Treework Environmental Practice

Address for correspondence
Postal: 33 Kings Road
Alton
Hampshire GU34 1PX
UK
e-mail: d.lonsdale2@btinternet.com
tel. +44 (0)1420 83742

The Old Rectory,
Pilgrims Way,
Chew Stoke,
Nr Bristol
BS40 8TT

Telephone 0117 244 0012
info@treeworks.co.uk
www.treeworks.co.uk

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To whom it may concern:

I have been requested by Dr. Caitlin Raschke, representing Save our Figs Inc., to comment on various documents pertaining to a group of Weeping Hill's fig trees (*Ficus microcarpa* var. *hillii*) in Laman Street, Newcastle, NSW.

Not having any first-hand experience of the trees or the area concerned, nor being familiar with the species of tree, I do not consider myself qualified to provide any specific advice. I have, however, commented below on various principles of tree assessment and management (and, in particular, tree risk assessment) as they appear to apply in the present case.

While drafting my comments, I looked at the following documents:

1. December 2006 - Review of the Root Plate Architecture of Hills Figs in Laman Street
2. June 2007 - Wind loading in Laman Street
3. 11 July 2007 - Investigation into stability of three Hill's Weeping Figs along Laman Street, Newcastle
4. 7 August 2009 - Assessment of Hill's Weeping Figs in the Civic Cultural Precinct, Laman Street
5. 2 September 2009 - QTRA Fig Trees Risk Assessment of Fig Trees in Laman Street, Cooks Hill
6. 10 December 2009 - Peer review of Marsden Report by Integrated Vegetation Management (89kb)
7. 11 December 2009 - Peer review of Marsden Report by Arboreport
8. 8 March 2010 - Social Impact Assessment Stage 1 - Hills Figs Trees, Laman Street, Newcastle
9. 9 March 2010 - Laman Street Hills Figs QTRA and Review
10. 9 March 2010 - Heritage Assessment and Recommendations
11. 12 March 2010 - Quantified Tree Risk Assessment (QTRA), Root Investigation Report and Memo
12. 16 March 2010 -Heritage Assessment and Recommendations
13. 1 July 2010 - Quantified Tree Risk Assessment and Review
14. 9 July 2010 - Feasibility Study - Tree Restraint
15. 12 August 2010 – Trenching Investigation of Hills Fig
16. 13 September 2010 - Fauna Habitat Assessment - An assessment of the habitat values of the Hills Fig trees in Laman Street and an assessment of the impacts of their removal on native fauna.
17. 11 November 2010 - Court Judgement on Parks and Playgrounds Movement Inc's application to stop the removal of the fig trees from Laman Street.
18. December 2010 - Report on the feasibility of a pull test on the Laman Street trees
19. July 2011 - Memo to Councillors on Laman Street Risk Identification and Management
20. July 2011 - Branch Failure in Laman Street
21. August 2011 - Questions and Answers and Laman Street Figs
22. September 2011 - Fauna Habitat Survey
23. Newcastle City Council: A case History Informing Tree Management in Laman Street 2000-2010

Directors
Treework Services Ltd
Neville Fay
Luke Fay

Associates
Alister Rankine
Caroline Davis
David Lonsdale
Jarek Kolarik
Ola Bengtsson
Simon Pryce
Vikki Bengtsson

Associated Companies:
ProNatura (Sweden)
SafeTrees (Czech Republic)
Tree Consult (Germany)
Tim Moya Associates (UK)

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Registered Office
The Old Rectory
Pilgrims Way
Chew Stoke
Nr Bristol
BS40 8TT

Registered in England
No 1621606

In summary, my general opinion is that a remarkable amount of painstaking work has been devoted to the assessment and evaluation of the trees concerned. I also consider that there has generally been a careful application of principles in the assessment of hazard and risk. I have, however, identified certain aspects of the assessments where different conclusions could be reached, depending on the assumptions that have to be about inherently subjective matters, such as the probability of failure of trees. I have set out my detailed comments below, under a series of headings.

1. Hazard assessment: use of visual tree assessment

I think that the principles of visual tree assessment ("VTA") have been carefully applied. As far as weak forks and branch attachments are concerned, the characteristics of the species or variety concerned [reportedly of mostly clonal origin (Doc. 23) in this instance] should always be taken into account when applying these principles. In this instance, for example, I see that certain criteria have been applied in order to determine whether a bark inclusion is severe enough to cause significant weakening of a branch attachment or fork. I think that this approach is reasonable where based on extensive casebook experience or other valid information. I would, however, generally expect additional factors to be taken into account; for example the extent (if any) of "welding", whereby part of a bark inclusion is surrounded by a corset-like shell of wood.

