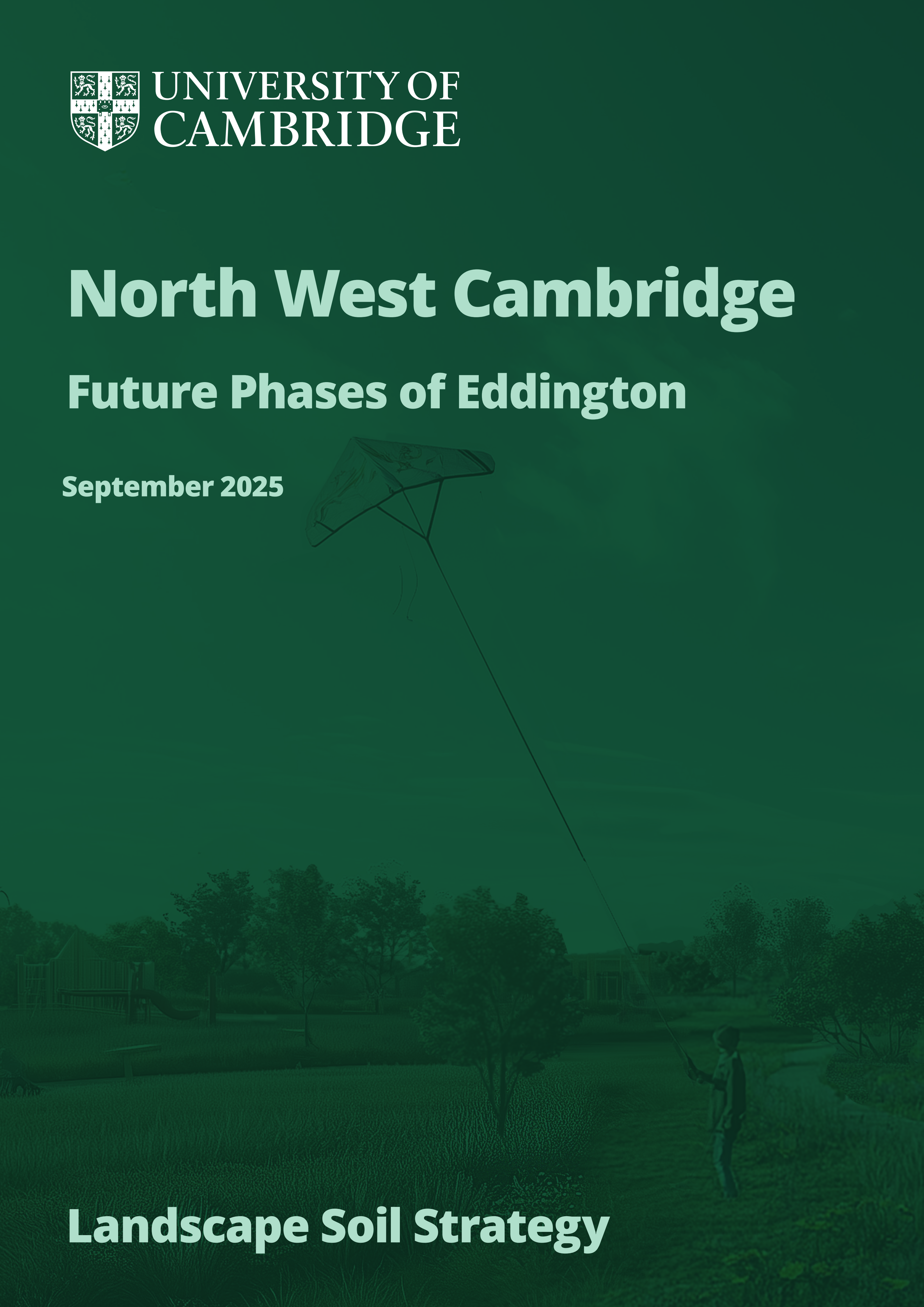
UNIVERSITY OF CAMBRIDGE

North West Cambridge

Future Phases of Eddington

September 2025



Landscape Soil Strategy

NORTH WEST CAMBRIDGE

LANDSCAPE SOIL STRATEGY

Prepared on behalf of:

UNIVERSITY OF CAMBRIDGE

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1.0 INTRODUCTION

Tim O'Hare Associates LLP was commissioned by University of Cambridge to provide soil science consultancy services relating to the horticultural soil requirements for future phases of the North West Cambridge (NWC) development, Eddington.

1.1 Background

The future development of the NWC site will build on the success of Phase 1 and will expand the Eddington development to include further residential units and amenities and extensive landscaping including trees, shrub and ornamental planting, amenity grass, allotments, shared and community gardens, foraging orchards and SuDS. Land to the west of the development will provide open space for informal use and areas of habitat creation. New sports facilities, including various sports pitches with artificial surfaces are also included within the proposals.

Several investigations of the site soil conditions across all development phases of the NWC development have previously been undertaken, most recently in December 2024 (TOHA Soil Resource Survey report TOHA/25/3550/HS) in which the overall re-use potential of the site soil resources for a range of landscape typologies is identified. This Landscape Soil Strategy report will provide further advice on soil types (site won or imported as appropriate) for the various proposed planting habitats and landscape soil build up, with reference to information contained within the current Gateway 3 Preferred Masterplan.

The design incorporates a diverse range of planting environments and therefore, soils of variable composition and function are likely to be required.

1.2 Limitations

This document is for landscape soils only to ensure that optimum conditions for plant growth are achieved, as such it should not be relied upon for alternative uses. This document is based on the Grant Associates Gateway 3 Preferred Masterplan package of information submitted to TOHA, via email from Turner Townsend, on 15th April 2025.

Any geo-technical, geo-environmental or engineering issues are outside of the remit for this landscape soil strategy.

2.0 SCOPE OF WORKS

A technical review has been undertaken of the various elements of the project's design currently available that will influence, or be influenced by, soils. This includes the following information (where available) relating to the current landscape design:

- landscape design (layouts, planting types, soil depths, tree pit details, etc.);
- anticipated topsoil and subsoil types;
- existing and anticipated ground conditions;
- drainage strategy;
- irrigation proposals.

2.1 Document Review

The following documents we submitted to TOHA for review:

- *Grant Associates – North West Cambridge – Landscape Strategy – Gateway 3, Document No. NEP-SB-030, dated 14/02/25;*
- *Grant Associates – North West Cambridge – BNG Strategy Landscape Proposals Plan – Draft for Information, Drawing No. NEP718-GRA-SK-052, Rev 05, dated 29/01/25;*
- *Grant Associates – North West Cambridge – Open Space Strategy, Drawing No. NEP718-GRA-SK-058, Rev 05, dated 04/11/24;*
- *Grant Associates – North West Cambridge – Proposed Tree Planting Strategy Parts 1 to 5, Drawing Nos. NEP718-GRA-SK-076, Rev 00, dated 30/01/25;*
- *Grant Associates – North West Cambridge – Plot E1 & The Common, Drawing No. NEP718-GRA-SK-079, Rev 00, dated 30/01/25;*
- *Grant Associates – North West Cambridge – Levels Plans 1 to 5, Drawing No. NEP718-GRA-SK-080, Rev 00, dated 30/01/25;*
- *Grant Associates – North West Cambridge – Hard & Soft Landscape Strategy – Illustrative Masterplan, For Information. Drawing No. NEP718-GRA-SK-085, Rev 03, dated 13/03/25;*

In addition, information contained within the TOHA Soil Resource Survey report TOHA/24/3550/HS has been referred to.

3.0 PROJECT PROPOSALS

3.1 Landscape Design

The overall scheme is divided into key development areas, referenced A, B1, B2, C1, C2, D1, D2, E1, E2, F1, F2, F3, G, H1, H2, H3 & J, each with their own landscape character. The new landscape scheme will be established at ground level. With provision for *green 'living' roof* and *vertical greening* indicated within the Landscape Strategy document, Public Realm – Living Streets and Community Lanes illustration.

Planting Typologies

The proposed landscape typologies are indicated in Table 1 below. In addition to these, a selection of existing trees and hedgerows and areas of existing grassland are to be retained.

