Photo

Suburban Trees and Urban Sustainability

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Save Our Suburbs, 15 November 2015

INTRODUCTION:

- Society has invested resources in tree establishment and management
- Trees have matured as assets and provide many and diverse benefits to society
- Over thirty years tree populations and cover in Australian cities have declined due to significant loss of private open and public open space (loss of front and back yards, redevelopment and new real estate developments (Mullaly, 2000).
- Australian cites have on average 35% cover (Canberra 56% and Adelaide 27%).
- In most cities, a majority of local government authorities that make up the greater part of the cities had a canopy cover of less than twenty per cent. In many situations there is insufficient open space - public or private - for the planting of trees
- Opportunities for vegetation to ameliorate the heat island effect, reduce wind speed, provide shade and reduce energy use are diminished.
- Such an outcome not only raises questions about the economic viability of these developments, but also about their long term environmental sustainability.

Photo

GOSCH'S PADDOCK

The Elms along Punt Road, Melbourne, are only there due to public action in the 1980's

All the elms along Punt Road were to be lost so that the road could be widened. The pipe fence was valued, but the elms were given a $0 value and were not on the plans. New road widening proposals again put these trees at risk

Photo

CITYLINK:

- The Citylink tunnels under the Yarra involved a cut a fill component, which would see a number of trees along the Yarra bank, particularly near Olympic Park, removed.
- Because of the protest and political hassles related to the Grand Prix and Albert Park, the government decided to minimise the tree losses
- On the Olympic Park side, 7 mature elms were lifted and stored in Olympic Park and later planted back along the River. They are still there.
- On the south side, a slight relocation of the tunnel allowed the preservation of one of the mature eucalypts.
- Fifty young trees were also planted in the vicinity of Gosch's paddock as insurance in case the relocated trees did not survive.

Heat wave related deaths in urban climates.

Heat and human mortality (modified from Tapper, 2010)	
Definition of heatwave (No formal definition)	BoM: "prolonged period of excessive heat"
	Largest cause of death from a natural event
	It is a passive threat
Examples	Most famous large event – Europe 2003
	Up to 35000 excess deaths
	Indicative of what might happen with climate change
Where deaths occur	Natural & built landscapes affect heat loads
	Demographic, health and socio-economic status influence outcomes
	In Melbourne greatest number of deaths in the western and northern suburbs
	374 excess deaths (Jan26-Feb 1 2009)
	66% of such deaths in 75+ age group

Cases of Trees Providing Unvalued Economic Benefit:

Recreational usage of Open Space Enhanced by the Presence of Trees:

The use of recreational open space for both active and passive recreation is known to be enhanced by the presence of trees in landscapes.The health benefits from increased activity/ can be quantified and are very substantial (1-2% increase saves Vic Health $274million per annum).

The Victorian Department of health noted:
promoting health and well being outcomes through promoting the use of alternative water resources such as stormwater to maintain green spaces, thereby enhancing physical activity and livability.
(Dedman, 2010)

Changes in tree cover for developed and undeveloped land in Richmond and Balwyn between 1993 and 2000 (Modified from Mullaly 2000)