With regard to I-beam formation in branches (Doc. 4), I have no professional experience of species that show this characteristic as strongly as *F. microcarpa* var. *hillii*. I am, however satisfied that the assessments have been made on the basis that this is a form of adaptive growth and that it should not be assumed to represent a defect unless accompanied by signs of possible weakness.

1.1 Defects of root systems

The root systems of the trees concerned have been found to be asymmetric, tending to be oriented along the highway because of restricted conditions for root growth (e.g. Docs. 1,3,4). I accept these findings and I note that these poor conditions have been attributed to "*poor planning when the initial planting was undertaken and subsequent poor tree management*" (Doc. 7). Poor tree management is said to have included "*disturbance of the root zone through the installation and maintenance of infrastructure and general root damage*" (Doc. 7). Also, I accept that there is cause for concern that the stability of some of these trees might depend on a small number of roots that have found anchorage amongst underground structures. In particular, I note that the severance of a single root of 150 mm in diameter led to the immediate failure of a fig in Tyrrell Street (Doc. 1), although it does not seem clear how much damage had been done to other roots prior to this severance.

I see no reason to doubt the above findings and I confirm that I still hold to the advice that I have published about the desirable rooting space for newly planted trees[1], as cited by Mr. Marsden (Doc. 4). On the other hand, I equally see a need to take account of the reality that restricted and asymmetric root systems are very frequent in street trees in town and cities all

[1] Lonsdale, D (1999) 'Principles of Tree Hazard Assessment and Management.' The Stationery Office, London.

over the world. Root restriction probably impairs stability to some extent in many instances but rarely enough to justify the removal of street trees, even when concerns have been heightened by the occurrence of tree failures in extreme weather.

In this instance, stability has been assessed on the assumption that the root systems are so restricted that they have a safety factor equal to 1 (Doc. 4), according to the criteria of Mattheck and Breloer[2], who suggest that the safety factor for uprooting or trunk failure is approximately 4.5 for trees in general. With a safety factor of 1, trees would be likely to fail whenever the windspeed exceeds the average for the area concerned. I understand that this has not been happening in this instance.

The criteria of Mattheck and Breloer could provide a means of roughly assessing impairment of the safety factor for circular rootplates but not, in my opinion, for highly asymmetric ones, as in this instance. As I have mentioned above, this is a very common difficulty with regard to street trees. In the absence of reliable criteria for assessing the stability of street trees, casebook experience of the species and sites can be helpful. Also, any evidence of serious loss of anchorage in individual trees (e.g. because of root severance or extensive decay) should be taken into account.

With regard to casebook experience, I refer to a table (Doc. 23), which shows that three specimens of *Ficus microcarpa* var. *hillii* failed at the rootplate in Newcastle (all in Tyrell Street) during the period 2000-2004. This period represents only a small part of the ‘life history’ of the tree population and cannot, in my opinion, provide an extensive or long-term casebook. I understand that there was a cluster of storm events during this period, followed by further events, notably in a storm of 2007, when trees in Laman Street were involved (Doc. 4). It is possible that such events are becoming more frequent, owing to climate change, but I understand any such trend in the long term cannot be established at this stage.

Although, for casebook purposes, the number of rootplate failures and the time-frame seem very limited, records of such events are potentially helpful in understanding the modes of failure that should be taken into for the purposes of risk assessment. I understand that there is some uncertainty as to whether the recorded cases of rootplate failure were cases of wind-rock (i.e. tilting of rootplates owing to partial failure) or complete uprooting. Some of the photographic evidence (Doc. 23) indicates that at least some of the failures might not have involved complete uprooting but I am not in a position to ascertain whether this was the case.

Not having seen any long-term casebook information on *F. microcarpa* var. *hillii* in Newcastle, I am not able to comment on the validity of the conclusion that failure typically begins at about 70 years of age in the tree population concerned (Doc. 4). In principle, however, I agree that a combination of increasing tree-height and a restricted rooting area (together with episodes of root damage from excavation) could lead to an increasing probability of failure with tree-age. On the other hand, I think that the effect of “sail area” (as represented by a tree crown) can be exaggerated by the analogy of the sailing ship, as depicted by Mattheck & Breloer (1994)[2], whose sketch is reproduced in one of the reports (Doc. 4). While accepting that this sketch is intended to illustrate the transmission of wind force from the crown to the rest of the tree, I think that this analogy fails to give credit to the partial dissipation of the force by the dynamic movements of foliage and branches. This dissipation occurs in addition to the reduction of drag that result from changes in crown shape under a constant wind force, as mentioned by Mattheck and Kubler[3], who are also cited (Doc. 4).