Table 1: Proposed Soft Landscape Scheme Typologies

Typology	Sub-Typology
Trees	Tree Type 01 Multi stem Trees (2-4.5m height) Tree Type 02 Junction Tree (30-35cm girth) Tree Type 03 Street Tree (20025cm girth) Tree Type 04 Fruit Tree (Standard 8-16cm girth) Tree Type 05 Standard Tree (8-16cm girth) Tree Type 06 Wayfinding/Landmark Tree (40-45 cm girth) Tree Type 07 Specimen Tree (30-35cm girth, or multistem 4-4.5m high) Tree Type 08 Forest Scale Tree (40-45cm girth)
Landscape Planting	Plant type & size to be confirmed
Woodland Planting Matrix	Bareroot transplants, 60-80cm height 8-10cm girth trees
Orchard	Fruit Trees (8-16cm girth) Plant size & typology to be confirmed
SuDS Swales / Raingardens	Plant size & typology to be confirmed
Private Gardens	Plant size & typology to be confirmed
Sharded Gardens	Plant size & typology to be confirmed
Neutral Grassland	Seed mix to be confirmed
Wetland grassland	Seed mix to be confirmed
Allotments	Vegetables, flowers, fruiting trees, shrubs
Hedgerows	Plant sizes to be confirmed

Green 'Living' Roof & Vertical Greening

Planting / seeding typologies within green roof and vertical greening areas has not yet been confirmed. The substrate thickness and functional requirements for the green roof and vertical greening will need to be confirmed by the project engineer and / or green roof system supplier.

3.2 Current Ground Conditions

Geology

The *British Geological Survey* mapping describes the bedrock as *Gault Formation – Mudstone*. Sedimentary Bedrock formed approximately 112 to 100 million years ago in the Albian Age during the Cretaceous Period. Pale to dark grey or blue-grey clay or mudstone, glauconitic in part, with a sand base. Discrete bands of phosphatic nodules and some calcareous nodules.

Superficial Deposits: Head – Clay, Silt, Sand and Gravel are shown within the north-eastern and western portions of the site only. Superficial Deposits formed by mass movement up to 2 million years ago in the Quaternary Period. Comprises gravel, sand and clay with lenses of silt, clay and organic material depending on upslope source and distance from source. Poorly sorted and poorly stratified deposits formed mostly by solifluction and / or hill wash and soil creep. Soliflucted deposits have variable sand/clay content.

Soils

A Soil Resource Survey of the future development phases, and stockpiled soils recovered in Phase 1, was undertaken by TOHA in December 2024 to assess the quality and suitability of the soil resources for re-use within the proposed landscape scheme (report TOHA/25/3550/HS). The survey identified reasonably consistent heavy textured soils across the majority of the site. The topsoil and subsoil characteristics are summarised in Table 2 below.

Soil Profile 1	• Field F5, • Stockpiles SP2, SP3, SP4, SP5, SP7 southern section (topsoil)
Soil Profile 2	• Fields F1*, F2, F4 • Stockpiles SP8, SP9, SP10, SP11, SP12 & SP7 northern section (topsoil) • Stockpiles SP1 & SP6 (subsoil/clay fill)

*soil type extrapolated from available soil information due to area not being accessible at the time of our survey

Table 2: Summary of Site Soil Characteristics

Soil Profile 1 (Topsoil 1 over Subsoil 1)	Soil Profile 2 (Topsoil 2 over Subsoil 2)
• Medium soil textured soils (sandy loam, sandy clay loam) • Slight to moderately stony with flint • Adequate organic matter and major plant nutrient levels. • Alkaline, non-saline	• Heavy soil texture (heavy clay loam, clay) • Low stone content • Adequate organic matter & most major plant nutrients • Phosphorus deficiency • Strongly alkaline, non-saline

Based on these findings, the existing site soil resources present some limitations for re-use for the proposed landscape scheme, including:

- **Heavy soil texture** – anticipated to have restricted permeability (drainage characteristics), vulnerable to physical damage during intensive soil handling, with a relatively narrow weather window when it can be handled safely.

At this stage, it is anticipated that the site won topsoil and subsoil will be reused for the proposed landscape scheme in most of the proposed planting typologies, provided the following conditions are met:

- The physical condition of the soils is maintained and improved where necessary. In order to achieve this, soil handing operations will need to be restricted to the Summer handling season (May to October). This will be communicated to the Main Contractor and Earthworks Contractor prior to commencing on site. Where the programme requires soil be stripped outside of the summer season, or whilst they are moist and plastic, time will need to be allocated to recondition the soils prior to planting or seeding.
- The moderate to high fertility status of the site *Topsoil 1* is not suited to species rich-rich grassland seeding. The lower levels of phosphorus in *Topsoil 2* are more suited to species-rich grassland establishment. However, the site won topsoil is likely to contain a seedbank which may contain undesirable species. This could increase competition from aggressive species and could result in reduced levels of floral diversity in the final swards. The establishment of any seedbank would need to be control by appropriate management of the new sward, particularly during the establishment phase.
- Suitably prepared, site won subsoil could be considered for use as a seedbed for species-rich grassland seeding and marginal habitats, where low soil fertility status is desirable. Subsoil is also unlikely to contain a seedbank.
- The moisture retentive character and slow drainage properties of the soils will need to be considered when selecting plant species and seed mixes. Species that prefer well drained soil may not thrive, particularly on the areas of level ground.
- The use of the site-won soils on areas of level ground have an increased risk of seasonal waterlogging. If this is not suitable, an alternative imported topsoil could be used for these locations.
- Drainage assistance is likely to be necessary, for example to prevent tree pits from acting as sumps.

The ultimate suitability of the site-won soils will be dependent on their management during the construction process, due to their inherent physical properties (namely heavy soil texture). As such, the soil management guidance provided Plan will need to be provided and adhered to, in particular soil stripping, stockpiling and respreading guidelines.

At this stage it is anticipated that there will be sufficient reserves of site won topsoil and subsoil for most of the proposed landscape scheme. Alternative imported topsoil and subsoil types will be necessary for more demanding planting habitats such as tree pits and use within tree cell systems in hard landscape areas (see Section 4.4).

3.3 Earthworks Requirements

It is understood that topsoil, and as necessary to achieve the development levels, subsoil will be stripped from the vast majority of the future development areas. The site-won topsoil and subsoil will be temporarily stored and re-used within soft landscape areas within the new development.

Soil stockpiles currently located within the future development area, but which contain soils recovered during the Phase 1 development, will be re-used as appropriate within future development phases, for example as landscape fill, subsoil or topsoil.

Deeper excavation may be necessary to accommodate the swales. Any materials recovered from greater than 1m depth should be considered as geological deposits and should be recovered separately from the overlying soil layers. At this stage, it is assumed that this material will not be re-used in soft landscape build-ups; however, if site derived material is used as general fill for example, its composition should be considered with respect to drainage capacity and how this may influence the overlying landscape soil profile.

3.4 Anticipated Soil Types & Depths

At this stage, anticipated soil types and depths for each of the proposed landscape typologies have not been submitted for review. TOHA soil profile build up recommendations are provided in Section 4.2 of this report.

3.5 Current Land Drainage Proposals

Tree Pits

No details on tree pit drainage have been provided.

TOHA recommendations for tree pit drainage are provided in Sections 5 & 6.

Swales & Raingardens

Two swales will be created at the northern end of the development area, with an existing swale retained at the southern end of the scheme.

No details on drainage layers and soil profile build ups have been provided for review at this stage.

The *Shared Gardens SuDS Strategy* illustration show raingardens will have pipe connections. The *SuDS Strategy* Illustration indicates Rain Garden planting beds and linear rain gardens with areas of permeable paving in surrounding parking and play spaces.

At this stage, no further details on SuDS have been provided for review.

3.6 Irrigation Proposals

Irrigation proposals for the project have not yet been confirmed. It is currently assumed that all planting areas will receive manual irrigation.