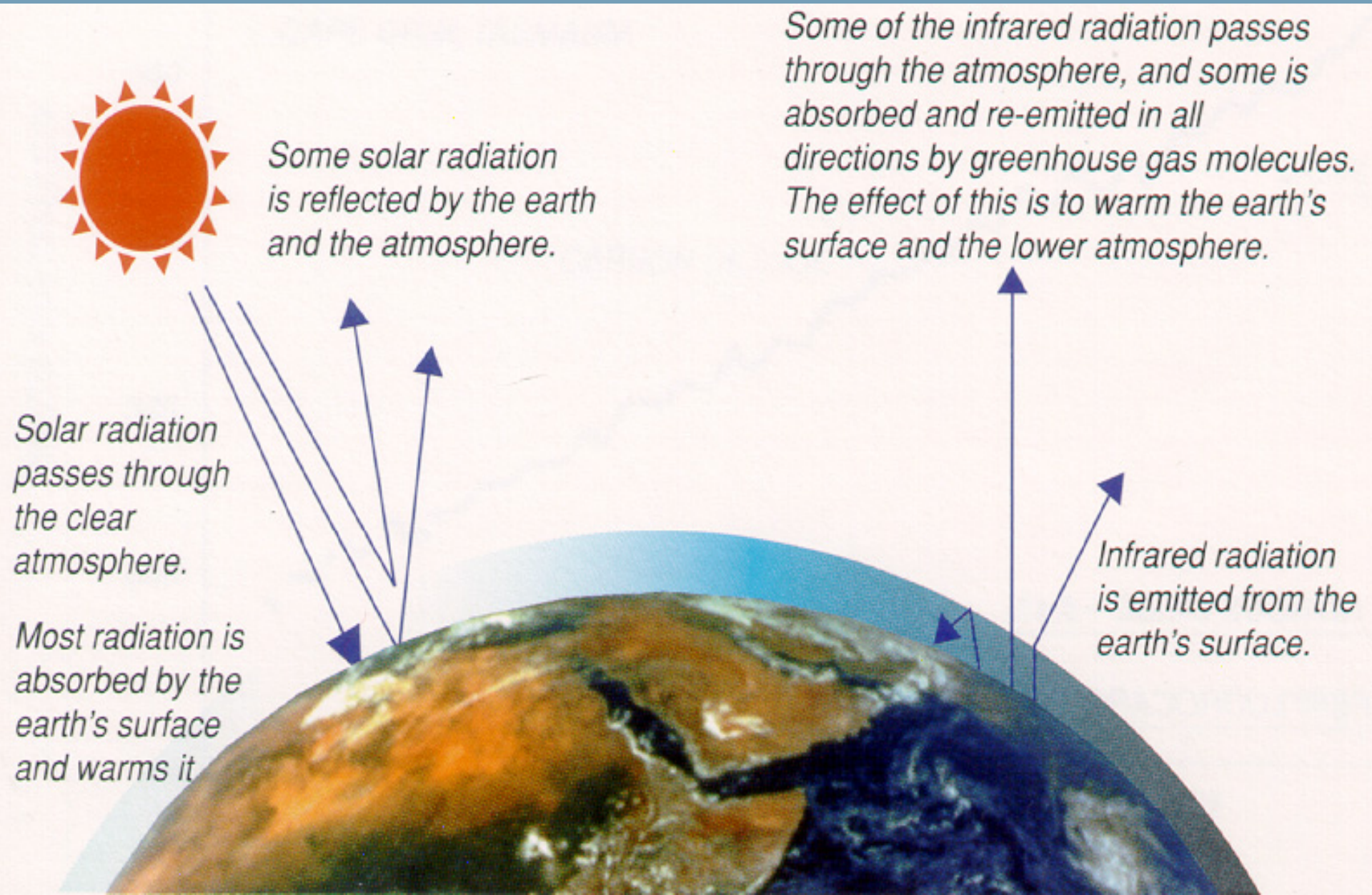
LAND TYPE	OWNERS OF LAND	BALWYN			RICHMOND		
Developed Land		1993	2000	CHANGE	1993	2000	CHANGE
	PRIVATE	19.23	10.49	-8.24	7.01	5.17	-1.84
	PUBLIC	3.45	4.65	1.20	2.65	2.12	-0.43
	TOTAL	22.68	15.64	-7.04	9.66	7.39	-2.27
Undeveloped Land							
	PRIVATE	20.00	17.47	-2.53	5.89	5.78	-0.11
	PUBLIC	6.25	7.81	1.56	2.84	5.45	2.61
	TOTAL	26.25	25.28	-0.97	8.73	11.23	2.50

LOSS OF CANOPY IN RICHMOND AND BALWYN:

Overall canopy reduction in Richmond by 2%.

Overall canopy reduction in Balwyn of 7 %.

- The change in canopy in Balwyn has gone largely unnoticed as Balwyn is a green and leafy suburb with about 2.5 times the canopy cover of inner city Richmond.
- The loss of canopy cover in Richmond has been on private space in particular due to urban renewal and high density housing development, and has been offset to some degree by extra planting in public open space.
- However, as urban renewal and high density housing continue there are fewer public open spaces available for planting.
- While changes of 2% and 7% may seem small over a decade they represent significant changes to canopy cover.


Some of the infrared radiation passes through the atmosphere, and some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the earth's surface and the lower atmosphere.
Some solar radiation is reflected by the earth and the atmosphere.
Solar radiation passes through the clear atmosphere.
Most radiation is absorbed by the earth's surface and warms it
Infrared radiation is emitted from the earth's surface.

