

LCC Guidance: Urban Tree Planting

(SC Rev C- Dec 2018)



NOTE this replaces the guidance entitled: Tree Planting in Hard Landscape 2016

INTRODUCTION

This guidance has been developed to help highway engineers, developers, tree officers and all those designing our urban spaces to make the right decisions in order to include urban trees in their designs. It provides principles on how to plant and maintain trees in our urban landscapes – our streets, civic spaces and surface car parks.

RETAINING EXISTING TREES

When designing a new development, wherever it is safe and practical, the design should incorporate existing trees worth retaining into the overall layout to provide a mature and established character.

Trees within the development site should be assessed in accordance with the recommendations included in British Standard (BS) 5837: Trees in relation to design, demolition and construction – Recommendations 2012. The assessment should cover their condition, significance and landscape and environmental value. Categories of A, B and C trees shall be considered for retention. The BS5837 default tree protection barrier shall be used to protect all trees agreed for retention during the construction process.

SOIL VOLUMES – calculations (for both Hard/Soft situations)

Adequate soil volume is one of the most critical aspects of the design

Soil volume requirements are proportional to the mature size of tree species. The source method of calculating soil volumes is the research by [Lindsey and Bassuk, \(1991\)](#) and [Urban \(1992\)](#). This calculation is based on the potential crown projection combined with nutritional and water requirements to produce a specific volume of soil. Crown projection is equivalent to the area under the tree's drip line.

Formula

Imperial: 2cubic feet of soil /1 square foot of crown area (applicable to UK)

Metric: **0.6 cubic metres of soil/ 1 square metre of crown area**

Projected mature canopy area (square metres) can be calculated from the radius using the formula ($A=\pi r^2$).

Worked example:

Projected Mature Canopy Diameter (metres) =8(Diameter) 4m radius

Projected Mature Canopy (square metres) ($A=\pi r^2$) =50 (Area)

Target Soil Volume (cubic metres), (Area x 0.6m) =30 (Volume)

Target soil requirements can be simplified by dividing mature canopy sizes into 4 categories based on the Lindsey and Bassuk formula

MATURE CANOPY	CANOPY AREA	TARGET SOIL VOLUME
LARGE (8m dia+)	50m ²	30m³
MEDIUM (5m -8m dia)	19.6m ²	12m³ (11.8m ³)
SMALL (3m -5m dia)	7.1m ²	5 m³ (4.24m ³)
SMALL to Medium		8.5m³

Also refer to LCC guidance “Guideline Distances from Development to Trees” tree dimensions tables for ultimate tree heights and spreads

NOTE- this formula does not apply to **fastigiated and columnar** habit trees. The soil volume requirements can be calculated for narrow trees by basing the canopy diameter on the natural growth form i.e. the widest spread of that particular species

NOTE: a full breakdown of the soil volume provision with calculations shall be submitted to support proposals. Volume cannot be achieved by providing extra depth. The maximum useful depth of soil (BS 3882) for tree planting is 900mm. BS5837 states that the root system of a tree is typically concentrated within the uppermost 600mm of the soil.

Trees planted in a lower volume of soil than that calculated will not reach their full potential and have a shorten life span. A lower soil volume will not be accepted unless there is an overriding justification/ special circumstances

NOTE- A design solution can provide for roots to extend beyond the pit into adjacent soil areas, e.g. into grass verges, gardens etc. which can count towards soil volume provision. Physical connections can be achieved through the use of “break out zones” also known as “root paths”

NOTE- If load bearing soil environment systems are being used then it is advisable to arrange them in corridors/ continuous trenches so that multiple trees can share them. The required rooting volume for each tree can then be reduced by up to 25% in this situation. This same discount can apply if trees share a very wide unpaved continuous soft Primary Rooting Zone such as a road verge.

TREES IN HARD LANDSCAPE

In a Hard Landscape situation the required soil volume/root growing environment for trees will be provided through the use of underground load bearing root zone technology. These broadly fall into three Categories that are supported by Leeds City Council:

- Structural growing media (*exclusive of tree sand /Amsterdam tree soil*)
- Crate systems/cell systems e.g. SilvaCells, Root Space, Stratacells etc

*For more information- these techniques are extensively reviewed in the free download document **Trees in Hard Landscape: a Guide for Delivery by TDAG** – <http://www.tdag.org.uk/trees-in-hard-landscapes.html>*

NOTE: Sand-based substrates (also referred to as tree soil/ Amsterdam tree soil) are not accepted for the following reasons. These soils are not conducive to root growth. High levels of compaction are required and low levels of organic matter present (with the subsequent need for regular soil management). There are risks from over compaction and requirements for automatic irrigation due to low water holding characteristics.

