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Executive Summary

Substantial errors have been made in the reports that council have relied upon in making the decision to remove the Laman Street fig trees. I trust that these mistakes were accidental but regardless, as a result, the decision that has been made to remove the Laman Street trees was based on reports that are demonstrably predicated on erroneous assumption and or contain information that is clearly not arboriculturally sound. In fairness to the rate payers, any decision made about historic trees should be based upon reports that are correct and arboriculturally sound.

Whilst it is alarming that it was rate payers and not council staff that picked up the errors it none the less demonstrates the importance of transparency in the decision making process that has occurred in this instance simply because it allows such mistakes to be found and corrected. The critical point now is that council takes no further action until the substantial defects in the reports are addressed. Only at that point of time can a decision be made that is sound and justifiable from a scientific view point.

Regardless of the final decision it is imperative that the outcome is based on reports that are correct in their content and assumptions and not reports that contain or are based on obviously incorrect assumptions that impact on the final outcome or provide information that is plainly incorrect or obviously inconsistent to everyday rate payers.

Background

I first became aware of the Laman Street fig tree issue when a copy of a QTRA report was sent to me that had not followed the process contained in the user manual and was at odds with the training provided by QTRA. Apart from pointing out the obvious absurdity of the RoH that was provided in this report I took no further action.

On the 21st of August 2010 I received a request from a colleague, Sean Freeman, to see if I could assist in visiting the site and reviewing the documentation as he believed that the substantial errors existed in a number of reports but was unable to act quickly, which he felt was essential. At Sean's request I reread the Arboricultural Statement prepared by Treelogic and contacted Caitlin Rashke who provided me with some additional reports, information and images.

I found myself being continually confused about the number of trees present and trees that had failed when compared with the information contained in photographs and reports. The first and most obvious problem was the number of trees that remained. The second problem was that "tree failure" was being used to mean a whole range of things and had clearly been misunderstood by the arborists that had been engaged by Council to prepare reports.

The storm

A storm occurred on the 8th June 2007. During the event "Storm force winds averaged 93 km/h and gusted to 135 km/h, causing widespread damage along the coast."[1] The strongest wind speed recorded at Newcastle was 124 km/h[2].

Along with strong winds there was heavy rainfall. This is important not just because of the additional weight that rain adds to the canopy of the tree but more importantly because it impacts upon the cohesion of soil particles. Based on the April and May rainfall figures combined with the 82mm that fell in the first week of June it is reasonable to conclude that the soil was already fairly moist.

This storm resulted in significant localised damage, according to council minutes which included losses due to failed "trees $5 mil depending on restoration level"[3] and "To date 1200 trees have been identified as felled. A large number have caused significant damage to kerb & gutter, footpaths, road side furniture"

Council minutes also reveal "The Art Gallery sustained minor damage with debris over the pavilion and a leak in one corner of the Gallery. Loss of income is the major issue due to the storm and closure of Laman Street until trees and debris were removed." Photo evidence shows that this was the case. 3 large fig trees were removed on Laman Street with there stumps being visible in and the image dated the 19th of June 2007, the very day of the council's emergency meeting.

Substantial errors

Marsden's Report

Photographs taken on the 19th June 2007 show 3 fig trees on Laman street that had been reduced to stumps. There was no evidence that "these trees were wind-thrown, that is, there root plate was tilted out of the ground"[4] (page 21). In fact to the contrary the evidence plainly shows that during a storm on the 8th June 2007 two trees may have moved in the ground but in fact none of the trees had been wind- thrown.

In fact I have seen no evidence to show that either of these two trees were leaning as a result of the wind or were observed moving in the ground after the wind. The evidence about the instability of the trees relates to some cracking in the pavement and gaps between tree roots

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[1] http://www.bom.gov.au/nsw/sevwx/0607summ.shtml

[2] http://www.bom.gov.au/nsw/sevwx/facts/events/june-07-ecl/e1-8-9jun.shtml#wind

[3] http://www.newcastle.nsw.gov.au/__data/assets/pdf_file/0018/17127/Draft_Minutes.pdf

Marsden, D (2009) "Assessment of Hills Weeping Fig *Ficus microcarpa* var. *hillii* In Civic Cultural Precinct, Laman Street Cooks Hill, Newcastle"

and curb stones beneath. In each case these observations could be readily explained by pressure applied to the roots of the trees that did not involve root failure.