3.7 Environmental Considerations

Ecology & Arboriculture

Sections of existing vegetation and some wildlife habitats are to be retained and protected. No further details on the location of habitat protection areas or further ecological constraints were identified to TOHA prior to this review. Tree / vegetation protection zones are to be established following guidance from the project's arboriculturist and ecologist.

Archaeological Constraints

No archaeological constraints were identified to TOHA prior to this review.

4.0 SOIL REQUIREMENTS

This section of the report considers the requirements for soils in order to support the current landscape design. At this stage, it is assumed that site-won soil resources will be utilised within most of the landscape areas. Suitable imported topsoil and subsoil will need to be used to create a suitable planting environment in more demanding planting environments, such as tree pits, where the heavy textured site soils are not suitable for use.

4.1 Soil Profile Functions

A typical natural soil profile consists of defined *topsoil* and *subsoil* layers of variable depth/thickness. These exist over the unweathered geological *parent material*.

On this project, where a new soil profile will need to be constructed after all earthworks at ground level, the topsoil and subsoil layers will be placed over the *formation layer* (see Figure 1 below), or and over the structural slab in podium areas or over ground floor basement.

TOPSOIL

SUBSOIL

PARENT MATERIAL

or FORMATION LAYER

Figure 1. Typical natural soil profile

Topsoil

A good "*Landscaping Topsoil"* is a rooting medium that provides the necessary properties and resources for healthy and sustained growth of trees, shrubs and grass. It should be suitably drained and aerated, and provide a sufficient source of water, plant nutrients, organic matter and soil microbes (fungi and bacteria) for sustainable landscape establishment.

The majority of the fine, feeder plant roots (those that take in plant nutrients) grow in the topsoil layer, as well as a small proportion of the larger, structural roots, which provide anchorage and support.

The main distinction between topsoil and subsoil is that topsoil usually contains a significantly higher amount of organic matter, soil microbes and certain essential plant nutrients (nitrogen, sulphur). Topsoil is therefore regarded as the main component in which plants can source their nutrients.

Subsoil

Subsoil is also a fundamental part of the soil profile and compliments the functions of the overlying topsoil. It has a number of key roles:

- Acts as a reservoir of water during dry periods;
- Absorbs surplus water percolating down from the topsoil layer above;
- Provides the main anchorage and support for large shrubs and trees;
- Supplements the topsoil with reserves of mineral plant nutrients (potassium, magnesium, calcium).

In a wider context, subsoil also provides a valuable 'environmental service' in the form of water attenuation during periods of high rainfall and helps ground water recharge.

In order to enable subsoil to fulfil these functions, it must possess sufficient volume of air-filled and water-filled (capillary) pores needed to enable root development, allow water movement and store water. Its lack of drainage can be mitigated by the installation of land drains and low levels of available water can be offset by irrigation. However, the health and stability of larger shrubs and trees will be greatly reduced if their root development is limited to only the topsoil layer.

If the composition of the subsoil, or its physical condition (soil structure), is not capable of these functions, the consequences may include: waterlogged and /or anaerobic topsoils (resulting in plant failure), surface water ponding, increased flood risk, additional irrigation during dry spells, shallow rooting (leading to increased drought stress and tree 'wind throw').

4.2 Required Landscape Soil Depths

Topsoil depths normally range from between 200mm to 400mm in natural soil environments, and this should generally be repeated when new landscape soil profiles are constructed. It is not advisable to place the heavy textured site-won topsoil too deep (greater than 300mm) as it is prone to anaerobism (oxygen depletion). This is because the oxygen requirement (Biochemical Oxygen Demand) for the microbes in topsoil exceeds the supply of oxygen to this depth, thereby resulting in a net deficiency. Anaerobic conditions, if they persist, impede basic root function and subject plants to significant stress and even complete failure. The lower portion of the soil profile should therefore be made up with a suitable subsoil.

The soil depths for trees in hard landscape will depend on the planting system selected (see discussion on this in Section 4.4).

The *Landscape Soil Profile* will need to comprise of suitable *Topsoil* and *Subsoil* to be used above the prepared formation layer.

TOHA Recommended Soil Depths

The follow soil depths are recommended for each of the proposed landscape typologies.

Table 4: TOHA Recommended Landscape Soil Depths

Typology	Topsoil Thickness (mm)	Subsoil Thickness (mm) *Minimum*	Notes
Tree Planting *Soft Landscape*	300mm	600-700mm *Depending on tree size & rootball height*	Indicative tree pit dimensions min. 1500 – 1800mm depending on tree stock size. Granular drainage layer may also be required, dependant on drainage strategy
Tree Planting *Hard Landscape*	*To be confirmed once soil system within areas of hard landscape confirmed*		
Shrubs, Herbaceous and Ornamental Planting	300mm	300mm	
Native Woodland and scrub	300mm	300mm	
Amenity Grass	150mm*	150mm	Any grass or meadow areas where high footfall is expected may require additional allowance in build-up for drainage assistance
Species-rich wildflower meadow, neutral grassland, wet grassland	150mm**	150mm**	
Marginal-Aquatic	300mm**	150mm**	
Allotments	300mm	300mm	
Rain gardens & swales	300mm	300mm	*To be confirmed when more detail on raingarden and swale functions are confirmed*

The subsoil thickness can vary to suit the level of build-up required.

*Increased to 250mm in areas of high foot traffic.

**The soil profile within species-rich grassland and wildflower meadow areas and marginal areas may be formed entirely of suitably prepared site-won subsoil as a substitute 'low nutrient topsoil'.

Accommodating Surplus Site-won Soil

It is anticipated that surplus site-won topsoil and subsoil may be recovered during the earthworks phase.

If surplus topsoil needs to be re-used on site, the topsoil depths for species-rich grassland and marginal areas (low footfall areas only), could be increased to a depth of 450mm. Surplus soil could also be considered for use within landscape bunds, subject to engineer approval.

4.3 Planting Requirements

Different planting environments require certain soil properties in order to meet their inherent cultural requirements, and to minimise the stress caused during transplanting and the establishment phase of a new landscape scheme.

Extra Heavy Standard and Semi-mature Trees

Extra heavy standard and semi-mature trees are a demanding planting environment to construct. Trees of this size and age have grown accustomed to optimum growing conditions in the nursery, and these need to be replicated when the rootballed or containerised tree is planted in the pit. In particular, aeration and drainage around the rootball as well as moderate to high fertility status are critical. Without these properties, trees will very quickly suffer and possibly die during their first few growing seasons after planting.

Given their demanding nature all rootballed trees should be planted with well-aerated and free-draining soils to the full rooting depth (normally considered to be 1.0m).

Standard and Heavy Standard Trees

Standard and heavy standard trees prefer well drained / aerated and nutritious soil. Smaller tree stock such as these do not tend to compact the underlying soils and have relatively compact rootballs, requiring less extensive planting pits.

Streetscape Trees

Tree planting in hard landscape will require a load-bearing system to support the surfacing and sub-base, whilst maintaining an uncompacted rooting zone for the trees. The nature of the system will depend on the specific load requirements, i.e. vehicular, cyclist and / or pedestrian traffic.

Shrubs and Ornamental Hedges

Shrubs and ornamental hedges usually establish from container grown stock. These planting types normally require shallower depths of soil than trees and the plants themselves can be variable in their specific soil requirements. Containerised specimens in particular are often less tolerant of adverse soils conditions and would normally require soils which are fertile, well drained and aerated.

Native Hedge and shrubs Planting

Native hedge and shrub planting comprises indigenous woodland plant species, usually planted as whips and feathered trees. These are less demanding than containerised stock. As such, a broader range of soil types may be re-used for these, provided the species selected do not require any specific growing conditions. The soils must possess a satisfactory structure to support plant growth. The topsoil and subsoil should have suitable pH and drainage characteristics for the selected species.

Allotments & Edible Planting

Planting beds for edible specimens in community gardens for example, usually require soils with a fairly balanced particle size distribution (soil texture) in order to provide adequate drainage, moisture holding and nutrient retention capacities, with acceptable soil handling characteristics. The topsoil should be fertile, containing adequate levels of organic matter and all major plant nutrients, with a broad pH allowance.