NOTE: medium- sized aggregate and the stone skeleton substrates typically only have 10-25% void space to support root growth (and to possibly accommodate surface water runoff). Designers should therefore take care to ensure that each tree has sufficient volume of growing medium for its lifespan. Growth is limited by the net soil volume rather than the total volume of the soil/stone mix. (Ref: BS 8545:2014 British Standard- Trees from nursery to independence in the landscape)

NOTE: trees are sensitive to pH (acidity and alkalinity) and pH can significantly affect the life and health of a trees and its ability to absorb nutrients. When using structural growing media the pH of the aggregate therefore must be carefully considered.

NOTE: geotextiles to surround the cell installation will not be supported if the membrane is a barrier to root growth beyond the planting pit thereby preventing trees exploiting adjacent native soil. This will adversely affect long term survival.

NOTE: Retention of water and nutrients in Structural soils/ tree sand has been cited as a potential problem (Trowbridge and Bassuk, 2004). Smiley et al. (2006) compared growth parameters on trees established in structural and non-compacted soil and surrounded by pavement. Trees in the non-compacted soil treatment outperformed structural and compacted soils in almost every parameter measured. This underscores the importance of compaction in urban soils and highlights the limitations of some structural soils in providing a suitable substrate for tree establishment.

Whatever the under-pavement system that is adopted, some means for air and moisture to reach the Growing Media must be provided to sustain Soil Life and to maintain moisture levels. Below-ground irrigation and aeration systems such as Greenleaf 'Root RainUrban' should be installed in all hard surfaced areas. Irrigation system only for all other trees

Documentation on soil /root growing environment for tree planting must be submitted for approval prior to installation in accordance with BS 3882: 2015 (or current version) and the remaining with loosened subsoil in accordance with BS860: 2013(or current version). A Formation Check will be subsequently carried out by LCC to confirm compliance

GENERAL REQUIREMENTS (for both Hard/Soft situations)

Statutory undertaker's equipment

At design stage, developers are encouraged to design tree planting and landscaping schemes in a manner which allows ease of access for future maintenance to underground services, such as gas and water pipes and electricity cables.

This is best achieved by not planting trees over or within 2 metres of statutory undertaker's equipment. Intelligent design and advanced planning should allow for highway trees to be positioned in the optimum locations, whilst also minimising future disruption for utilities contractors and allowing any future maintenance works to be undertaken in accordance with BS 5837 and National Joint Utilities Group guidelines.

Drainage

Too little water shortens both the lifespan and growth of the tree but too much water creates anaerobic conditions (no oxygen) that are lethal to roots. The tree-growing environment therefore needs to facilitate water infiltration and retention as well as drainage.

It is a prime requirement of any tree planting situation that planting pits do not hold water and become waterlogged. In new construction the minimum requirement is a layer of stone consisting of 200mm deep of clean aggregate 50mm nominal size in the base of the pit topped with a geotextile blanket, to reduce contamination of the drainage layer by fines. This will allow surplus water to drain freely from the rooting zone.

Directing surface water run-off into Rooting Zones

Where possible, try to direct a little surface water run-off into Rooting Zones. This helps keep the Growing Media within them charged with moisture and can help ventilate soil. However, it must be done with caution to avoid the Growing Media becoming saturated. For this reason, for basic designs Rooting Zones may not receive input from a total surface area greater than 1.5 times that of the overall permeable surface area over them - and only then from footway

surfaces (not carriageways). In addition, that input must be distributed evenly across the Rooting Zone.

Full hydraulic and water quality design calculations must be undertaken for larger input volumes. Notwithstanding the ability to direct water from surrounding pavements to Rooting Zones, permeable or semi-permeable surfacing must be provided over a minimum of 70% of the top area of each Rooting Zone in new streets and parking spaces. Surfaces must be set to falls so that run-off will drain positively to a gully if infiltration fails.

SuDS

Rooting Zones may be used as part of sustainable urban drainage best practice management systems – including for water quality treatment of surface water run-off from pavements. Tree pits can help reduce flow rates from a site by facilitating infiltration and/or by providing attenuation storage. Refer to: The SuDS Manual (C753) 2015 - chapter 19

SUMMARY OF REQUIREMENTS (Hard Landscape situation)

- A named proprietary soil cell structures to support paving over extended sub-surface rooting areas
- Soil cell volume /soil volume calculations
- specification of topsoil including additives and conditioners
- Tree grilles and guards (if required) and means of anchoring root balls. Built-in Root Irrigation Pipe system with end cap and aeration system.
- Passive and / or active irrigation including directed use of grey water / roofwater or surface water infiltration to benefit planted areas. Details of distribution system and controls
- Drainage system for tree pits.
- Where applicable -details of protection measures for statutory utilities and drainage
- a brief report on the installation of the rooting zone structures, including supporting photographic evidence, when the works are still “open” to allow inspection prior to any surfacing works
- A 3 year irrigation programme for the trees (in accordance with BS 8545-2014 Trees from Nursery to Independence)
- Confirmation of irrigation compliance shall be submitted a quarterly basis for the full 3 year programme period

TREE SELECTION and PLANTING

Tree selection

Subject to site constraints there is a presumption in favour of large canopy trees. Large, mature trees are the most valuable and have the greatest landscape impact. The developer shall design for the largest, longest lived species suitable for the given space.

