides, for example: the ability of the soil to hold water, provide nutrients to plants, and to enable food crops to grow.
- **Soil organic carbon** – this is the organic carbon that is stored in soils and originates from the ecological processes in soils, through plants, roots and organisms.
- **Soil processes** – this include all the biological, chemical and physical processes that occur in soil, for example, nutrient cycling, water cycling, organic matter storage and carbon sequestration.
- **Soil sealing** – this is the covering of soil with impermeable surfaces in urban areas, such as asphalt, concrete, stone or paving.
- **Soil structure** – the arrangement of pore spaces and solids within soil.

Photography courtesy of **Birgit Hontzsch** and **John Quinn**

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Appendix 1:
What should a soil survey contain?

A soil survey provides information about soil properties and functions beyond the information given in a geotechnical survey, contamination survey or agricultural land classification. It enables an understanding of how the soil functions, including the texture and structure, nutrient availability, water holding capacity, ability to store carbon and support vegetation growth.

The soil survey should

- Be based on representative site sampling and laboratory analysis
- Include a description of the soil types on site, their thickness and properties including soil texture, pH, water content, nutrient content, carbon content / stock, and any heavy metal or contamination issues.
- Include a map displaying areas of different soil types
- Include a report that describes the different soils on site and their suitability for future uses in the designed scheme

What the soil survey data tells you

- **Soil texture and water content** – this will tell you about the soil's permeability, clay / sand content and ability for water to infiltrate and be stored in the soil.
- **Soil thickness** – gives an indication of the volume of soil resource available and will determine how earthworks will be undertaken.
- **pH** – this will tell you about the chemistry of the soil which controls nutrient availability, biological processes such as micro-organism and fungi activity, and the behaviour of contaminants or heavy metals.
- **Nutrient content** – provides information on how fertile the soil is. This should be used to determine the type of habitat and planting scheme that will be used in the design of the scheme.
- **Carbon content / carbon stock** – this gives an indication of the soil carbon storage of each type of soil at the time of the survey. It is often referred to as soil organic carbon (SOC). It should be used to consider which areas could be protected from soil handling and compaction to maintain the carbon in the soil and prevent its loss to the atmosphere. It could also be used to plan for planting and soil management to increase soil carbon storage.
- **Heavy metals and contamination** – this information will highlight risks from the soil which will need to remediated.

The British Society of Soil Science document: *Working with Soil Guidance Note on Benefitting from Soil Management in Development and Construction* (BSSS, 2022) makes similar recommendations for soil surveys and soil management plans. It states that a survey should be conducted by a professional soil scientist with the appropriate competencies as set out in BSSS *Working with Soil Professional Competency in Soil Science* Documents. See the guidance note for more details.

Appendix 2:
What should a soil management plan contain?

A soil management plan sets out how the soil will be planned for, handled, and managed so that the soil is able to function on completion of the project. The soil management plan will use data from the soil survey to inform plans for the site. It should include plans for:

Soil Protection

Plans for haul routes and laydown areas to minimise the extent of soil compaction across the site and ensure clear signage to prevent additional damage and compaction outside of these areas.

The potential use of Soil Protection Zones (SPZs) where soil will be fenced off and protected from all disturbance or compaction from vehicle traffic. These will be clearly signposted.

Soil handling

- The location, size and duration of stockpiles that are appropriate for soil texture, moisture and weather conditions
- Methods of stripping and stockpiling
- The separation of stockpiles for topsoil and subsoils and clear labelling
- The prevention of mixing of soils with rubble or waste materials
- Haul routes and materials laydown to minimise soil compaction

Soil use

- How soil will be reused across the site, the volume that will be reused, and plans for any excess soil.
- Soil reinstatement that is appropriate in depth, nutrients and texture for future planting and green spaces, private gardens, and SuDs features.

Soil remediation

- How any damaged or compacted soil will be remediated.
- The plan should also state who will be responsible for supervising soil management on site.

Soil management plans should always refer to the latest Defra *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites*. This provides detailed soil handling guidance for soil stripping, stockpiling, reinstatement and remediation of compaction. See more in the Defra Code of Practice.

Appendix SMP7

Planning Aftercare and Advice – Natural England (April 2022)

GOV.UK

Home > Environment > Food and farming
> Reclaim minerals extraction and landfill sites to agriculture

NATURAL ENGLAND

Guidance

Planning and aftercare advice for reclaiming land to agricultural use

Updated 19 April 2022

Applies to England

Contents

This publication is available at https://www.gov.uk/government/publications/reclaim-minerals-extraction-and-landfill-sites-to-agriculture/planning-and-aftercare-advice-for-reclaiming-land-to-agricultural-use

1. Plan to reclaim land to agriculture

Natural England is a statutory consultee (https://www.gov.uk/guidance/consultation-and-pre-decision-matters#Statutory-consultees) in the planning process. Planners should use this advice to make sure developers understand what's needed to reclaim sites to agriculture.