Certain salad or vegetable crops have a high nitrogen uptake and often require further nitrogen inputs during the growing period if optimum production is to be achieved. Herb species commonly prefer light textured, well-drained (often alkaline) soils.

Growing 'edible' species is considered a sensitive end-use with respect to potential contaminants due to the anticipated consumption of produce. Therefore, the suitability of soils used in such areas will need to be confirmed by appropriate testing and comparison of results against relevant assessment criteria.

Soil depth provision for edible species will be dependent on the selected mixes within the beds (e.g. vegetables, herbs, fruit trees for example), but generally, an allowance of at least 600mm total soil depth could be considered a reasonable allowance in the first instance.

Amenity Grass

Amenity grass anticipated to receive low rates of foot traffic can typically be established on a wide range of soil types provided the soil has a reasonable structure and no significant compaction to a depth of at least 300mm. Soil with a low stone content is normally required for seeded amenity grass, and moderate to high levels of fertility are required to promote a health grass sward.

In situations where the amenity grass is expected to receive a high volume of foot-traffic and/or maintain a high quality of sward, the soil types, depths and levels of maintenance increase significantly. In such instances, a higher performance growing medium, a greater soil depth and a robust maintenance regime are necessary to support the demands of this usage.

Soils for high use lawns need to be capable of a high infiltration rate during winter to enable rapid dispersal of water off the surface. They also need to be able to retain water and nutrients during the summer to achieve optimum health. Consideration may need to be given to irrigation provision to supplement moisture for grass growth in the summer months.

For low use grass lawns, provision for a total soil depth of 300mm is recommended, which can be made up of 150mm topsoil over 150mm of subsoil. The composition of the topsoil and subsoil can be broad-ranging, and include soils with high clay and silt contents and those with broad pH and nutrient ranges.

For high use grass lawn areas, the topsoil depth should be increased to 200-250mm, and the total soil depth be increased to 400mm. Sand-dominant soils are required, with moderate organic matter contents and high fertility levels.

Where grass is established as turf rather than seed, new turf comes with a dense root/soil mat which is usually smeared/compacted from cutting/handling/laying. After it is initially laid, it can form a very slowly permeable cover over the ground. In order to address this problem, decompaction / aeration measures are important as part of the turf's initial maintenance.

Species-Rich Meadow Grassland, Neutral Grassland and Wetland Grassland

'Semi-natural' species-rich meadow grassland occurs in the UK on soils with a low fertility status (*infertile*) but typically containing moderate to high quantities of organic matter and total nitrogen.

Plant available phosphorus is the key nutrient when considering the fertility status of soil in relation to these meadow types. Whereby low levels of phosphorus are preferred to prevent domination of the sward by grasses and aggressive weeds such broad-leaved dock (*Rumex obtusifolius) and stinging* nettle (*Urtica dioica*).

The required soil drainage performance/moisture retention characteristics vary according to the grassland type and selected species / seed mix. Wetland seed mixes prefer heavier textured, moisture retentive soils.

Neutral grasslands produce relatively high levels of biomass in comparison to other 'unimproved grasslands' and are the typical 'old meadows and pastures' of lowland England. The traditional management of these sites for hay cutting favoured the development of a specialised herb-rich plant community which was adapted to flowering and setting seed before the hay was cut.

Neutral grasslands may occur on moist *brown earth* soils, periodically flooded stagno-gley soils or permanently wet sites, with non-calcareous soils in the pH range of pH 5.0 – pH 7.0.

Marginal Planting

Marginal planting is typically located around pond edges and within wetland areas. The plant species selected are normally suited to intermittent/permanent periods of waterlogging. They are not typically tolerant of drought/ or periods during which the soils dry out. Given their close association with water bodies, highly fertile soils are not normally used for marginal planting to minimise risk of water enrichment.

SuDS Features

SuDS features are proposed to be constructed on site. Details concerning the required functioning and properties of the back-fill media for these SuDS features have not been provided for this review.

Residential Back Gardens

Residential back gardens often receive high rates of foot-trafficking and, as such, can receive high levels of 'wear and tear'. The soils therefore need to be able to resist the compaction caused by such activities. Free-draining, sandy soils are usually preferred.

Where grass is established as turf rather than seed, new turf comes with a dense root/soil mat which is usually smeared/compacted from cutting/handling/laying. After it is initially laid, it can form a very slowly permeable cover over the ground. In order to address this problem, decompaction / aeration measures are important as part of the turf's initial maintenance.

In addition, residential back gardens are considered to be a 'sensitive' end-use in relation to concentrations of potential contaminants (e.g. heavy metals, hydrocarbons). As such, the contaminant levels in the soils used should comply with the project's environmental requirements.

4.4 Tree Planting in Hard Landscape

Planting trees within or adjacent to hard landscape necessitates use of a suitable system to ensure that the tree has the appropriate growing conditions, whilst ensuring that the hard surfacing is supported. This presents challenges and all too often compromises are made, with trees failing to thrive.

At this outline stage, the intended planting system for trees in hard landscape has not been confirmed. The suitability of the intended system would need to be confirmed by the project Engineer. An overview of each product type and their advantages / disadvantages is given below.

There are a number of systems available for tree planting in hard landscape:

- Cell Systems
- Sand-based load bearing substrate
- Stone-based load bearing substrate
- Raft Systems

Structural Cell Systems

Structural cell systems consist of modular plastic units which fit into each other forming an underground open void structure.

The void created by the structure is filled with soil. As the weight is supported by the cells, the soil does not have to be artificially compacted and it retains its functions (e.g. aeration, drainage, water attenuation etc.). The plastic cells support the hard surfacing, and the uncompacted soil within the cells provides sufficient rooting for the trees. Potential volume of rootable soil is usually over 95% so the system is very appropriate for areas with limited space. Such systems can be capable of supporting vehicular as well as pedestrian traffic. Underground services can also be incorporated with this system within ducts though the cell system, making cell systems beneficial for congested spaces.

Cell systems typically offer a favourable rooting environment from a horticultural perspective for trees that must be established in or adjacent to hard landscape, given that there is no requirement to compact the actual growing medium itself. In addition, such systems should be used where the tree planting pit / trench is completely constrained by the surrounding hard landscape / engineered ground. This is because in such situations, there is no opportunity for the tree(s) to extend root growth beyond the original pit/trench and so the planting system must support the tree for the entirety of its required lifespan. This cannot usually be achieved by use of load bearing substrates (see discussion below), unless there is an adjacent soft landscape zone for roots to extend into. This is because as by their nature they are a compromise and can only enable the tree to extend sufficient rooting mass for the short to medium term, whereas cell systems can support longer term growth as long as a large enough area has been filled with the cells.

Light-textured soils are usually recommended for backfilling the cell stack and these can be specified to be lightweight to adhere to any loading constraints. Whilst it is good practice to always handle soils when they are in a suitably dry state, the infilling of some cell products necessitates this for even filling of the cells. For this reason, 'open, box style' cell units are preferable (e.g. SilvaCell by DeepRoot or RootSpace by GreenBlue Urban).

If proposals require placement of hard surfacing right up to the base of trees (as opposed to a grille or soft surfacing in the vicinity of the tree), the soil in the *tree planting aperture* itself where modular cells are not located would also need to be load bearing, or alternatively placement of some sort of supporting structure considered.

Disadvantages to such systems may include the following:

- Maintenance access may be more difficult as roots develop around the structure. Again, this will depend on the shape of the cell units.
- Typically, more expensive than other systems in the initial outlay.
- Compaction of the sub-grade (to create a stable platform) may necessitate the installation of drainage assistance.
- Requires installation of extra 'infrastructure' into the ground, which could have implications for highway maintenance operations.

Many cell systems commonly require installation of a geotextile membrane beneath structural tree cell units to provide a stable base where the underlying ground may not achieve the required compaction level. Any geotextile material used will need to be permeable to enable surplus water to exit the pit. Suitable subsoil will also need to be used over the top of this membrane to prevent blocking up the membrane apertures with soil fines.