Ultimate Mature height

Small – to approximately 10 metres

Medium – to approximately 15 metre

Large – greater than 15 metres

NOTE: The use of fastigiated or columnar trees will only be accepted in justifiable constrained circumstances or if a special landscape visual effect is desired.

Over reliance on one or a few species in the urban environment decreases the resilience of the tree population as a whole to the impact of pest and/or disease. Given the climate model projections for mid-century indicate an increasing risk of hotter drier summers and warmer wetter winters, coupled with increased frequency of extreme weather. The selection of species more suited to extended dry periods and high heat will be beneficial.

Up to date advice is available from the Forestry Commission: www.righttrees4cc.org.uk

NOTE- Studies are underway to survey all trees a city wide basis in Leeds. When the studies are complete this will inform species selection on a local scale to ensure that they contribute to city wide tree population resilience objectives. The aim will be to ensure that no single species should account for more than between 5-10% of any single city wide population. This is reflected in the recommendations made in BS 8545:2014.

In the meantime depending on the scale of the scheme a variety of tree species shall be incorporated into any schemes. Repeating patterns of blocks or individual species is the preferred approach.

Planting specification

The specification for the tree stock shall be in accordance with BS 8545:2014 which provides a comprehensive reference for the construction of detailed specifications to encompass good practice in nursery production, handling and storage, planting and aftercare and maintenance

Size of planting

Street tree planting sizes will be agreed with the Authority on a site by site basis. All trees shall be Container Grown unless otherwise agreed with the Authority. Container sizes for the different size trees must accord with Table D4 BS8545: 2014. The containerised trees must be produced in peat free organic compost.

- **Extra Heavy Standard**

14-16cm girth More resistant to casual damage and generally the preferred minimum size in a public location. (container size 45-100cm)

- **Semi Mature**

16-35cm girth Trees of this size will provide good resistance to casual damage and provide excellent initial impact. However they require specialist handling and greater attention during the establishment period.

- **Mature**

35cm girth + the above comments apply. Trees planted in these sizes and above would be considered suitable for planting in the city centre or in a development where a strong focal element is required. Advice should be sought from the city council landscape architect.

Shrub planting and grass

BS 4428: 1989 Code of practice for General landscape operations

BS3936 1992: Nursery Stock part 1 Specification for Trees and Shrubs.

BS 7370 1993: Part 4, Grounds maintenance recommendations including shrub pruning

Planting the tree

The root flare of the newly planted tree should be clearly visible at the soil surface. It should not be buried by excess soil or mulch.

(Refer to section 10 and Table 1 checklist for planting BS8545: 2014)

NOTE- Root circling in containers leads to a distorted root system which prevents lateral root development and reduces stability after transplanting.

Purchasers must request the Nursery supplier to submit evidence of the length of time for which young container grown trees have been in a container, giving potting dates. This evidence shall be submitted to the Authority.

NOTE- Since the root systems of rootballed, containerized or container-grown trees are not visible until the time of planting, a sample of the actual root system should be checked by breaking open a small percentage of rootballs or containers. The Authority shall be given 7

days' notice to come to site to witness this check prior to planting. If circling or girdled roots are visible all the trees will be rejected.

NOTE- wire baskets, hessian and twine used in the rootballing process shall be carefully removed (without root ball disturbance) to ensure that future root development is not inhibited. This must be carried out only when the tree is positioned in the planting pit – not on the ground surface.

PLANTING PIT DETAILING

Irrigation and aeration systems

Below-ground irrigation and aeration systems such as Greenleaf 'Root Rain Urban' are required in all hard surfaced areas where underground load bearing root zone technology is being used

In soft areas all trees (heavy standards and above) shall also have an irrigation pipe with a hinged cap.

As standard all trees shall be watered immediately after planting with approximately 25 litres of water. This will ensure that there is good contact between the root ball and the backfill material. This will also ensure that the soil is uniformly moist and this is very important in order to give the trees a good start.