Likely outcomes from climate related changes in south eastern Australia (modified from Moore, 2012).

Generally warmer winters and hotter summers
Lower annual rainfall (10-15% lower) with more summer rainfall events
A more tropical climate extending southward
More easterly winds and summer storms
More frequent major storm and severe strong wind events
More days of extreme fire risk weather
More bushfire prone regions, extending to peri-urban parts of major cities
Changed weather and fire patterns
Fewer frosts, and in some places elimination of frosts completely
Many more days above 30C and double the number of days above 35C
Higher summer rainfall with more intense rainfall events
Local flooding in cities during high rainfall events
Flooding of lowland coastal areas – probably minor
For every one degree temperatures rise, the snowline rises 100m
Agricultural productivity will change, in some cases improving
Some crops will not be grown but others become viable
Housing and building construction processes will change
Energy demands and patterns of use will alter

Some of the many benefits that tree provide in your garden (expanded from Moore 2012) :1

Shade can reduce roof temperatures by up to 8° C. This cools the house in summer and reduces air conditioner use and electricity consumption	Vegetation cools the area around houses. This reduces the urban heat island effect (UHI), cools cities and saves on water and electricity consumption
Trees can reduce storm wind speeds reducing the damage to roofs and other structures during storms	Absorption of water can reduce the risks of local flooding and removes the need for larger storm water gutters and pipes
Trees stabilize soil on steeply sloped blocks of land reducing building cost by thousands of dollars	Vegetation increases urban biodiversity so that there is more urban wildlife
Trees humidify air, which can help reduce the effects of hayfever and asthma and other respiratory ailments	Plants help off-set your carbon emissions and so reduce your contribution to the greenhouse effect and global warming
Trees remove airborne pollutants especially in cities and along major roadways, which helps keep levels lower and reduces health risks	Noise abatement is not easily achieved by trees alone, but a mixed planting of trees and evergreen shrubs with a high leaf area index (LAI) can reduce noise levels

Some of the many benefits that tree provide in your garden (expanded from Moore 2012) :2

Vegetation provides many human health benefits, such as reducing blood pressure and improving the quality and longevity of life	Vegetation provides social benefits. Green and leafy suburbs tend to have lower rates of vandalism, violence and graffiti
Vegetation, especially trees, encourages both active and passive recreation by people, thereby improving their health and lowering health costs	The shade provided by trees lowers water evaporation from the soil saving water and helping to reduce the UHI effect
Vegetation, particularly trees slow the front of flood waters and can be used as part of flood mitigation	Reduced water speed in floods also minimizes the erosion of river banks and the down stream silting of waterways and estuaries
Green and leafy suburbs, especially those with tree-lined streets, have a higher property values and so add to a property owners capital value	Reduced stream flow rates during storm events can be used in litter management, by allowing litter collection on land after the flood waters retreat. It is cheaper than trying to collect litter in waterways
The shade from trees protects children and adults from harmful radiation, reducing the risks of sunburn, skin cancer and melanoma	Trees contribute to the aesthetics of the landscape giving a sense of scale, providing screens for unsightly aspects of the urban landscape and acting as focal points. All adding to real estate value

Climate and Environmental Values associated with Trees

Climate related values:	Environmental values:
• Shade • Shelter from the wind • Thermal insulation • Temperature modification • Reduction in Glare • Humidification of the air • Filtration of polluted air • Interception of rainfall • Reduced water runoff • Reduced stream turbidity • Altered effective precipitation	• Production of Oxygen • Fixing of Carbon Dioxide • Reduced soil erosion • Edaphic environment • Protecting watersheds • Ameliorating windflow • Improved air quality • Altering ambient temperature • Noise abatement • Wildlife habitat • Create ecosytems

Gross Annual Benefits from an Adelaide Street Tree

BENEFIT CATEGORY	Value	
Energy Savings	$64.00	
Air Quality		
CO2 (reduced power output)		$1.00
Air Pollution		$34.50
Storm Water		$6.50
Aesthetics/others		$65.00
Repaving Savings	?	
Estimated Gross Benefits	$171.00	

These estimates were made in 2002.

A more recent estimate in 2009 puts the value at $424.00.

The estimate has more than doubled in 7 Years

Costs of running an air conditioner over summer and the savings in electricity due to shade from trees in you garden (Moore 2013).