The fact that these trees had not fallen over is very important. It of course raises a large number of questions but most significantly it is clear that Marden was told or some how formed the opinion that these trees had actually fallen over. (To be fair to Marsden, Simonsen and Swain make identical assumptions as will be discussed later). In fact Marden after saying 'these trees were wind-thrown, that is, there root plate was tilted out of the ground' continues to say 'other Hills Figs elsewhere on Laman Street and on Bruce Street failed in the same manner in the same storm.' Clearly this is not true.

Firstly the trees had not fallen over they were cut down. Up until that time the trees were standing upright! Lonsdale considers partial uprooting by saying 'Failure of root plates is by no means always total. Partial failure sometimes leaves a tree leaning, with signs of soil mounding on the upwards side of the lean. The anchorage of such trees is usually rather poor, at least in the short term … but in many instances partially uprooted trees regain there stability by developing new roots.'[5] (Page 50)

Even if the trees had shifted slightly in the ground, simply reducing the forces applied to the root system by subsequent storms, whilst the tree was developing new roots, could have avoided the need to even remove these trees. To reduce the force on the roots would require thinning or reduction pruning. The function of this pruning is not to remove forces altogether but rather to simply reduce the forces associated with wind blowing through the canopy. This sort of pruning is dismissed by Marsden (see below).

Secondly given the fact that these trees had not been blown over I question if other trees in Laman Street had been blown over and if so why a similar investigation has not been undertaken into the portion of Laman Street where these failures are also alleged to have <u>actually</u> occurred.

In his brief Marsden is asked to "*Investigate and review a range of risk management options with the view to retaining the trees as long as practicably possible"* (page 5) and that "*Risk management options …that need to be reviewed include:*

1. *Reduction pruning and thinning (per AS4373)"*

Marsden dismisses reduction outright because 'The form of the trees do not lend themselves to reduction pruning.' (page 26) He unfortunately provides no explanation other than the foliage tends to be at the ends of the branches. Whilst I agree that this is the case this seems to simply mean that reduction is somewhat more difficult but there are a number of skilled arborists who could perform such work.

In fact Marsden himself knows that this sort of work is achievable because he stated in his earlier report[6] that a number of the trees 'could be retained but will require selective pruning

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[5] Lonsdale, D (1999) 'Principles of Tree Hazard Assessment and Management' HMSO, London

[6] Marsden, D (2006) 'Investigation into Root –Plate Architecture of Hill's ..Weeping Figs along Laman Street outside Newcastle Regional Art Gallery'

or shortening of defective branches.' Shortening of branches is reduction pruning and I am convinced that he can provide no logical reason why defective branches can be reduced but non defective branches cannot be reduced. Of course they can the problem is that Marsden gets his physics wrong!

Marsden concludes that the trees would need to be reduced to the *"to the point that no or very little leverage was exerted on the root plate*." (page26) This is of course illogical at its best. If the tree has not failed during extreme wind conditions then nothing needs to be done to avoid failure in lesser winds other than to maintain the tree at the size that it was when it was exposed to these winds and or to stimulate additional root growth.

Furthermore reducing the canopy and thinning would result in less force being transferred to the root plate. The less drag the less force, the shorter the lever arm the lower the rotational forces. A 5% reduction in drag and a 5% reduction in height results in just under a 10% reduction in the force applied to the root plate whilst root growth is being stimulated.

Simonsen's Report

The first and obvious error with Simonsen's report is he also believes the trees fell over since he records two failures. He says "we can calculate the probability of failure for 2007 calendar year (the year the 2 failure occurred) as 2/15 or 1/7.5"[7] (page 6) As has already been pointed out none of the trees had actually failed and it is questionable as to whether a partial failure had even occurred.

In order to be hit by a falling part complete failure is essential. You can't get hit by something if it doesn't fall. This may seem to be pointing out the ridiculous. Unfortunately it is required in order to point out the folly in assuming that standing trees have failed even if they may have shifted in the ground.

To this day 14 figs remain. In addition 3 fig trees were cut down. By any known method that equals17 trees so the failure rate using Simonsen's logic of taking the failure rate of this grove for the year is 0/17 or zero. If this was applied to QTRA it would result in the figs posing absolutely no risk of harm and that would clearly be in error.