Grilles

Check with the local authority about their specific policies on the use of tree grilles. If used, tree grilles should have removable inner rings (that allow for tree growth) and should be detailed to reduce drainage into tree pits by water contaminated by de-icing salts.

The advantages and disadvantages of different tree pit surfacing materials in Table F.1 of BS 8545:2014.

Protecting Tree Bark from Injury

Maintaining the integrity of the bark and outside layer of the trunk of a tree is essential to its survival. Below are examples of how this can be achieved depending on the context. The method will be agreed with the Highway Authority on a site by site basis

- Metal tree guards.
- Raised kerbs,
- Street furniture (seating, bicycle racks)
- 1.5m dia circle of bark mulch where trees are located in grass areas (conserves moisture and protects bark from mower and strimmer damage). The mulch shall be 75mm deep

NOTE- once a tree is established certain forms of tree protection e.g. tree guards should be removed to avoid potential damage to the trees

Tree support

In soft areas heavy standard trees shall have double stake and bridge. In relation to the main stem the stakes shall be as low as possible to encourage stem thickening at the fulcrum point. Underground anchoring systems shall be used for trees in hard landscape and for all semi- mature trees.

AFTERCARE

Adequate aftercare is required in terms of protection, watering, mulching, and formative pruning, as described in BS 8545:2014 Trees from Nursery to Independence. These best practice guidelines shall be incorporated into a submitted Aftercare Management Plan. Below is a summary of the main features.

Where applicable, shrub and grass areas shall also be incorporated into the Management Plan.

Irrigation

Trees are required to be watered about twice each week with 20 L of water adequate to keep an 800 mm diameter rootball well irrigated, and that 40 L of water or less thoroughly moistens a soil ball of 500 mm to 600 mm. BS 8545:2014 (Section G2). The frequency of irrigation is more important than the volume of water given at any one time.

An Irrigation Plan must conform to the BS. An Irrigation Plan must also include a system for reporting back to the Authority to confirm implementation of each irrigation operation.

The period over which irrigation is required shall be for at least three full growing seasons. As the root system develops, the frequency of irrigation can be reduced.

Formative pruning

Formative pruning is an essential part of the post-planting management and maintenance of transplanted trees. BS 8545:2014 (Section G3)

Routine maintenance

A formal assessment of young tree health and development should be carried out annually. This assessment should include foliar appearance (i.e. lack of leaf chlorosis and/or necrosis), leaf size and leaf canopy density, extension growth and incremental girth development. Continual assessment on an ad hoc basis should be carried out throughout the year, to inform maintenance requirements.

All stakes and ties should be checked at least annually to ensure that the root system remains stable and firm in the ground, and that ties are still effective and not causing any damage to the tree. Any stakes and ties that are found to be not fit for purpose shall be adjusted, replaced or removed.

All stakes and ties should be removed as soon as the developing root system is strong enough to support the tree.

NOTE: two full growing seasons are usually long enough for this to occur.

Wires or straps used in underground guying systems that could cause damage to the growing stem or structural roots should be cut as soon as the tree is self-supporting.

The area around the base of the tree should be free from competing vegetation

NOTE Selection of an appropriate herbicide, when used to control competing vegetation, is essential to avoid environmental contamination and damage to the tree.

All mulches should be replenished to their original depth, 75mm, and hand-weeded as necessary and at least once annually.

NOTE- The mulched area should be enlarged, if practicable, as the tree develops to the canopy drip line, taking care to avoid a build-up of mulch around the root flare and the base of the stem.

All grilles, grids, guards and other protective furniture should be checked at least annually. Such furniture should be removed as soon as it is no longer necessary to protect the tree, or where there is a risk of physical damage to the tree.

The soil around newly planted trees should be regularly inspected for soil capping or compaction. Remedial action should be taken as necessary.

NOTE -Inspections can be visual, but where conditions are extreme, on-site testing and amelioration might be necessary. This can include manually loosening the pit surface with hand tools or more extensive action using an air spade or equivalent.

All trees should be checked on a regular basis for mammal, human and other external damage. Remedial action should be implemented as soon as practicable following discovery.

All trees should be checked on a regular basis for pests and diseases. Remedial action should be taken promptly on discovery, where necessary.

Unless specific nutritional deficiencies are identified, no fertilizer should be applied to newly planted trees in the first season.

NOTE- If visual inspection reveals symptoms of nutrient deficiency such as leaf scorching, pale foliage or necrotic spots, then further investigation will be necessary with remedial action taken. Remedial action may, in addition to fertilizer application, include pH testing, assessment of organic content and levels of compaction.

References

- BS 8545 2014 Trees from Nursery to Independence
- Tdag- Trees In Hard Landscapes (September 2014)
- The SuDS Manual (C753) 2015



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