Water Management of Mature Street Trees

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City of Melbourne Experience

The City of Melbourne is internationally recognised for its tree-lined boulevards, parks and gardens. Trees beautify, define and soften landscapes and give scale to buildings in addition to providing shade and wildlife habitat. Trees are the most life enriching of all the types of vegetation used in the urban environment. They also contribute significantly to the maintenance of a healthy urban environment by trapping airborne pollutants and absorbing carbon dioxide.

The City of Melbourne manages approximately 60,000 trees including approximately 18,000 street trees. Using the City's 'tree amenity valuation formula' the total value of Melbourne's trees is estimated to be over $600 million. This asset is irreplaceable in the short term and the tree population requires close monitoring and management to ensure its continued good health. Street trees also increase values of adjoining properties.

Melbourne has some of the most significant stands of mature elm trees remaining in the world following the destruction of many of the elm populations in the Northern Hemisphere by Dutch Elm Disease. The elms lining the major boulevards of Victoria Parade and Royal Parade, along with the avenues of trees in the Fitzroy Gardens are registered as significant by the National Trust.

Of the City's tree stock approximately 15,000 trees have grown in turf areas with regular irrigation. These include park trees and those grown in turf medians such as Royal Parade. Irrigation systems in the past have generally been designed to water the park surface, median or nature strip grass using manual or automatic surface sprinklers. Although this method of watering keeps the grass green it is not efficient in watering trees as it encourages them to develop surface root systems. Regardless of the species of trees and because of historical horticultural practices and the perception that water is a limitless commodity, trees have become dependent on regular surface watering and are less drought tolerant. Many of the trees in the City of Melbourne have been stressed over recent years as a result of low soil moisture.

The severity of the problem has increased over the last couple of years. There are a number of factors that have contributed

to this situation. Reduced rainfall in recent years with Melbourne experiencing 10 years of drought. Reduced application of supplementary water through changes to irrigation management initiated by water restrictions. Reduced uptake of rainfall through increased hydrophobicity of soils.

In response to the drought and a move away from using turf sprays to irrigate trees the City of Melbourne has used a range of alternative ways to deliver water effectively to tree root systems and maintain soil moisture at levels to maintain trees in a healthy condition.

Soil moisture readings are taken in the City's main gardens and boulevards in order to inform water application by monitoring the available water for the trees. The City's irrigation systems are being changed in order to ensure that the trees are provided with adequate water.

In a major move away from turf sprays over 160km of sub-surface drip line has been installed. These systems are hooked up to existing infrastructure. A fleet of water tankers and water-filled barriers have been brought in to supply water to drought stressed trees that cannot be adequately watered using the irrigation systems. The water tankers are taking reclaimed water from the Royal Park Wetlands.

Recycled mulch has been placed under a large number of trees in parks that may be more susceptible to the dry conditions.

The sub-surface drip lines are considered to be a temporary measure and a more permanent and robust system has been developed to deliver water efficiently in a sustainable way. Street trees present particular challenges in terms of irrigation. These challenges include:

- Tree roots contained within median and street structures – limited water storage volume and limited catchment opportunity
- Tree root distribution highly variable and non symmetrical
- Access to root systems often limited by hard surfaces
- Tree roots in competition with turf roots for irrigation water
- Significant roots located deep within the soil profile – water needs to be delivered at depth
- Canopy interception of rainfall can be significant
- Compacted soils (low infiltration rates) - particularly on nature strips
- High peak daily water requirement
- Street trees are often high traffic and high maintenance areas
- Root disturbance and damage e.g. excavation reduce the effectiveness of parts of tree root systems
- The street trees may already be stressed due to disease or damage

A key consideration for the future watering of the trees will be the development of tree watering systems that will be permanently installed and supplied from a sustainable water source.

The following criteria were developed to establish the context within which a suitable tree watering technique could be identified.

Irrigation water effectively delivered to the tree root soil volume so that healthy growth can be maintained. Watering throughout the depth of the soil profile and lateral distribution are required.