Sand-Based Load Bearing Substrate

Sand-based load bearing substrate (sometimes also known as 'Amsterdam Tree Soil' or 'Urban Tree Soil') could potentially be considered for tree planting *in ground* within hard surfaced areas for pedestrian use. This type of substrate may not however, be appropriate for some hard surfaced areas over basement slab or at podium level as its weight (bulk density) cannot usually be reduced as this can affect its compaction performance.

This type of substrate is made up of well graded rounded sand particles (predominately medium to coarse sand) blended with either green compost or topsoil. The overall particle size distribution is narrow, which allows pores to be retained for good aeration when the material is compacted, whilst ensuring stability as a pavement subgrade.

Specialist high sand content soils can be a good medium for tree growth if their limitations are fully understood. Soil nutrient holding capacity will need to be improved through the addition of organic matter to the blend (e.g. green compost), together with appropriate soil conditioner if required. They tolerate high levels of compaction before they become root-limiting; this level of compaction (up to 80% maximum dry density) will allow light foot traffic only (no vehicles) and are best beneath flexible or granular materials rather than traditional paving. During installation the compaction tolerances are sensitive and should be monitored and tightly controlled.

One perceived problem with sandy soil is its low water and nutrient holding capacities. However, whilst sandy soils drain reasonably quickly, the majority of this water is available for plant uptake. The compost in the blend acts like a sponge and greatly improves water retention and cation exchange capacity for nutrient supply. Water and nutrient retention capacities can also be improved by incorporation of soil conditioners with the substrate.

Due to the lower organic content, the depth to which this material may be placed is greater than that for 'normal' topsoil (usually up to 600mm).

The loading capacity requirements for the Urban Tree Soil (i.e. its California Bearing Ratio (CBR)) will need to be confirmed by the project engineer to ensure that it is compacted sufficiently to support the overlying surfacing. Usually such products can achieve a minimum CBR of 5% but should not ideally be compacted to greater than 15% CBR in most situations as this may affect root extension.

Sand-based substrates are however, a compromise with respect to tree growth. The necessary compaction of the material will still likely affect development of larger diameter roots as the tree matures. Furthermore, there must always be a limit on organic matter content as this can affect the compactive properties of the substrate. Organic matter is a major source of nutrients and given the constrained environment of trees in hard surfacing, ongoing applications of fertiliser are not practical. Therefore, this substrate may possibly only support trees for short term growth, <u>unless</u> there is an adjacent soft landscape area(s) to the hard landscape tree pit / trench for the roots to eventually extend into.

Stone-Based Load Bearing Substrate

Stone-based systems are essentially formed of two components: stone/aggregate and clay soil particles. There are two main products available (e.g. Stockholm Tree Gravel or CU Structural Soil™), which vary according to the size range of the aggregate fraction and inclusion of other components (e.g. water holding polymer) to stabilise the mixture.

These products work according to the same principal, whereby:

- A stable base is provided by the compacted aggregate, which will not be deformed or altered by environmental conditions and will allow traffic (pedestrian or vehicle) over the area.
- The clay soil component is to provide an environment for tree growth.

These products can be heavily compacted (potentially by c. 95% of their dry density). The aggregates used may vary according to product, but the wider the range of aggregate sizes and less angular stones, the less space for soil and roots.

Whilst stone-based loading bearing soils provide flexibility in placement and can be capable of withstanding vehicular as well as pedestrian loads; from a horticultural perspective, they can place significant limitations on the longevity of trees established within them. This is because the proportion of fine particles (<2mm) and organic matter are very low, both of which retain plant nutrients and water. In addition, the high stone content constrains root extension, impacting on root density. As such, the growth and canopy cover of trees grown in these substrates can be significantly lower than within other systems.

Raft Systems

Raft systems provide a base layer that 'floats' over the rooting environment and beneath the hard surfacing to spread the loading across the width of the installation. These systems aim to prevent compaction of the underlying soils. There are two broad categories of raft systems:

- **Cellular confinement systems (also known as anti-compaction mat or geocell)**. This is a network of 'honeycomb' shaped cells typically formed with HDPE sheets that are filled with aggregate.
- **Geocellular sub-base replacement systems**: Cellular units that are mounted together and anchored to provide a load bearing sub-base replacement layer. Such systems may include the use of plastic tiles (80-150mm depth). The installation is often partially filled with a soil mix, which allows for water infiltration/attenuation.

Raft systems can typically provide effective load bearing capacity for pedestrian or cycle traffic, with some potentially suitable for parked vehicles. They may also be effective when used in conjunction with other load bearing systems such as urban tree soil to enhance load bearing capacity or provide an aeration layer between the sub-base and soil below.

Disadvantages to such systems may include the following:

- Maintenance access to the ground below the raft may be costly. Complete removal and reinstatement is often the only option in order to retain the strength of the overall installation.
- Can be relatively expensive (depending on the product).
- Tile raft systems have a limited implementation history (c. 10 years) so there is no evidence of their long term resilience.

Soil Depths in Hard Landscape Tree Pits

The depth of soil within hard landscape tree pits will be dependent on the system selected and arrangement of the trees in relation to the hard surfacing (i.e. wholly within it or with the tree itself in soft but the pit extending under adjacent surfacing).

Cell system products are available with cell units of differing height that can be chosen according to the best fit for the depth of soil required in each part of the pit. Cells can also be stacked on top of one another to create a deeper profile where required. In the tree planting 'aperture' itself, the soil depth would usually be as recommended above in Table 6 for trees in soft landscape, whilst the pit 'extension beneath adjacent surfacing could vary in depth. Usually, the upper layer of the cell stack is backfilled with topsoil, whilst the lower portion with suitable subsoil. Depending on whether surfacing is installed right up to the tree base or if a supported grille is used, a load bearing substrate may be required within the planting aperture.

Sand-based load bearing substrate with an appropriate grading and organic matter content can usually be placed up to a depth of 600mm, with suitably graded, quarried and washed sand normally used as subsoil.

4.5 Planting Schedule Review

At this outline stage, detailed landscape schedules are not required and will be considered separately under RMAs. We are therefore unable to comment on the specific drainage and soil pH preferences of the proposed planting and seeding mixes at this stage.

4.6 Landscape Soil Sources

It is anticipated that site-won topsoil and subsoil will be utilised within most of the new soft landscape areas. Suitable imported soils will be required for specific areas, such as backfill in larger tree pits. At this stage it is anticipated that there will not be a shortfall in site-won soil resources.

4.6.1 Site-won Soil Sources

Based on the findings of the TOHA Soil Resource Survey, the existing site topsoil and subsoil resources are suited to use in the majority of the proposed typologies, provided they are suitably structured, aerated and drained and the species selected are tolerant of heavy, moisture retentive soils. The site won soils are not suited to planting typologies that require light free draining soi conditions. The suitability of the site soils is summarised below:

Table 6: Site-won Topsoil and Subsoil Suitability

Planting Environment	*Soil Profile 1 Topsoil*	*Soil Profile 1 Subsoil*	*Soil Profile 2 Topsoil*	*Soil Profile 2 Subsoil*
Rootballed Tree Planting (Extra Heavy Standard and Semi-Mature)	✓	X	X	X
Rootballed Tree Planting (Standard and Heavy Standard)	✓[b]	✓[b]	O [b]	O [b]
Trees in Hard Landscaping	c	c	c	c
Ornamental Shrubs and Hedges	✓	✓	O	O
Native Shrubs and Hedges	✓	✓	✓	✓
Amenity Grass (Low Footfall)	✓	✓	✓	✓
Amenity Grass (High Footfall)	~	~	~	~
Species-Rich Meadow Grassland	X	✓	✓[d]	✓
Neutral Grassland	X	#	#	#
Marginal Wetland Habitats	X	✓[a]	✓[d]	✓[a]
Allotments	✓	✓	✓	✓
SuDS Features	See Section 5.5			

Key to Soil Suitability Table

✓ = Soil suited to this landscape type provided the soil is in good physical condition. For the *Heavy Soil*, species tolerant of moisture retentive soils should be selected.

