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Better Best Practice Note
Sizing Tree Pits for Multiple Benefits

Healthy trees thrive when they are provided with good soil conditions - enough soil volume to provide the stability, nutrients and moisture they need.

Trees planted in conventional street tree pits in urban environments often fail to reach their full potential or have a shortened lifespan due to many factors including:

1. The soil volume provided in a tree pit is too small.
2. The quality of soil is not compatible with the long-term needs of the tree.
3. The soil moisture is not regularly replenished as the tree pit may be sealed by concrete or bitumen reducing the potential for rainwater to infiltrate into the soil.

Street trees are competing for space with in-ground services and utilities, car parking, footpaths and other infrastructure.

Constrained urban trees in these conditions seek out moisture to survive, and can cause damage to surrounding pavements and utilities through uplift and root intrusion.

Arborists, horticulturists and soil scientists have collaborated to create innovative solutions that allow tree roots to access sufficient volumes of soil without damaging infrastructure.

Current best practice uses street tree pits which are essentially trenches, often under footpaths or roads, where soils are optimised for tree growth. The contiguous design of these trenches allows maximum soil volumes for trees and creates some separation from in-ground utilities.

However, challenges can exist due to incompatibility with surrounding unmodified site soils: if the surrounding soil is a heavy, compacted soil with undesirable chemical properties, roots will not readily move into this soil. Smearing the sides of a trench, following excavation with a mechanical digger for example, may further reduce the capacity of roots to penetrate into site soils.

It is important to encourage root growth into the surrounding soil for many reasons, the main ones being access to larger reserves of soil moisture and increased stability of trees from radial root growth.

Best practice street tree pit design aims to capture rainfall using the principles of water sensitive urban design to reduce stormwater runoff, waterway pollution and pressure on drainage systems resulting in flooding.

Capturing this stormwater not only provides trees with essential water for life, it also captures nutrients that trees can use, entrains sediments that may otherwise end up in our waterways, and provides a pathway for detoxification of pollutants in the soil.

Figure 1. Installation of street tree pits

Step 1. Determine soil characteristics

Soil on site needs to be 'characterised' to understand its properties and its capacity to support healthy root growth. This will determine if the soil needs to be repaired.

At a minimum, efforts are required to assist with 'keying in' of the new imported soil and the existing site soil. This will involve 'roughing up' the side and the base of the trench to increase surface area contact between the two soils so they start to work together.

Action: Undertake an assessment of the local soil conditions by appointing a soil specialist.

Step 2. Determine tree pit volume

Leake & Haege (2014) is one recommended methodology to calculate tree root volumes, and minimum tree pit volumes should be based on this (or equivalent industry recognised standards).

The method of Urban (2008) states 'best practice soil volume for each tree must be approximately one third of projected canopy volume prepared to a depth of 1m'.

Calculation of tree pit volumes should include an estimate of usable native soil adjacent to tree pits as provided by a soil scientist.

Action: calculate tree pit volumes which provide for one third of projected canopy volume and to a depth of 1m.

Step 3. Determine if supporting structures are required

Where tree pits are covered by hard infrastructure such as footpaths or roads, consideration of supporting structures is required. Support structures are designed to carry the weight of the road or footpath while protecting the structure of the underlying soil.

There are two principal types of support structures – structural soils and strata vaults.

a) Structural soils are a blend of large (63mm) aggregate rock plus a fine textured soil.

b) Strata vaults are plastic structural units with large spaces for soil.

The large aggregate of the structural soil takes the weight of infrastructure and may be compacted to a high level. Roots grow in the soil held in spaces between the aggregates. Strata vaults are filled with soil and provide greater soil volumes per unit area compared to structural soils. The choice between structural soils or strata vault is usually dependent on the quality of surrounding soil to support plant growth, capacity to capture and store water, and cost.

Action: Select tree pit support structures by assessing the quality of the surrounding soil to support plant growth; the capacity of the soil to capture and store water; and the cost implications of different options.

Figure 2: Strata vaults are one option to support healthy trees. (Source: Citygreen)

Step 4. Ensure design allows for maximum tree health and stormwater treatment

There are design solutions available which will support tree health (through use of good quality soils in sufficient volumes and access to passive irrigation) and will facilitate the achievement of best practice stormwater treatment requirements.

Soil selection for stormwater capture requires a balance between potentially competing properties – rapid infiltration and maximum water retention. For this reason, soil specification for stormwater capture and tree health requires assessment of local soil conditions and the needs of the trees.

Studies of tree growth in containerised environments (such as tree plots) have shown that the ultimate growth and canopy diameter of a tree is related to both the soil volume and the frequency of access to water.

The figure below demonstrates this relationship, for example 20m^3 of soil can support a tree with a canopy in excess of 6m, if frequently irrigated, 4m if occasionally irrigated and only 2.5m if there is no irrigation.

Action: Use the above advice for early design consideration of stormwater flows and tree health.

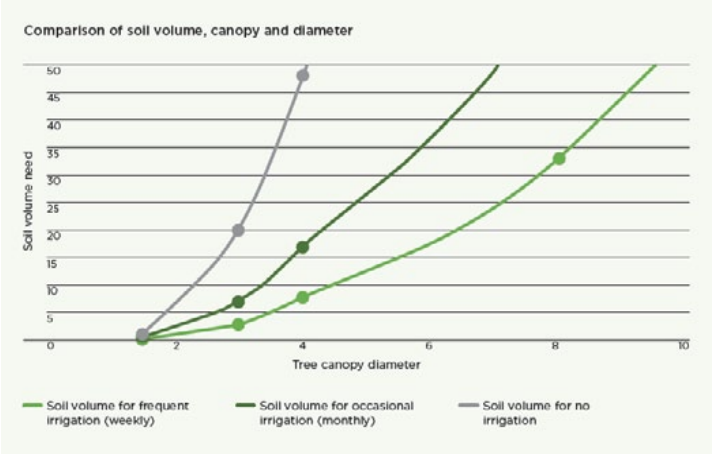

Figure 3: Comparison of required soil volume to achieve the desired tree canopy in containerised environments under varying irrigation conditions in Melbourne (Source: Hitchmough, 1994)

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