It applies to planning and aftercare of:

- mineral extraction sites
- landfill and land raising sites (landforms created by above ground waste) - referred to as 'landfilling' in this guide

It provides advice to planners on:

- what to check for in planning applications
- how to manage development proposals

Refer to sections 4 and 5 in the Guide to reclaiming mineral extraction and landfill sites to agriculture (https://www.gov.uk/government/publications/reclaim-minerals-extraction-and-landfill-sites-to-agriculture) to make sure the proposed afteruse is appropriate.

2. What to check for in planning applications

You should check that development proposals for mineral extraction and landfill include considerations to reclaim land to agricultural use, where it's appropriate. Read this section for more information.

2.1 Restoration plan

Development proposals should have a restoration plan and statement that includes:

- an assessment of agricultural land and soil resource of the site before work started, refer to section 5 in the Guide to assessing development proposals on agricultural land (https://www.gov.uk/government/publications/agricultural-land-assess-proposals-for-development)
- how a developer intends to restore the site to agricultural use after mineral extraction or landfilling has finished

- an aftercare programme (usually for 5 years) to reach a satisfactory standard of agricultural afteruse from activities such as, cultivating, reseeding, draining or irrigating, applying fertiliser, or cutting and grazing the site

Maps to show the intended:

- landform after restoration showing contours on the map at appropriate intervals
- surface features, such as ditches, field boundaries and tracks
- habitat and water features

2.2 Agricultural land classification (ALC) report

Read section 4 in the Guide to assessing development proposals on agricultural land (https://www.gov.uk/government/publications/agricultural-land-assess-proposals-for-development).

2.3 Soil resources report

A soil resources report can use the same soil data as an ALC survey. The report should show how to deal with each soil type during the works and through restoration. It should include:

- soil profile and depth (usually to 1.2m)
- soil texture and stoniness
- soil structure
- volumes of soil types and suitability for reuse
- soil drainage status (a measure of its wetness)
- available water capacity (a measure of how dry and arid it is - its 'droughtiness')
- nutrient status, organic matter content, and pH (the acidity or alkalinity of the soil)
- chemical characteristics, such as salinity or potential contaminants (if appropriate)

Include soil data in the restoration plan to show:

- the intended stripping depths and volumes of each soil type
- the intended standard of restoration you expect to achieve

- how to replace lost soil that was part of the extracted mineral, such as stony or sandy subsoils, clay or brick earth
- how to safeguard soil with ecological significance, such as peats or woodland soil containing a seed bank and low nutrient soils

An experienced soil specialist should prepare these reports, such as a member of the British Society of Soil Science.

The reports should show soil and land quality comparisons at the beginning and end of workings so you can be sure restoration and aftercare provision will meet the required standard for agricultural use.

2.4 Soil handling plan

A soil handling plan should show how the developer proposes to:

- replace soil (for example its intended location, depth, composition and contour)
- handle soil to avoid mixing and contamination
- move and store soil to avoid compaction
- avoid double handling (to minimise soil losses, mixing and structural damage)
- keep different types of soil separate from each other when moved
- avoid compacting unstripped and partly-stripped soil especially on large-scale phased developments and show haulages routes
- avoid compaction
- remedy compaction (for example by ploughing into the subsoil or loosening hard layers of soil using agricultural machinery)

The plan should:

- show the intended storage location
- specify the equipment and technique needed for each soil type to strip, store and replace it (such as loose tipping from a truck with soil spreading using a 360 degree excavator) - read the Institute of Quarrying Good Practice Guide for Handling Soils in Mineral Workings (https://www.quarrying.org/soils-guidance)

Moving soil

Operators should use a soil specialist to advise on the methods for using and handling different soils and the best time to strip soil and move it to limit damage.

The proposals should include moving soil in the drier months from April to September. The drier season can be longer in the east and south of England.

Test soil wetness

Soil tests should include a visual examination of the soil and a physical assessment of the soil consistency. Refer to the Institute of Quarrying Good Practice Guide for Handling Soils in Mineral Workings Part One Table 4.2 (https://www.quarrying.org/soils-guidance) (this document may not be accessible to assistive technologies).

A soil moisture meter can test the wetness of soil samples. 80% of samples must meet the lower plastic limit for each soil type - that is the point at which the soil changes from pliable to crumbly. The lower plastic limit should be known for each soil type before using the moisture meter.