O = Soil maybe acceptable for this landscape type provided selected species are tolerant of moisture retentive soils and consideration is given to the installation of drainage at vulnerable locations.

X = Soil not suited to this landscape type.

a = Suitability depends on whether necessary measures are made to ensure that the soils remain moist or wet throughout the year.

b = Suitability will depend on the size and location of the tree and amount of disturbance to the surrounding ground. Modifications to tree pit design, for example mounding around trees, may be required.

c = A specialist imported soil is likely required for tree pits in hard landscapes; suitability of the site soil for use within a 'soil cell system' will be dependent on the system used and load requirements. *Soil Profile 2* soil preferable for use within a soil cell system.

d = Topsoil only suited to use within these areas provided adequate management is employed to control the establishment of the inherent seedbank and undesirable species.

~ = Suitability of the soil will be dependent upon the intensity of use, maintenance regimes and installation of drainage at vulnerable locations. Alternative imported topsoil may need to be used in high use areas.

= Soil pH level is above the typical pH range required for neutral grassland, further consultation with the project ecologist is recommended to confirm suitability of this soil for neutral grassland establishment.

4.6.2 Imported Topsoil Sources

Imported topsoil may be required within the more demanding planting environments of this project, for example larger tree pits or for any species that prefer light free draining soil conditions. Depending on their required functions, imported topsoil may also be required for use in swales and rain gardens. The options for imported topsoil will either be to select a *Natural Topsoil* derived from former greenfield sites or *Manufactured Topsoil*, produced by blending various mineral and organic substrates into a growing medium that will function as a topsoil.

Manufactured Topsoil is the preferred option for imported topsoil for this project. By their nature, manufactured soils will be granular in nature to enable an evenly mixed blend of the components.

See Sections 4.6.3 below for differentiation between subsoil types for the various planting environments.

Manufactured Topsoil

A manufactured topsoil is essentially a soil that is formed when two or more components (mineral and organic) are intimately mixed to form a rooting medium that will provide all the necessary physical, chemical and biological components to support plant life in a landscape environment.

In many instances, manufactured topsoils are a better alternative to natural topsoil. Their attributes include a consistent composition, a greater availability, the ability to control and modify the product to suit the end-use, and they are free from weeds, disease and contamination, provided suitable substrates have been selected for the mix.

Natural Topsoil

The main characteristics of natural topsoil that affect its re-use are its variable quality and composition, its inconsistency in availability, the presence of weeds and seeds, and potential contamination.

Natural topsoil is very variable. As the soil properties change, so does the potential to re-use the topsoil for landscaping purposes. This is a key factor that is often overlooked by both topsoil suppliers and topsoil buyers. To many end-users, topsoil is just 'topsoil' and in this respect, it is treated as any other building and quarried material.

It is important to understand that all natural topsoil that is supplied to the landscape industry is derived as a by-product of 'Greenfield site' development. It is not quarried like aggregates and sands and it is illegal under the Agricultural Land (Removal of Surface Soil) Act 1953 to remove topsoil from agricultural or forestry land.

It is not available all year round and not available locally where there is no Greenfield development. This is becoming increasingly common in urban regions, such as London.

Natural topsoil will virtually always have a seed bank with annual and perennial weed seeds. It can often contain rhizomes of persistent weeds and grasses, such as creeping buttercup, bindweed and couch grass.

Natural topsoil that is derived from former agricultural land may contain elevated levels of heavy metals from the repeated application of sewage sludge. This is of particular importance if the topsoil is to be re-used in sensitive end-uses, including public parks.

4.6.3 Imported Subsoil Sources

The imported subsoil selected for use in tree pits on the project should ideally be sand-based. For larger trees, washed sand will be required in the base of tree pits. Sand based soils may also be necessary in the proposed swales and rain gardens, depending in their required function within the wider SuDS system.

Materials that are often used as 'subsoil' in landscaping projects include *Recycled Skip Waste*, *Quarry Overburden* and *Washed Sand*, with limited use of natural subsoils. *Quarry Overburden* and *Washed Sand* are the preferable sources for suitable subsoil materials for the proposed landscape scheme.

Natural Subsoil

Subsoil is not bought and sold in the construction industry in the same way that topsoil is supplied. Natural subsoils are not usually removed from greenfield developments during the construction process, as they are usually suitable for re-use beneath buildings and infrastructure. However surplus material may be available in limited quantities where cut and fill operations are imbalanced for example.

Skip Waste Soils

Skip Waste Soil is the result of screening materials derived from site clearances, building and demolition operations and the 'muck away' market. The coarse fraction is removed and used as recycled aggregates whilst the fines (soil fraction) are stockpiled for re-sale as 'subsoil' or even 'topsoil'.

The skip waste soil usually consists of a mixture of topsoil, subsoil, clay and fragments of building waste materials – brick, concrete, mortar, ash, clinker, and to a lesser extent glass, metal, wood and plastic. In terms of its physical and chemical soil properties, the material is usually extremely alkaline with a pH range of 8.0-10.0, saline, low in organic matter and plant nutrients, can often have elevated levels of zootoxic and phytotoxic contaminants and contain 'sharps' e.g. glass and metal.

The material is therefore at the fringe of the requirements for a landscaping soil. It would not be considered suitable for this landscape scheme, where design contains quality trees and ornamental planting.

Quarry Overburden

Quarry Overburden generally represents the materials that are deemed to be uneconomical primary mineral deposits at quarrying sites, or the by-products of secondary processes at mineral extraction operations e.g. washing plants. Overburden materials that are often suitable for use in landscaping include as-dug sands and gravels, rock sand, China Clay waste spoil and crushed stone fines.

As the materials are derived from natural geological deposits, the risk of contamination is low. Likewise, the presence of weed seeds, sharps and other undesirable components is highly unlikely.

Washed Sands

Quarried and washed sands are primary mineral deposits from quarrying sites. These can be graded according to different particle size specifications to meet the necessary requirements for the end-product (for example glass production, cements, building sands, etc etc). Selection of well-graded sand has benefits for use in landscaping as it will retain porosity, even when subject to compaction.

4.9 Soil Ameliorants

The site won soils will require amelioration to improve levels of soil organic matter, nutrient status and to boost the populations of beneficial soil microbes. In addition, imported soils may also required amelioration to improve nutrient retention. Various soil ameliorants to be considered are discussed below.

Compost

Green compost is likely to be the most appropriate organic ameliorant for site won topsoil this project. Green compost is generated using suitable commercial or domestic 'green waste' (i.e. vegetation) and therefore provides a sustainable end-use for this material. Good quality green compost can be used to increase organic matter content and is a valuable source of soluble and slow-release plant nutrients. It can also improve long-term nutrient cycling, by introducing beneficial active microbe and mycorrhizal populations to the soil blend. Whilst green compost is inherently alkaline, this is due to the presence of potassium ions rather than from calcium carbonate (lime). Therefore, its use is not restricted specifically to plants tolerant of alkaline conditions, although selected true calcifuge (acid-loving) species may not always be suited to it.

Terra Cottem

It is anticipated that any imported soils will be predominantly sandy in nature, this means that the nutrient retention capacity of such soils will need to be maximised. This is especially important for planting areas that will not be irrigated beyond establishment. Ameliorated of any imported soils with an appropriate mineral soil conditioner (e.g. TerraCottem *Universal*) and biochar products. Only a one-off application is required for both of these ameliorants.

TerraCottem products are predominantly made up of volcanic rock particles. Upon application, these continue to weather and, in doing so, release mineral plant nutrients and trace elements (e.g. magnesium, calcium, potassium, molybdenum, iron) into the soil for plant uptake. Furthermore, the particles have an extremely high cation exchange capacity, so they are able to catch hold of nutrients being leached from the topsoil and release them for plant uptake over a prolonged period. A water storage polymer is also incorporated into these products to further facilitate moisture retention and provision of water.

Biochar

Biochar that is derived from wood improves soil ped aggregation, aeration, water holding capacity, nutrient retention and supports a soil microbe population. These properties all lead to improved soil health. The microbes form symbiotic relationships with plant root hairs – moving nutrients to the roots in exchange for sugars (food) from the roots. There is growing evidence this root zone activity stretches beyond nutrient transfer. This can also increase the roots' defences against pathogens and diseases.