2. Wind-load after proposed demolition of the existing Art Gallery

The reported results of wind tunnel experiments on a scale-model (Doc. 2) are, in my opinion, consistent with the widely recognised fact that trees are usually subjected to increased wind-force if nearby buildings are demolished. This is a frequent problem in urban areas but it does not necessarily mean that mature trees have to be removed in all such instances. The question is whether the probability of failure would increase sufficiently to impose an unacceptable risk of harm, taking into account the other components of risk analysis. In such instances, some form of risk mitigation is appropriate but does not necessarily entail the removal of trees. The wind tunnel report (Doc. 2) mentions other solutions that the authors considered possible in this instance; i.e. pruning (on which I have commented elsewhere in this letter) or the erection of a temporary wind shield until the new Art Gallery has been constructed.

3. Pruning in order to reduce tree-height and thus to improve stability

A very severe form of pruning (topping) has been identified as necessary to overcome instability on the assumption that the safety factor for root anchorage has the very low value of 1 [in comparison to the presumed normal value of approx. 4.5 (Doc. 4)]. As I have mentioned elsewhere in this letter, I see a need to question this assumption about the severe lack of stability.

Although perhaps a more moderate form of pruning might be sufficient, there is always a need to be aware that pruning is a form of damage, which sometimes leads to the extensive development of dysfunction of living tissues and to decay. Some species are more susceptible than others are to the potentially adverse effects of pruning and I note (from Doc. 6) that *Ficus* spp. are said to be known for their predisposition to sunburn (and thus to dysfunction and decay) if the bark is suddenly exposed to unaccustomed sunlight (as when a large area of foliage is removed). Also, shoots that develop after pruning of various tree species tend sometimes to be weakly attached.

With regard to these trees in particular, I think that Mr Marsden (Doc. 4) is right to point out that their branches are not very well suited for crown reduction, since they carry much of their foliage near their tips. Removal of this foliage in order to shorten the branches would tend to leave long lengths with few secondary branches. Also, in order to achieve a

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[2] Mattheck, C, and Breloer, H. (1994). *The Body Language of Trees - A Handbook for Failure Analysis*. HMSO, London.
[3] Mattheck C, and Kubler, H. (1997) 'Wood – The Internal Optimisation of Trees' Springer, Berlin.

worthwhile reduction in the lever arm, the pruning cuts would probably need to be more proximal in position (and thus larger in diameter) than was the case when the trees were periodically pruned.

In view of the above concerns, there would be a need to decide whether the trees would be likely to tolerate a reinitiated programme of pruning. If there is any serious cause for concern in this regard, the general principle that can be applied to most dicotyledonous tree species is to carry out a phased crown reduction, whereby the intended height reduction is achieved in two or more phases. Depending on the propensity of the species concerned to grow new shoots after cutting, phased reduction is often helpful where the branches carry most of their foliage near their tips, as in this instance. Each successive phase is carried out only when the new twigs and branches are well established, so that some of this new growth can be retained.

I note Mr. Marsden's concern (Doc. 1) that the previous pruning regime led to the formation of weakly attached new branches that now present a hazard. If a pruning regime were to be reinstated, I would envisage a need to identify any newly developing weak attachments and, if appropriate, to deal with them by selective pruning.

Another pruning option, as mentioned in the wind tunnel report (Doc. 2) is to remove or shorten branches so as to thin the crown in order to increase its "porosity". On the other hand, I suggest that the creation of gaps in the crowns could allow a greater amplitude of branch-swaying, and hence an increased probability of branch failure. If so, a general reduction in crown-size (as also mentioned in the wind tunnel report) would probably be a better option for reduction of wind-force on the trees.

4. Age-structure

I note the following observations (Doc. 7): "*Developing uneven aged stands is an ideal strategy when managing large groups of trees. Some of the benefits of an uneven age stand include spreading the maintenance and removal costs and minimising visual impact at the time of tree removal. However, the above benefits of an uneven aged stand need to be weighted against the grandeur of an established even-aged avenue*."