Ignoring the error, using the rate of failure as 1 in 7.5 has no place in terms of a QTRA report. If the actual Probability of Failure was 1 in 7.5 a tree should have failed in the first 9 months and by now almost 4 of the remaining trees would have already failed. Clearly the estimation is wrong!

At no point does the User Manual or the QTRA training recommend that the historical failure rate of any particular year be used as the Probability of Failure. The use of historical information is important in becoming informed on failure patterns but it does not for the basis of determining the Probability of Failure. In fact the loss of a tree may significantly reduce the

[7] Simonsen, D (2009) 'Arboricultural Statement'

Risk of Harm associated with a grove of trees because it may result in the loss of the only defective tree.

This unfortunately is the starting point of the errors of Simonsen's use of QTRA. As will be seen the report does not follow the User manual. As a result each item needs to be reconsidered in line with the QTRA User Manual. Most critically the Probability of Failure needs to be considered as follows 'Having assessed the tree, the assessor should visualise 100 similar trees in a similar state in the same environment and estimate how many would be likely to fail during the coming year. If the answer to the question is none, then consider1,000, 10,000, 100,000, 1,000,000 or 10,000,000 trees.'[8]

It can be easily demonstrated that on average a tree without any obvious visual indicators of structural defects (such as these figs) has a probability of Failure of less than 1 in 10,000. This demonstration is a part of the QTRA training.

The target figure used is likewise derived in a manner that is not provided for in the QTRA user manual. Furthermore the target data whilst presumably accurate (having being provided by council staff) it has been assumed that each person walks under each of the trees and this would generally not be the case since they would need to wall the full length of the grove on both sides of the street.

Simonsen has deviated from recommend 5 seconds by calculating the time it takes a person to walk 20 metres. In most instances however a pedestrian walking along the path would not be exposed to 20 metres of any of the trees canopy spread but rather just a few metres of the main trunk and branches.

For reasons that have not been made clear, Simonsen has failed to use a weather multiplier. Whilst this is at the assessor's discretion it makes complete sense to do so. It is reasonable to presume that the use of the gallery and the library is substantially diminished during inclement weather. What we can be certain of is the when the severity of storms increases recreational pedestrian activities decrease and for this reason the use of a weather multiplier is quite acceptable

As an exercise it would be interesting to find out how many people visited the art gallery on the 8th June 2007. I decided that I would make this enquiry. The answer was '52 people including 1 school group … all other bookings that day cancelled'. Using the annual average attendance at the gallery of 72,155 (a daily average of 197) provided in Simonsen's report the use of the facilities was significantly less than average. In fact the details were as follows 'for June 6th 192 visitors, June 7th 76 visitors, June 8th 52 visitors, June 9th 37 and June 10th 150 and the following Friday June 15th 108 visitors'. Based on this information it would be reasonable to adopt a weather factor of 2.

This does however raise one question and that is the reliability of the pedestrian numbers which has been stated as precisely '648,232 or 1,776 pedestrians a day' (page 5). This equates

[8] Ellison, M (2007) 'QTRA User Manual'

to 74 people an hour. In the 3 hours that I was present in Laman Street (from 4:30 pm to 7:30 pm) those numbers of pedestrians were not present. In fact it is unlikely that the pedestrian usage from 8pm to 8 am is substantial at all and is likely to be less than 10% of the day time usage.

Swain's report

This report does not in any way review the previous reports. Instead it continues to adopt the same incorrect assumptions contained in the earlier reports by Marsden and Simonsen including believing that the trees fell over. Swain provides a brief summary of each document in his observation and unfortunately assumes that they are accurate and does not spot or question basic mathematical errors.

In fact Swain says 'On review I believe that this report provides a reasonable assessment of the quantified risk of harm associated with the subject tree.'[9] As has been already demonstrated the QTRA assessment is not reasonable because it was not performed in accordance with the user manual and QTRA training. Unfortunately the mistakes appear to continue.