Power (Size) of Air Conditioner (kW)	**6**
Hours of use in an unshaded home over summer	**200**
Electricity tariff (an off peak general average) (cents per kWh)	**30**
Total air conditioner electricity bill ($)	**360**
Reduction due to one tree shading the afternoon sun (kWh)	**50**
Saving in electricity bill ($)	**90**
Reduction due to two trees shading the afternoon sun (kWh)	**100**
Saving in electricity bill ($)	**180**

Economic value of shade for an urban street lined by 100 trees prolonging the life of bitumen.

Approximations used	**Value**
Estimated length of street (m)	**500**
Width of road surface (m)	**7**
Area of Bitumen road surface (m^2)	**3500**
50 trees on each side of the street so total number of trees	**100**
Shade from an individual tree canopy (m^2)	**75**
Area of bitumen shaded by tree canopy, estimated at 33% of total (m^2)	**37.3**
Total area of bitumen shaded by tree population of 100 trees (m^2)	**3,730**
Cost of resurfacing bitumen per m^2 (AUD$)	**450.00**
Total value of extending the life of the shaded bitumen from 20 to 30 years due to the 33% shade from 100 trees (AUD$)	**1,678,500**

Economic value of shade from an urban forest of 100,000 trees (after Moore 2012).

Approximations used	Value
Number of trees in the urban forest population	100,000
Electricity saving due to shade per tree per annum (kWh per annum)	30
Total electricity saving per annum (kWh)	3 million
Value of electricity per kWh AUD$	0.30
Total value of electricity saving per annum (AUD$)	1million
Value of savings in electricity use per annum for one tree (AUD$)	10.00
Water saved by reduced electricity use at 100L per kWH (L)	300 million
Total value of water saved at $1.50 per kilolitre per annum (AUD$)	450.000
Value of savings in water use per annum for one tree (AUD$)	4.50
Total value of savings in electricity and water use per annum (AUD$)	1.45 million
Total value of savings in electricity and water for a tree per annum (AUD$)	14.50

Tree Value and property value

- A good tree in a adds at least $5,000 to domestic property value
- Others put the value as high as $50,000 or 5% of the property value
- There a positive return if you spend wisely on landscaping
- The Real Estate industry sees the value of trees in adding to values.

- Planet Ark (2014) reported that for a house valued at $500,000 Australians would be prepared to pay an extra $35,000 for a house in a green and leafy area (34% would pay an extra $100,000).

- 73% of Australians want a backyard and 57% of Australians want a park within a 5-10 minute walk of their home

- In many green and leafy suburbs, permit applications for townhouses and multi-unit developments on large blocks full of mature trees reduce the value of adjoining properties

Economic contribution of trees and gardens to residential property value.

	Basis of Estimate and Source	Value of Estimate
Value of single tree	**Real estate agent valuation (Anon 2010)**	**AUD $5000**
	Real estate agent valuation (Boyd 2010)	**5% of property value**
	Real estate agent valuation of nature strip tree (Gonzalez 2007)	**30% added to property value**
Value of Treed Garden	**Real estate agent valuation (Boyd 2010)**	**AUD$50,000**
	Real estate agent valuation (Boyd 2010)	**5% of property value**
	Planet Ark survey (2014)	**AUD $35 -100,000 on a property worth $500,000**

Table 5: Carbon lost in pruning a mature urban tree canopy.

Approximations used	Single Tree	100 Trees
Average weight of whole tree, including above and below ground components (t)	100	
Amount of carbon sequestered in each tree (t)	13	
Amount of carbon sequestered in the canopy of each tree (t)	6.5	
Amount of carbon lost if 30% of canopy pruned from each tree (t)	1.95	195
Amount of carbon lost if 20% of canopy pruned from each tree (t)	1.30	130
Amount of carbon lost if 10% of canopy pruned from each tree (t)	0.65	65
Value of 1tonne of carbon $AUD	23	23
Value of carbon pruned from trees when 30% pruned (AUD$)	44.85	4485.00
Value of carbon pruned from trees when 20% pruned (AUD$)	29.90	2990.00
Value of carbon pruned from trees when 10% pruned (AUD$)	14.95	1495.00
Value per annum of carbon pruned per tree (30% pruned 3yr cycle) (AUD$)	14.95	
Value per annum of carbon pruned per tree (20% pruned 3yr cycle) (AUD$)	9.97	
Value per annum of carbon pruned per tree (10% pruned 3yr cycle) (AUD$)	4.98	
Value per annum of carbon pruned per tree (30% pruned 5yr cycle) (AUD$)	8.97	
Value per annum of carbon pruned per tree (20% pruned 5yr cycle) (AUD$)	5.98	
Value per annum of carbon pruned per tree (10% pruned 5yr cycle) (AUD$)	2.99	

Table 7: Economic value of trees in stabilizing a suburban house site from landslip.