I think that these observations are valid, especially in view of the desirability of maintaining a tree population with a wide age-range (for maximum value and for sustainability). I note, however, that Mr. Marsden takes a contrary view, (Doc. 4), pointing out that that a phased removal of trees would expose the remaining trees to increased wind force. He also points out that the shade cast by the remaining trees would make it hard to establish other trees in the gaps created by tree removal. Nevertheless, the difficulty of managing an even-aged group of trees does not necessarily justify the removal of all of them. This is a difficulty that occurs in many urban tree populations, and yet other solutions are widely adopted, in order to avoid a sudden and severe loss of value that would result from wholesale removal.

5. "Safe Useful Life Expectancy" (SULE)

An assessment of the trees, according to the SULE system, devised by Jeremy Barrell, has indicated that some of them warrant removal in the relatively near future (Doc. 2). The assessment also indicates that removal of these trees would expose the remaining trees to increased wind force, making them more hazardous and thus reducing their SULE ratings (Doc. 4).

I think that the SULE system can be a very useful tool in tree management, with the following provisos:

- The system relies on the definition of "dangerous trees", and yet there cannot be any hard and fast distinction between "safe" trees and "dangerous" ones, since any tree could fail under sufficiently severe mechanical loading. It is, in my view, therefore necessary to replace the definition of "dangerous" with a definition based on risk assessment (i.e. taking account of the presence of people and property). In this instance, however, a risk assessment, using Quantified Tree Risk Assessment, has been conducted for this purpose and I have commented on this elsewhere in the present letter.

- "Life expectancy" seems to imply something to do with the aging process in trees. Such an interpretation is misleading because it is based on a false assumption that trees generally have a life expectancy like human beings. This may be partly true of certain kinds of tree, but the majority of trees that show secondary thickening of their woody parts have an indefinite growth habit, which means that they, in theory, could also survive and grow indefinitely. For complex reasons, trees eventually die but not because of a fixed lifespan. I therefore think that "Safe Useful Life Expectancy" could more appropriately have been named as (for example) "Safe Useful Retention Time". In the present context, I note that there is a reference (with which I disagree in principle) to "the lifespan of the species" (Doc. 10).

- Much as I agree that any requirements for remedial work should be considered when assigning a SULE category to a tree, I have some concerns about the underlying logic. For example, one of the descriptions of Category 3 trees is that they "require substantial remedial care and are only suitable for retention in the short term". This seems to pre-empt the final decision as to whether they are suitable for retention.

- The SULE system takes account of various aspects of the value of trees, but only in respect of trees that are deemed to have outstanding value ("*trees of special significance for historical, commemorative or rarity reasons that would warrant extraordinary efforts to secure their long term retention*"). This enables the SULE system to be applied without undue deliberation for the sake of less exceptional trees, but I disagree with the effective presumption that all other trees have so little value that they can be considered suitable for removal merely because a lot of remedial work would be needed to make them (and keep them) suitable for retention. Also, the listed kinds of value are not comprehensive and thus seem to exclude criteria such as biodiversity value. In this instance, however, I note that many aspects of the value of the trees to the Newcastle community and for wildlife have been taken into account (Docs. 10, 12,16).

With regard to this particular SULE assessment, I agree that the removal of the most hazardous trees would have difficult implications for the retention of the remainder. I see a need, however, to ensure that the risk assessment has been applied appropriately, in order to aid the decision as to whether any of the trees poses sufficient risk to warrant its removal.

6. Use of QTRA for risk assessment

A risk assessment, using Mike Ellison's method of Quantified Tree Risk Assessment (QTRA), was carried out in 2010, with the result that a risk of harm of 1 in 20 was calculated (Doc. 13). This value considerably exceeds the generally accepted threshold of tolerability, and so the recommendation was to remove the trees and to enforce a current system of excluding vehicular and pedestrian traffic when windspeeds exceed 50 k.p.h (Doc. 13).

Normally, a QTRA calculation is based on one particular type of failure in a single tree, and so I am not sure how the above calculation relates to all fourteen of the trees concerned. I can, however, comment as follows on the evaluation of each of the three risk-components as follows:

- *Target evaluation:* in this instance, this was based on the number of pedestrians entering the target zone in one hour. This number was assessed at 1 in 1, ostensibly in order to take account of evidence that the road closure system in windy weather was not being enforced and that the area was being used considerably for the parking and unloading of vehicles. I am not in a position to comment on this assessment, except to point out that a value of 1 in 1 represents a constant occupancy within the target area, day and night, over an entire year, such as might occur in a motorway or very busy shopping area, with no allowance made to reduce occupancy during the sort of weather most likely to lead to tree failure. If this does not fit the description of the site concerned, a re-evaluation would be appropriate.