5.0 LANDSCAPE DRAINAGE

5.1 General Considerations

At this stage, the soft landscape areas are currently assumed to be poorly drained, based on the heavy texture of the site soils. The specific drainage strategy for the planting areas has not yet been confirmed. Options for this are discussed in Section 5.2 – 5.5 below. Drainage media is considered in Section 6.6.

The drainage strategy needs to be capable of preventing development of a persistent perched water table in the landscape soil profile, which can have a severe impact on the planting scheme and the overall function of the site for end-users. This includes:

- Waterlogged and anaerobic topsoil
- Surface water ponding and runoff on to hardstanding
- Plant failures, including grassland sward
- Access restrictions due to wet, muddy ground

The handling and preparation of the soils in all soft landscape areas should aim to maximise water infiltration and percolation through the soil profile to increase the soil's water attenuation capacity and minimise the risks of flooding, erosion, waterlogging and plant failure.

5.2 Tree Pit and Planting Bed Drainage

Drainage of surface and sub-surface draining water will need to be considered in order to prevent tree pits and planting beds from acting as sumps and becoming waterlogged. Waterlogged tree pits and planting beds are one of the most common causes of plant failure on development sites, where the cohesive nature of the ground and compaction following earthworks can reduce the infiltration performance. Options for landscape drainage are given below.

Soakage Layer

The inclusion of a *granular layer* in the base of tree pits could be considered. The aim would be to provide an individual water attenuation layer to deal with the surplus of water. A minimum of 400mm, ideally 600mm depth of suitable drainage gravel should provide suitable storage volume. The layer will have the dual function of providing additional water reserves (through capillary rise) during the main growing season when the rate of water uptake by trees and planting increases considerably.

The gravel layer can also be accompanied by a vertical monitoring/extraction pipe installed down into the gravel layer to check water levels in the pit and to enable extraction of stagnant water if necessary. Monitoring of the water level within the vertical pipes is usually required for at least the first 3 years (establishment phase) and should be carried out on a quarterly basis and particularly at the end of the winter period and well before the start of the growing season to enable any waterlogged pits to be de-watered.

Figure 2 below demonstrates the arrangement of an attenuation layer and water monitoring pipe within a tree pit.

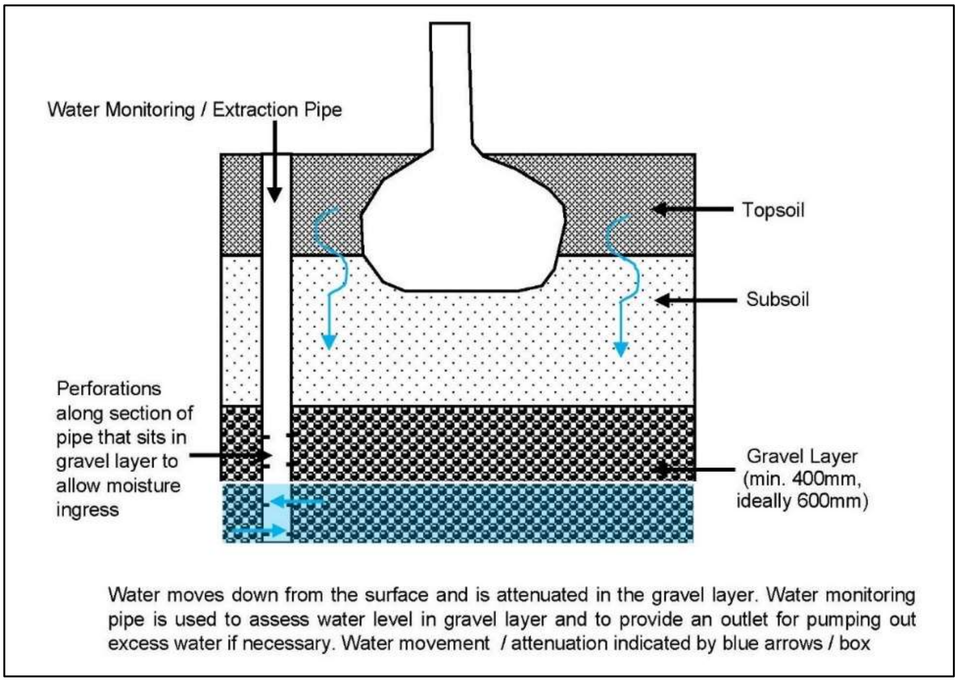

Figure 2. Tree Pit with Attenuation Layer and Water Monitoring Pipe

Alternative Options

Figures 3 & 4 demonstrates alternative drainage options for tree pits, the piped positive drainage will require a suitable outfall.

Where trees are located on slopes, drainage pipes could be constructed to run from the gravel layer in the tree pit, out towards the slope surface. Connection to the drainage network is not required as the water will outfall to the slope. Any moisture that doesn't infiltrate into the soil would run-off the surface to the swales or land drain network at the toe of the slope. Where this option is considered for swales, it should only be selected where the outfall pipe can be situated above the maximum water level height within the swale to avoid water entering the tree pit when the swale is full.