	Opportunity lost being unable to build for 10 years (Simple Interest)	Opportunity lost being unable to build for 10 years (Compound Interest)	Immediate Piling Replacement Option
Number of trees	**5**	**5**	
Cost of Piling AUD$			**50,000.00**
Value of Land AUD$	**200,000.00**	**200,000.00**	
Simple interest rate	**5% per annum**	**5% per annum**	
Value of lost opportunity from the land	**100,000**	**125,800**	
Total value of service provided by 5 trees over 10 years AUD$	**100,000**	**125,800**	**50,000.00**
Total value of service provided by a tree over 10 years AUD$	**20,000**	**25,160**	**10,000**
Value per tree per annum AUD$	**2000.00**	**2516.00**	**1000.00**
Amortised Value of 5 trees over 50 years AUD$	**2000.00**	**2516.00**	**1000.00**
Amortised Value of a tree over 50 years AUD$	**400.00**	**503.20**	**200.00**

Economic value of urban trees in providing outdoor shade for schools and other public buildings.

	Shade sail Replacement Option	**Amortisation of Value from a tree over 50 years**
Cost of shade sail (50m^2 and supports poles) AUD$	5000.00	
Number of shade sails required	1	5
Useful life of shade Sail (Years)	10	10
Value of shade provided by tree over 10 years AUD$	5000,00	25000.00
Value of shade provided by tree per annum AUD$	500.00	500.00

Cases of Trees Providing Unvalued Economic Benefit:

Roadside Trees as a Speed Control Measure;

In Britain a AUD$122,000 scheme to plant trees increasingly closer to the verge is part of a $2.5million scheme to reduce speed and improve safety.

Trees are also planted at so called “lazy diagonals” which makes the road appear to narrow as you approach small towns and villages. Motorists naturally tend to slow up in response.