- *Impact potential:* this was based on the assumption (which I think was reasonable) that whole tree failure was the main hazard. This component was assigned a value of 1 in 2, so as to allow for the impact probably involving a branch rather the trunk. This evaluation was also said to allow for the cushioning effect of the numerous branches but I might have expected a further downward adjustment of the impact potential on that basis. Otherwise, the evaluation seems reasonable.

- *Probability of failure:* This was assessed as 1 in 10, which was described as "moderate". I do not agree with the term "moderate", since a value of 1 in 10 lies at the top end of the second-most severe of the five QTRA value-ranges for this component. In fact, it is a high value which, if realised, would equate to an annual 10% failure rate amongst a large population of trees in such a condition. The QTRA manual, as appended to the report (Doc. 13), does not use terms such as high or moderate in respect of the probability of failure. I suppose, however, that a "moderate" value would equate to the middle of the centre-range; i.e. between a value of 1 in 100 and 1 in

1,000. My only other comment concerns the casebook experience of rootplate failures of the species concerned in Newcastle. If it is taken into account when evaluating the probability of failure, there seems to be a need (as I have noted above) to ascertain whether the previous failures involved complete uprooting, as opposed to rocking or tilting of the rootplates.

7. Current risk mitigation

I note that the City Council has put in place a number of measures to reduce the occupancy of the target areas of the trees concerned, especially during windy weather (Doc. No. 8). I regard such measures as a useful means of mitigating risk but I note that these measures have been entirely discounted in the QTRA assessment (as noted above), where the occupancy was assumed to be constant (partly because the people were not being excluded as intended in windy weather).

8. Conclusion

Although I have seen evidence that the assessments of hazard and risk for these trees have been conducted carefully and, in most respects, according to appropriate principle, I think that certain aspects of the assessments deserve reconsideration. These include the following:

- Assessment of the probability of failure of the various trees
- Assessment of occupancy of the target areas
- The severity of pruning that might be required to reduce the lever arm of the trees enough to improve safety to a more acceptable level.

David Lonsdale

Appendix: *copy of letter received from Dr. Caitlin Raschke, 26-Dec-2011*

Save Our Figs Inc
PO Box 155
Islington 2296,NSW
Australia
26.12.2011

Dr. David Lonsdale
33 Kings Road
Alton
Hampshire GU34 1PX
UK

Dear Dr Lonsdale,

Save Our Figs is trying to determine the possibility and processes required to retain 14 Ficus hillii without subjecting the public to unreasonable risk. As a result we are seeking to gain a better understanding of the risk assessment process and the management process that would normally be required to retain these trees, as expert opinions seem vary considerably. SOF would rather see the trees retained if that is possible by undertaking standard arboricultural work but believe that cutting the trees to a stump is not desirable.

In addition, SOF if concerned that the extremely high Risk seems to be at odds with the fact that to date none of the figs have fallen over. Lastly, in considering a "case book", as you suggest in your book, to determine what should be done, would it be normal to just consider failures over a short period of time or would you generally also consider similar trees that didn't fail and apply standard statistical analysis to the casebook data?

The basic facts are as follows:

* There were originally 17 trees in the precinct outside the art gallery and library on Laman Street, Cooks Hill, Newcastle, NSW Australia.
* During a significant storm (the Pasha Bulker storm in 2007) several of the trees may have been "wind- rocked", potentially resulting in slight movement of the root plate.
* As a consequence of movements (outlined in the Case History link below) 3 trees were removed, 2 of them within days before they were independently assessed.
* Thirteen of the fourteen remaining figs were planted more than 70 years ago.
* Council has engaged three main arborists in the process of assessing the trees and the risk associated with them.
* The first Arborist, Mr Marsden, undertook a VTA and did not find any significant issues of concern above ground.
* Mr Marsden's examination that the tree roots were not distributed evenly and close to the surface and therefore the tree had eccentric root plates.
* Because eccentric root plates (also referred to as a linear root plate), combined with other issues such as eccentric canopies and a history of service repairs in the street the council looked at removing the trees as a management option.
* Council sought the assistance of two arborists Mr Simonsen and Mr Swain to prepare QTRA reports.
* The QTRA produced ROH as high as 1 in 19.8 and in both cases had a PoF of 1 in 10 or greater. Given the abundance worldwide of urban trees that are confined by roads and adjacent structures (thus resulting in eccentric or linear root plates), SOF find it hard to believe that 1 in every 10 such trees fails every year.

Yours sincerely,

Caitlin Raschke

for Save Our Figs Inc