When not to move soil

Operators shouldn't move soil if:

- the soil wetness tests or moisture meter indicate the soil is too wet
- it's raining or just been raining
- there's heavy rain forecast
- there are puddles on the soil surface
- the ground is frozen or covered by snow
- from October to March, when it's wetter, unless you get permission from the mineral planning authority (MPA) - refer to section 1.2 in the Guide to reclaiming mineral extraction and landfill sites to agriculture (https://www.gov.uk/government/publications/reclaim-minerals-extraction-and-landfill-sites-to-agriculture) for a definition of MPA

Keep land vegetated for as long as possible before moving topsoil. Avoid soil erosion by planting quickly. This:

- allows natural drying through evaporation and transpiration
- develops the soil structure

2.5 Soil storage proposals

Store soil in mounds (known as 'bunds'). To store soil for more than 6 months (or over winter), you'll need to:

- seed it with grass
- treat it for weeds

- cut the grass at least twice a year

To keep soil aerated, reduce erosion, runoff and ponding, soil bunds should:

- be no more than 3m high for topsoil and 5m high for subsoil
- be located on dry level ground
- not disrupt natural surface drainage
- be stable structures with side slopes between 25 degrees and 45 degrees

Loosen soil under the bunds when you remove them.

Soil storage areas need to be large enough to store soils separately. To reduce mixing, soil bunds should be:

- of a single soil type including topsoils and other soil forming material
- located on similar material, for example remove topsoil to store subsoil and store topsoil on similar topsoil (like-on-like)

Single bunds should have different soils separated by another material, such as straw bales or a synthetic barrier (geotextile).

2.6 Drainage and landform

Restored land must drain properly. Proposals may need to include adding surface ditches and underground drainage systems to restore land to its previous quality, even if the land was free draining before.

Minerals such as sand, chalk and gravel act as natural drainage. You must take this into account if your development takes away any natural drainage.

You should:

- replace soil to a depth specified in your restoration plan, typically 30cm of topsoil and 90cm of subsoil
- fill all uneven surfaces with suitable soils
- remove stones (larger than 10cm across) from replaced soil to avoid danger to livestock and damage to machinery

For mineral sites that don’t need filling with ‘overburden’ (the geological material above the mineral being extracted) or imported material, you should replace topsoil and subsoil directly onto a well prepared and loosened base layer.

For landfill sites, replace soil over a capping layer - this forms a barrier to the waste products below.

The final landform should:

- have an even gradient for drainage and lets farm machinery operate safely and efficiently (for best and most versatile agricultural (BMV) land the gradient must be 7 degrees or less) - see section 4 in the Guide to assessing development proposals on agricultural land (https://www.gov.uk/government/publications/agricultural-land-assess-proposals-for-development) for a definition of BMV land
- have open-ended valleys to avoid drainage problems
- avoid a lower level restoration which could lead to wet soils and drainage problems
- merge with adjoining land to avoid sudden changes in levels and potential 'ponding' of water

3. Record keeping

Operators should keep records for:

- each soil bund - you should label every one you create
- all restoration operations including dates, volumes and types of soil moved and where the soil came from
- weather conditions during stripping and moving
- any problems encountered to help with future decisions

Operators should check their records each year to make sure they match the restoration plan, as this can change when works start. You can ask for these records when:

- deciding on planning permission
- monitoring the site at a later stage

4. Aftercare plan and conditions

You should check that operators have an aftercare plan to reclaim land for agricultural use. You should attach planning conditions to planning permission that sets out an appropriate outline strategy for aftercare for the site see section 4.2

Fully reclaimed land (that's restored land and its associated aftercare) should have topsoil and subsoil replaced as described in the restoration plan see section 2.1.

It must be cultivated and treated appropriately for up to 5 years to restore its structure and stability for normal agricultural use - this is often longer (by agreement) for woodland, amenity, or wildlife conservation.

You should refer to the planning practice guidance on restoration and aftercare (https://www.gov.uk/guidance/minerals#Restoration-and-aftercare-of-minerals) for more detail.

4.1 Operators' responsibilities for aftercare

Operators must pay for the restoration and aftercare of the site. Operators must discuss any extensions to their aftercare agreement with you.

4.2 Outline strategy for aftercare

Operators must submit an outline strategy for aftercare with their planning application. For projects with a long lifespan you can create a condition.

As part of the outline strategy, operators should:

- map all areas in the aftercare plan and include any operations taking place in different phases
- state when, where and how they'll establish grass or crops
- describe the hedgerows, trees and surface features they'll establish
- outline drainage plans and water supply if appropriate
- explain their plans for agriculture, soil management, using fertiliser and controlling weeds and pests
- commit to an annual meeting with you and other interested parties

4.3 Phased restoration and aftercare

Operators should agree care and maintenance plans with you (as an interim stage). You should do this when restoration of small parts of a larger site is taking place in phases, such as a landfill operation. The aftercare period starts when the smaller parts have made up a large enough area to start aftercare management. Operators should agree this size with you.