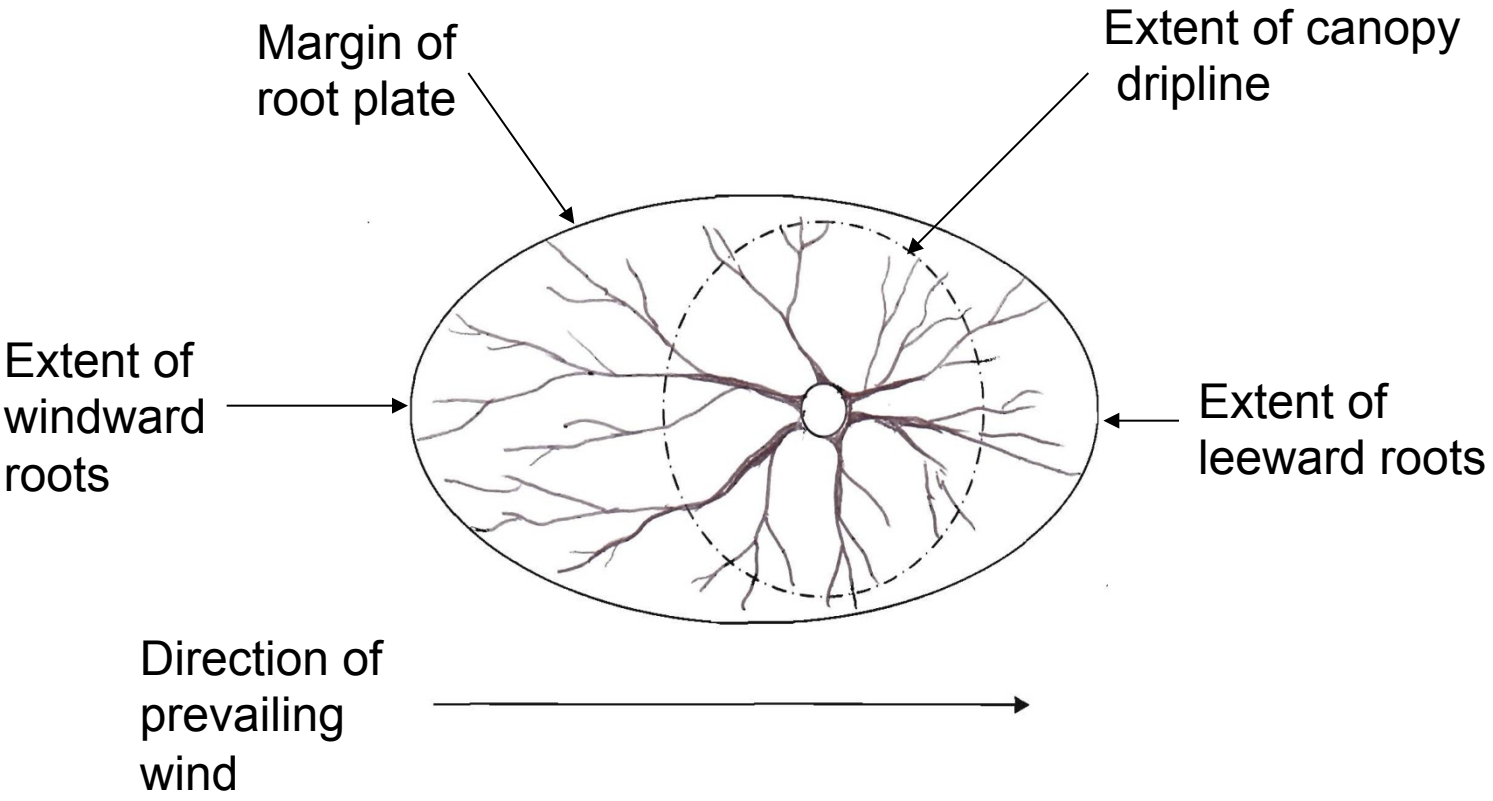
The scheme would be an eye-opener to Australian road authorities whose management or roadside trees is usually nothing short of appalling.

Figure 2. The spread and depth of a typical tree root system. From (Watson and Neely, 1994).

Mature root systems: the importance of the root plate, lateral and descending roots 1:

The root system of mature trees tends to be spreading and relatively shallow consisting of a relatively shallow, spreading root plate, consisting of the root crown, structural roots and the network of shallow, spreading, absorbing roots that are located close to the soil surface (300-60mm deep) and often spreading well beyond the dripline of the canopy

