



SOIL ISSUES



**for
URBAN TREES**

**Independent consulting, laboratory,
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**Sydney
Environmental
and Soil
Laboratory**

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SIMON'S POSTULATES

1. In any biological production system-

$$\text{Phenotype} = k \times \text{genotype}$$

2. In the most efficient production system
(no limiting physical or chemical
conditions)

$$k = 1$$

3. K is always < 1 in streetscapes.

Limiting Above Ground Conditions are:

- Wind velocity profile
- Temperature regime
- Albedo (surface reflectance)
- Humidity
- Mechanical injury (vandals, vehicle impact, dog urine, pests and disease)

So who cares about wind?



Most Limiting Below Ground Conditions are:

- Rooting volume limitations
- Limiting soil oxygen levels
- Inappropriate moisture regime (alternating waterlogging and drought)
- Neglect of soil nutrition (nutrient deficiency)
- Metal toxicity (zinc and other metals)

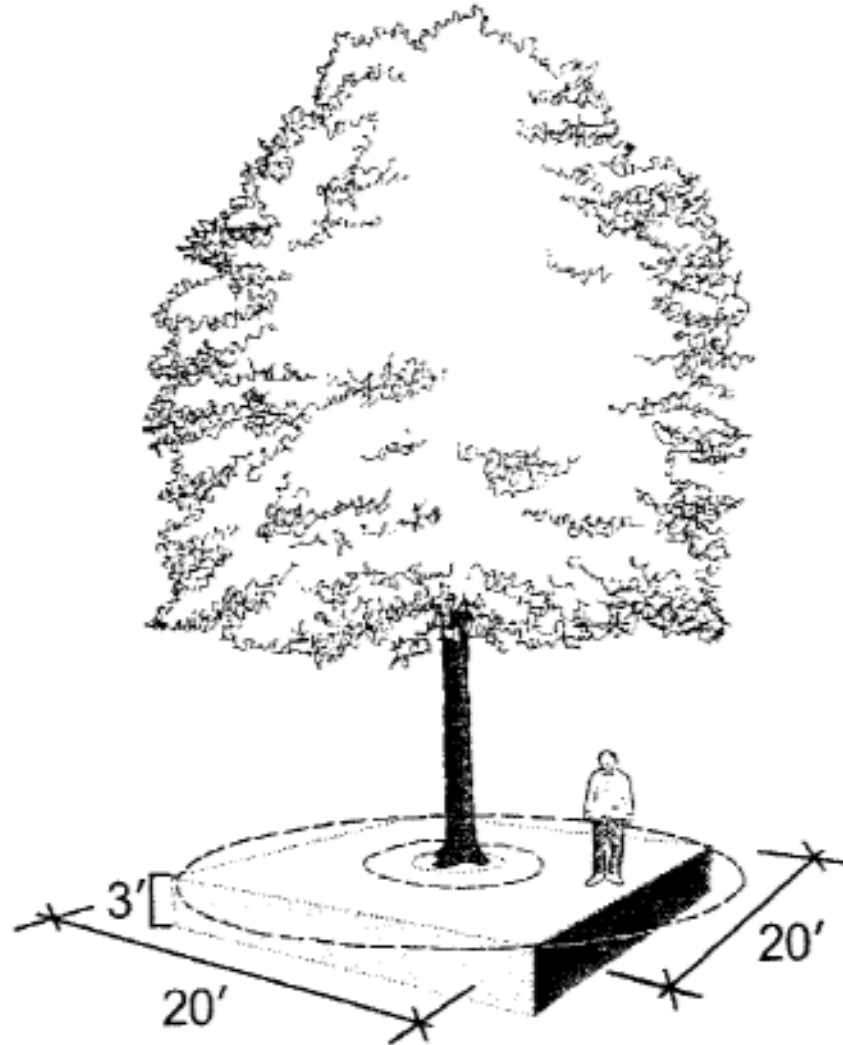
Actual Root System of an 80-year old Oak



After Watson (1997)

Ideal Rooting Space: In your Dreams!

(after Urban 2008)



Design idea meets limiting root volume:

- Increase design and maintenance interventions-
 - Irrigation
 - Drainage
 - Aeration
 - Fertiliser
 - Pruning
 - Pest control
 - Footpath maintenance.

Estimating “effective rooting volume”, factors to consider:

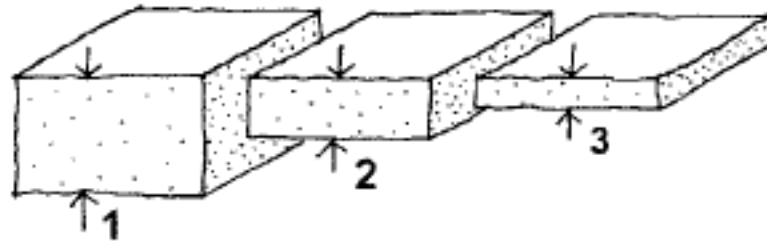


Figure 2.4.43. Estimate the value of existing soil's contribution to the available soil volume calculation.

1. 36 inches or more: Soil supporting existing plants and trees.
2. 18 inches: Soil near root-limiting bulk density.
3. 9 inches or less: Soil under pavements.

Design solutions when volumes are limiting:

- Increase design support structures (eg irrigation, drainage maintenance)
- More is not necessarily better, one large tree may be better than a line of stunted ones
- Link root volumes
- Tree choice
- Engineered solutions.

What's it all about?

OXYGEN, OXYGEN, OXYGEN!

Ultimate tree size

Crown Spread Sq Ft <i>m2</i>	DBH-Trunk Diameter Inch <i>mm</i>
1200	24
111	610
1000	20
92	508
800	16
74	406
550	12
51	305
350	8
32	203
150	4
14	102

Example: A 16 inch/406 mm diameter tree requires 1000 cu ft/28.3 m3 of soil.