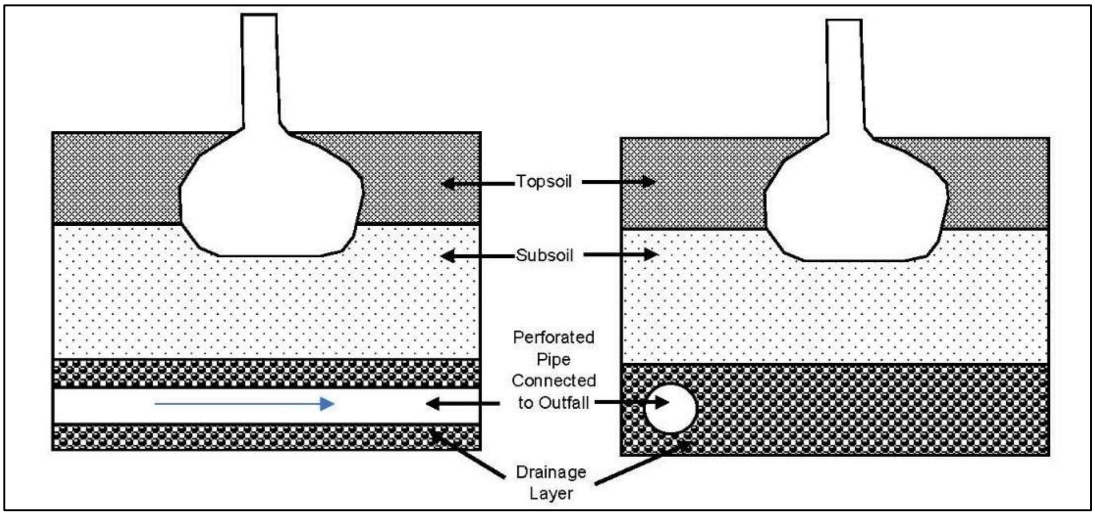

Figure 3. Tree Pit with Positive Drainage

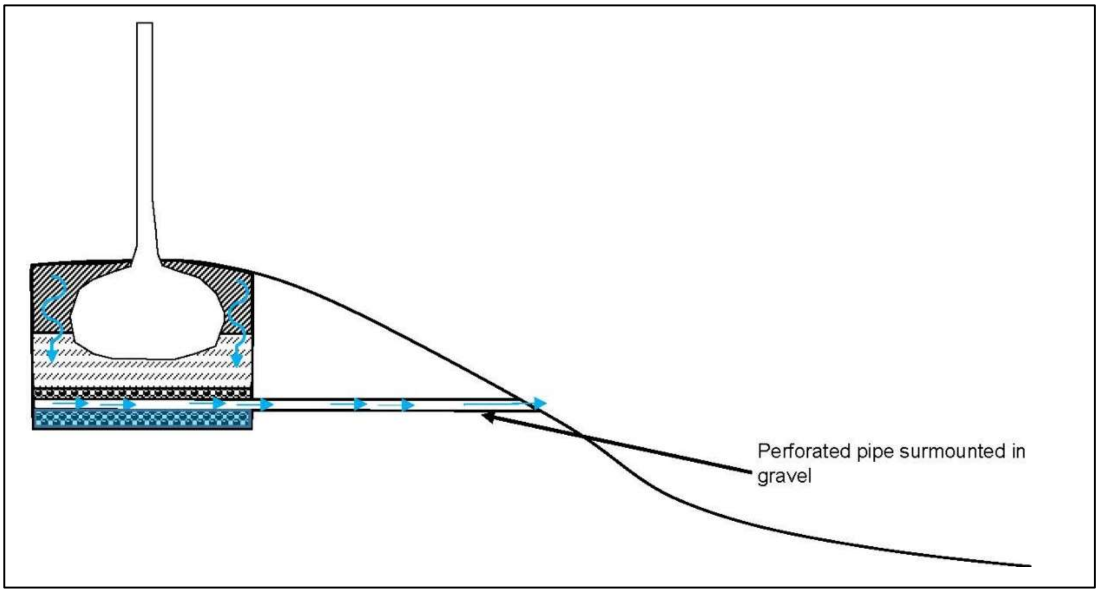

Figure 4. Tree Pit with on Slope with Outfall Pipe

For smaller trees and planting beds consideration could be given to mounding around trees or groups of trees as necessary / feasible to effectively lift the rootball above the layer of potential waterlogged soil.

Drainage assistance (e.g. French drains or slot drains) may also be required in areas where surface draining water may collect, e.g. at the toe of slopes or alongside pathways. It should be noted that positive drainage will require a suitable outfall.

5.3 Drainage in Swales

The swale drainage design and function within the SuDS system on this site has not yet been provided for review.

5.4 Drainage in Amenity Grass & Meadow Areas

In instances where areas are anticipated to receive limited foot traffic, soil drainage assistance is considered to be unnecessary in this instance.

Should the usage levels change within any areas of grass establishment to levels of heavy foot traffic, consideration may need to be given to alternative more 'wear resistant' soil types, intensive management to aid aeration of the soil or even installation of gravel filled drainage trenches may need to be considered.

5.5 Drainage Behind Structures

Surface draining water could potentially collect behind structures, leading it to back-up in the soil profile. As such, drainage assistance may be required behind structures to take the water to a suitable outlet, particularly where the soil profile slopes down towards a structure and / or abuts concrete footings.

5.6 Drainage Media

The selection of an appropriately graded drainage media is important to enable hydraulic continuity from the soil layer above. Hydraulic continuity is the ease with which water can move through pore spaces in the soil. This process requires a gradual change in pore size, otherwise water will be held within the small pores by pressure caused by air within the larger pores. If the gravel aggregates are too coarse the increase in pore size compared to the soil above will be too large and hydraulic continuity will be lost, leading to retention of water within the soil rather than drainage into the gravel. Usually pea shingle comprising aggregate no greater than 10mm in size is used in this capacity.

5.7 Geotextiles

If geotextiles are used to wrap any drainage trenches, it is strongly advised that they are not wrapped over the top of the gravel trench (base and sides only) where the gravel interfaces with overlying soil. This is because even 'permeable' geotextiles can become blocked up by soil 'fines' over time. If required, a 'blinding layer' of grit sand could be used where necessary (e.g. 1-4 mm grit sand).

6.0 TREE PITS

It is recommended that tree planting is grouped wherever possible. This will simplify the installation process and maximise the rooting area for the trees. Furthermore, this would streamline the drainage provision for the pits.

Where individual pits are constructed for semi-mature trees, it is recommended that they have a *minimum* surface dimension of 1.5m by 1.5m (x the specified depth). The surface dimension and depth may need to be increased according to the size of the rootball.

The site soil (topsoil and subsoil) is not suitable for use as backfill in tree pits for trees >16-18cm girth and alternative imported topsoil and subsoil should be used, in conjunction with appropriate drainage measures. For small to medium rootballed trees, the site won topsoil and subsoil is only suited for use as tree pit backfill provided consideration is given to improving the drainage potential of the pit.

7.0 FURTHER CONSIDERATIONS

Soil Specification & Soil Management

There will be a need to develop specifications for the topsoils and landscape subsoil for the purpose of sourcing appropriate soils.

It will also be important to provide detailed soil management information to ensure the soils are handled, ameliorated and prepared correctly.

Soil Reconditioning

Where the soils have become severely compact and structurally degraded during the stockpiling phase, particularly within soils recovered during Phase 1 and stockpiled for several years, sufficient time will need to be allowed within the programme for the soils to be dried, reaerated and suitably decompacted and cultivated prior to any planting, seeding or turfing.

Soil Cultivations

The heavy cohesive nature of the site soils and formation level will mean that it is likely to have poor soakage potential. This will necessitate drainage assistance (see Section 5.0); however, it will also be beneficial to prepare the ground before placement of the landscape soil profile using appropriate cultivation methods. Loosening the ground will increase pore space within the soil, which could provide some attenuation capacity for surplus water prior to exit to the drainage system, as opposed to it backing up in the landscape soil profile above. These works will need to be coordinated with project environmental consultant and engineer.

Stone Removal

The presence of larger stones can inhibit seed emergence and root growth and can also hinder maintenance operations such as mowing. A stone removal exercise may therefore need to be factored in to remove stones greater than 50mm in certain planting areas and 20mm in seeded areas.

Geotextiles

Fine gauge woven textiles, whilst marketed as 'permeable', can present some problems if incompatible soil material is used in direct interface above them. This is because even 'permeable' geotextiles can become blocked up by soil 'fines' over time thereby reducing permeability over time and adversely affecting the function of the landscape soil profile above.

Therefore, the use of suitable sand as a 'blinding layer' could be considered as a robust alternative for permeable textiles in certain applications.

Root Barriers

Where root barriers are intended for use as part of the design (e.g. service trench protection etc), their specified locations should allow maximum soil volume availability for the adjacent planting.

Maintenance

Appropriate ongoing maintenance operations will be required to retain a satisfactory soil profile for the landscape scheme, e.g. decompaction / aeration treatments and amelioration requirements (e.g. compost / fertiliser) as necessary.

Frequently used grassland areas will require a suitably robust maintenance programme to support the demands of their usage.

Species-rich grassland areas will require maintenance to control the growth of undesirable species and to prevent the loss of diversity over time.

Lime Stabilised Materials

If any site-won excavated material (e.g. from piling works) is potentially remediated for re-use as clean fill for example, the treatment strategy will need to be considered if any of these materials are to be located beneath soft landscape areas. If lime stabilisation is used for instance, the material will not be appropriate for use in the rooting zone within the soft landscape build-up. This is mainly because lime stabilised material is too alkaline for plant growth.

Haunching / Upstands

It is recommended that concrete haunching alongside adjacent planting areas is trimmed to the minimally acceptable width for the associated edging as it will infringe on the rooting area for plants or turf placed towards the edge of the planting beds. This also applies to the fixings for metal upstands.

Imported Soil Requirements

Any imported soil types will need to meet the specific horticultural requirements of the planting environment in which it will be used. A number of different imported soil types may be required to achieve this. It is anticipated that any soils imported to site will also need to meet the site's environmental requirements in terms of permitted levels of potential contaminants.

It is assumed that the substrate used for green 'living' roof and vertical greening will be a proprietary product provided by the green roof system supplier.

TOHA would like to thank University of Cambridge for entrusting the practice with this commission. TOHA trusts that this report meets with your approval and provides the necessary information. Please do not hesitate to contact the undersigned if further assistance is required.

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For & on behalf of Tim O'Hare Associates LLP

Report Qualifications

This report outlines the design considerations for the soil elements of the soft landscape design for future phases of the North West Cambridge development. It should not therefore be relied on for alternative end-uses or for other schemes. This report has been prepared solely for the benefit of our client University of Cambridge. No warranty is provided to any third party and no responsibility or liability will be accepted for any loss or damage in the event that this report is relied upon by a third party or is used in circumstances for which it was not originally intended.

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