- No overflow or surface flooding
- Minimum damage to existing roots through installation
- Installation technique not to impede root development
- Technique to work effectively in a range of soil types
- Plumbing of water delivery to allow regulated, low flow rate, delivery with minimum risk of blockage
- Installation technique to be flexible should large roots, services and/or rocks be encountered

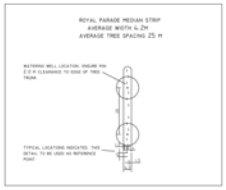
- Installed technique to allow ground footprint area to be safely trafficked and not subject to subsidence. It should withstand loading that is expected from maintenance machinery and vehicles including trucks
- Robust construction of water delivery system
- Water delivery hardware to be accessible and protected using appropriate valve box and secure cover
- Technique to remain functional, without need for major restoration works, for a period of ten years
- Installation to be environmentally sensitive and responsible e.g. not waste water, any soil waste used responsibly
- Technique can be readily and safely installed and cost effective
- Water delivery program to be able to be accommodated within existing irrigation scheduling capability
- Technique to be repairable should tree root and soil conditions interfere with the functioning of the system.

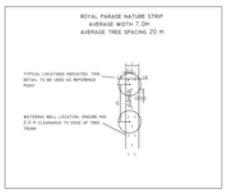
The City of Melbourne decided, in early 2007, to investigate watering techniques that could be used to maintain trees, located in high profile streets and boulevards, in a healthy condition. The trial investigated a range of drip watering and tree watering well products. Restricted root systems, highly variable soils, high traffic and high exposure characterize these trees.

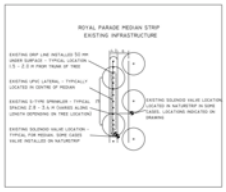
The trial was carried out in Royal Parade, Parkville, where elm trees are positioned in both medians and nature strip areas. The medians are typically raised concrete structures, approximately 500 mm high and 4 metres wide.

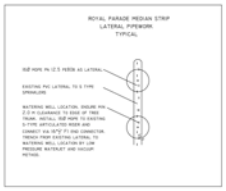
A range of water well products and a watering trench were trialled with the watering trench found to perform best.

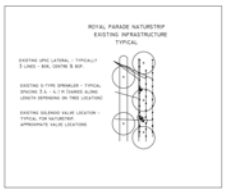
The key evaluation criteria included the (a) distribution of water (vertical and lateral), (b) presence of overflow and (c) installation requirements.

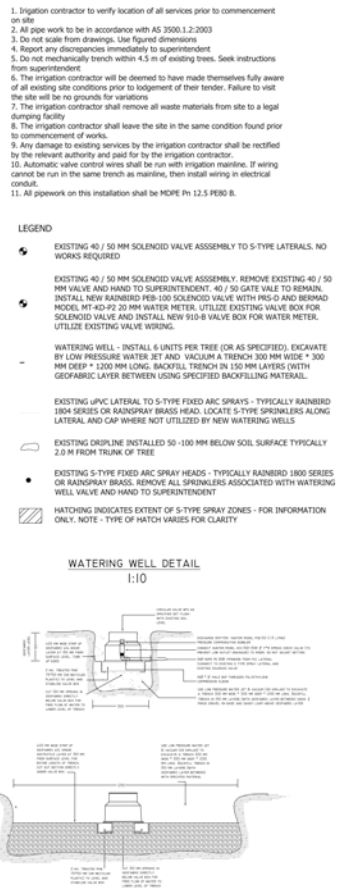


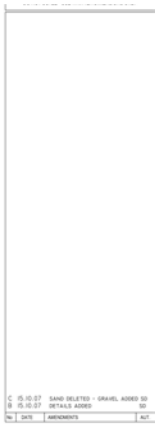












The trench was considered to potentially have the advantage of providing a wider distribution of water, allow a relatively large volume of water to be delivered rapidly and, if necessary, allow grass to be grown over the surface.

The basic dimensions of the trench was approximately 1.2 metres long, 300 mm wide and 300 mm deep. The total volume of the trench cavity is approximately 110 litres. Both sand and graded gravel (7 mm), referred to as quarter minus, was used as the trench medium.

The trench version which performed best consisted of quarter minus gravel. The quarter minus provided ample void water space for water storage (approximately 30%) was stable when saturated. The washed sand material was found to become soggy or slushy and provided virtually no top loading support. This is an important

consideration for a watering system in these areas is that that present no undue risk to the public.

Water distribution from the trench was found to be variable however typically in the range of 500 mm laterally, beyond the edge of the trench, at a depth of 500 mm.

The water jet technique was considered to be the most effective in terms of constructing this type of trench. However the watering jet technique is potentially expensive and requires considerable support in terms of roadway traffic management restrictions to accommodate the truck. The trench watering system has been installed in the majority of Royal Parade, sections of St Kilda Road and in sections of Birrarung Marr

The change to sub-surface delivery of water has improved the health of trees. Generally trees have taken one summer season to adapt to the new source of water and by the following summer are displaying greater health with fuller canopies and minimal indications of drought stress.