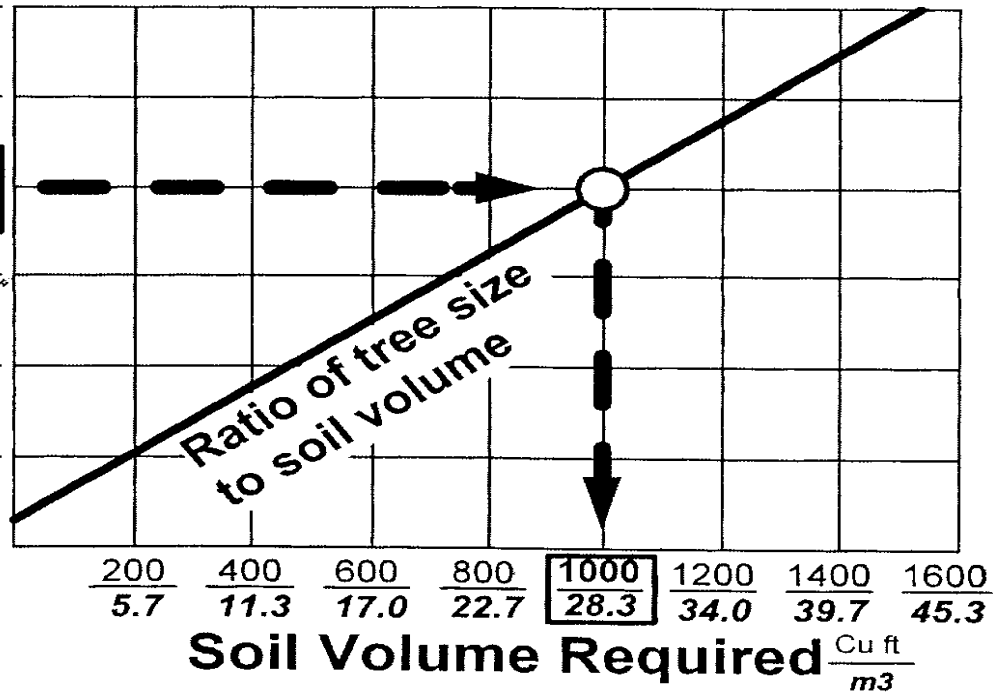


Table 1. Soil Properties for Root Growth and Function

Soil Property	Partial Pressure of O ₂
Free atmosphere	21 %
Root survival	2.5%
growth	5 %
root initiation	12 %
nutrient absorption	15%

Engineering has all the answers?

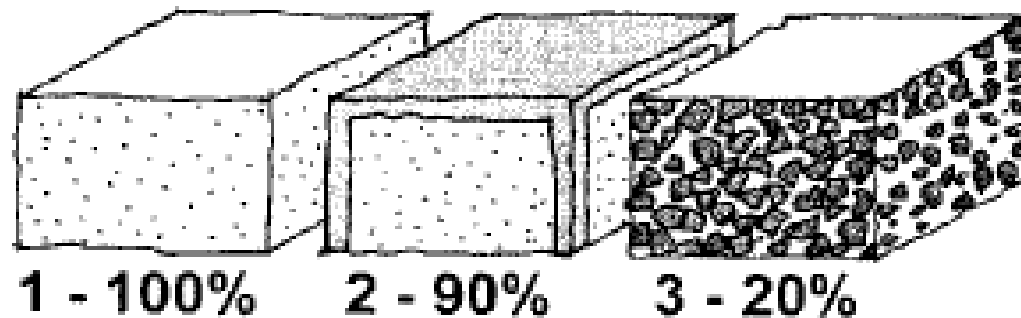


Figure 2.4.44. Soil volume value of different soil systems.

1. Loam soils: 100 percent.
2. Suspended structure filled with loam soil: 90 percent or greater.
3. Rock-based structural soil: 20 percent.

Trees don't need fertilising!

Not unless-

- Rooting volume is limiting
- Tree is too big for its effective soil volume
- Tree is in structural soil
- Nutrient removal is significant over time
- Tree is diseased, roots compromised or generally deficient.

Leaf Tissue Testing of Chinese Elm (*Ulmus parviflora*) Hyde Park Sydney.

Nutrient % dry weight basis	Symptomatic* Foliage	Post Treatment•	Normal Range
Nitrogen	1.78-2.1	2.1-2.28	2.17-2.64
Phosphorus	0.15-0.16	0.19-0.25	0.17-0.28
Potassium	0.59-1.6	1.9-2.0	1.06-1.76
Calcium	2.0-2.3	1.4-1.9	0.52-2.56
Magnesium	0.41-0.85	0.27-0.39	0.22-0.35

*Symptoms are necrotic and blackened (burnt) leaf margin.
Tested in Feb 2006.

- Treatment was potassium sulphate at 100g/sqm. Post treatment testing was Dec 2006.

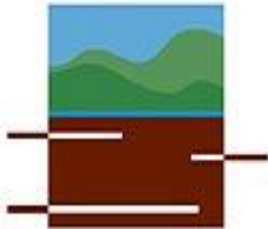
Remember, there was no-

- Rooting volume
- Soil depth
- Drainage or aeration
- Root coiling
- Light, temperature, wind

Or any other problem for this *Ulmus* at Hyde Park,
just nutrients.

Reference:

- Urban, J. (2008) *Up by Roots. Healthy soils and Trees in the Built Environment*. International Society of Arboriculture. Illinois USA.



**Sydney
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Specialists in Soil Chemistry, Agronomy
and Contamination Assessments