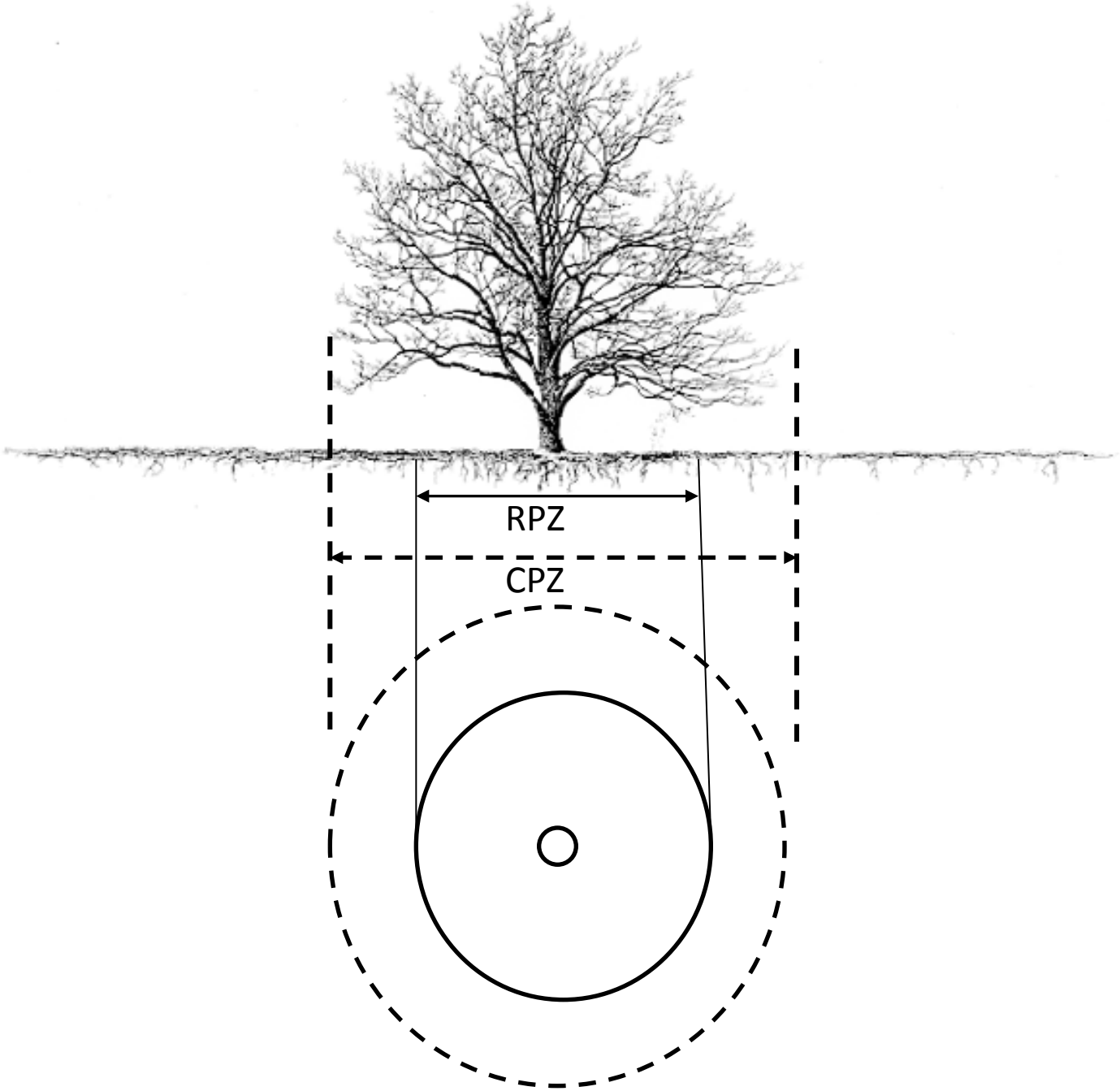
The root plate of lateral spreading roots is complemented by the presence of descending (or vertical, sinker or oblique) roots, which tend to occur within the dripline of the tree and are often denser closer to the trunk. The descending roots tend to become more important to trees as they mature, particularly in the development of a heavier root plate (Nielsen 2009)


Margin of root plate
Extent of canopy dripline
Extent of windward roots
Extent of leeward roots
Direction of prevailing wind

PROTECTING TREES ON DEVELOPMENT SITES. AS 4970

Development includes the following:

(a) The use of land (e.g. festival events, use of park areas and other events) that requires approval.
(b) The subdivision of land.
(c) The erection of a building.
(d) The carrying out of a work.
(e) The demolition of a building or works.
(f) Road works.
(g) The installation of utilities and services.
(h) Any other act, matter or thing as defined by the relevant legislation.


RPZ
CPZ

CALCULATING THE MINIMUM RPZ

(EXCEPT FOR PALMS, CYCADS AND TREE FERNS, SEE CLAUSE 3.2.2.2)

Tree age	Tree vigour	RPZ radius (m)
Young trees (age less than 20% of life expectancy in situ)	Good vigour	6 × DBH
	Poor vigour	9 × DBH
Mature trees (age between 20% and 80% of life expectancy in situ)	Good vigour	9 × DBH
	Poor vigour	12 × DBH
Over mature trees (age greater than 80% of life expectancy in situ)	Good vigour	12 × DBH
	Poor vigour	15 × DBH

NOTES:

1 Radial distances are measured from the centre of the stem at ground level.

2 The RPZ distances in this table are based on a good species tolerance to site disturbance. There are no scientific data of tree tolerances for Australian conditions.

3 No tree should have RPZ less than 2 m or greater than 15 m.

CONCLUSION:

* Urban trees and landscapes are major community assets that must be managed as assets
* Urban tree values will steadily increase
* Climate change will have a deleterious affect on human health, social structures and the economic components of our society as well as the environment, if we fail to plan for it.
* There are significant opportunities for proactive urban tree management in Australian cities that must be captured if our cities are to cope with global climate change.
* We have to develop landscapes that value trees, recognise the value of water and the need for sustainable economic and environmental management