Swain says "The target vale would be a high value >10 pedestrians an hour or 1/ 20" I would agree with this statement in part. Unfortunately I am unable to agree with Swain's maths. Using basic maths and following the process outlined in the User Manual, 10 pedestrians an hour results a target value of 1 in 72. To get a target value of 1 in 20 would require 72 pedestrians an hour (this is close to council's estimate of 74 per hour). As I have already pointed out it is unlikely that each pedestrian would walk once under every tree as this would require them to walk the full length of both sides of the grove.

When it comes to impact potential Swain again gets things wrong. The impact potential is determined by the size of the part that fails and not the size of the part that is likely to impact with a person. The impact potential is therefore 1 in 1 but as any intelligent person can see this is more conservative than required. QTRA accepts this element of conservatism in the process as more desirable rather than underestimating the risk.

Ellison describes a tree with a 1 in 10 probability of failure as "a tree that you could tie a rope onto and pull over". It is a tree that a reasonable arborist would feel uncomfortable standing under during a light breeze. These trees do not come into that category. In fact again given that there are still 14 trees present shows that the Probability of failure is not 1 in 10 or even 1 in 42 or for that matter even 1 in 500

Swain, A (July 2010) 'Laman Street Figs, Cooks Hill Newcastle Quantified Tree Risk Assessment and review'

Other Important information

Sandy soils

Because the matter has not been considered in any report to date I need to point out that root growth in figs is stimulated by warmth (usually above 16 degrees) and moisture. In fact this is evident by the fact that they go so far as to produce aerial roots. Marsden points out that the soil under the road is a sandy fill and there was no evidence of high soil moisture levels.

Lateral movement of moisture in sandy soils is comparatively poor but vertical movement is quite fast. As a result trees in sandy soil types often develop deeper root systems sometimes many metres deep. Sandy soils often result in and altered root morphology with trees developing more sinker roots, tap roots and in some instances root plates on two distinct planes.

QTRA

The following QTRA assessment is based on the pedestrian data provided by council's staff and contained in Simenson's report. It must be understood that these figures are not strictly correct because some trees will actually have greater number of pedestrian movements beneath them whilst others will have fewer pedestrian movements beneath them.

Because there a no obvious structural defects (and there has been no recent root severance that was associated with at least one fig failure) Probability of Failure is a very conservative 1 in 500. The reality is that it is more likely to be 1 in 5,000. If NCC has more than 500 fig trees planted near road verges that are free from obvious defects with this probability of failure then we should anticipate one failure every year. Failures of figs do not appear to be this regular and mostly appear to be associated with significant storm events.

A probability of 1 in 1000 would appear to be far more in line with my own observation of this species and the tensile strength of their roots and is certainly far more realistic that the absurd 1 in 7.5 or 1 in 10 figures that have been brandished about.

Based on 74 people per hour and allowing 2 movements for each pedestrian the target value is approximately 1 in 19.4
If we are considering whole tree failure the impact potential is 1 in 1
Probability of Failure as explained above 1 in 500
A weather factor of 1 in 2 has been demonstrated as acceptable based on available figures.

This results in a RoH as follows

Target X	Impact Potential X	Probability of Failure X	Weather Factor =	**Risk of Harm**
19.4	1	500	2	**19,400**

How does a Risk of Harm of 1 in 19,400 compare with other things in life? The answer is, using Table 1 contained in appendix 1 of Simonsen's report, less than half the risk of mortality associated with a motor vehicle and comparable with the risk of dying from an accident in our own home.

Affects of modifying Target and improving tree health

Earlier reports considered the impact of modifying the target by removing parking and installing barricades during strong winds. I believe that is not required but if these systems are used and people deliberately and intentionally ignore these restriction then these people are to a greater extent accepting the risk. (See the Civil Liability Act 2002 (NSW). This is much like people swimming when there is a 'Beach closed' sign.

Without question when people venture out in severe storms like those of June 8th 2007 they are aware that branches can fail and that they would be better to seek shelter and stay indoors during such events. They realise there is a risk that if a tree or a branch fell it could hit them or their motor vehicle. This is what is meant by an obvious risk under the Civil Liability Act.

What would happen to the Risk of Harm if the trees were to be pruned and new root growth stimulated? The answer is that we could confidently reduce the PoF to 1 in 5000 and this would result in a modified Risk of harm as follows

Target X	Impact Potential X	Probability of Failure X	Weather Factor =	**Risk of Harm**
19.4	1	5000	2	**194,000**

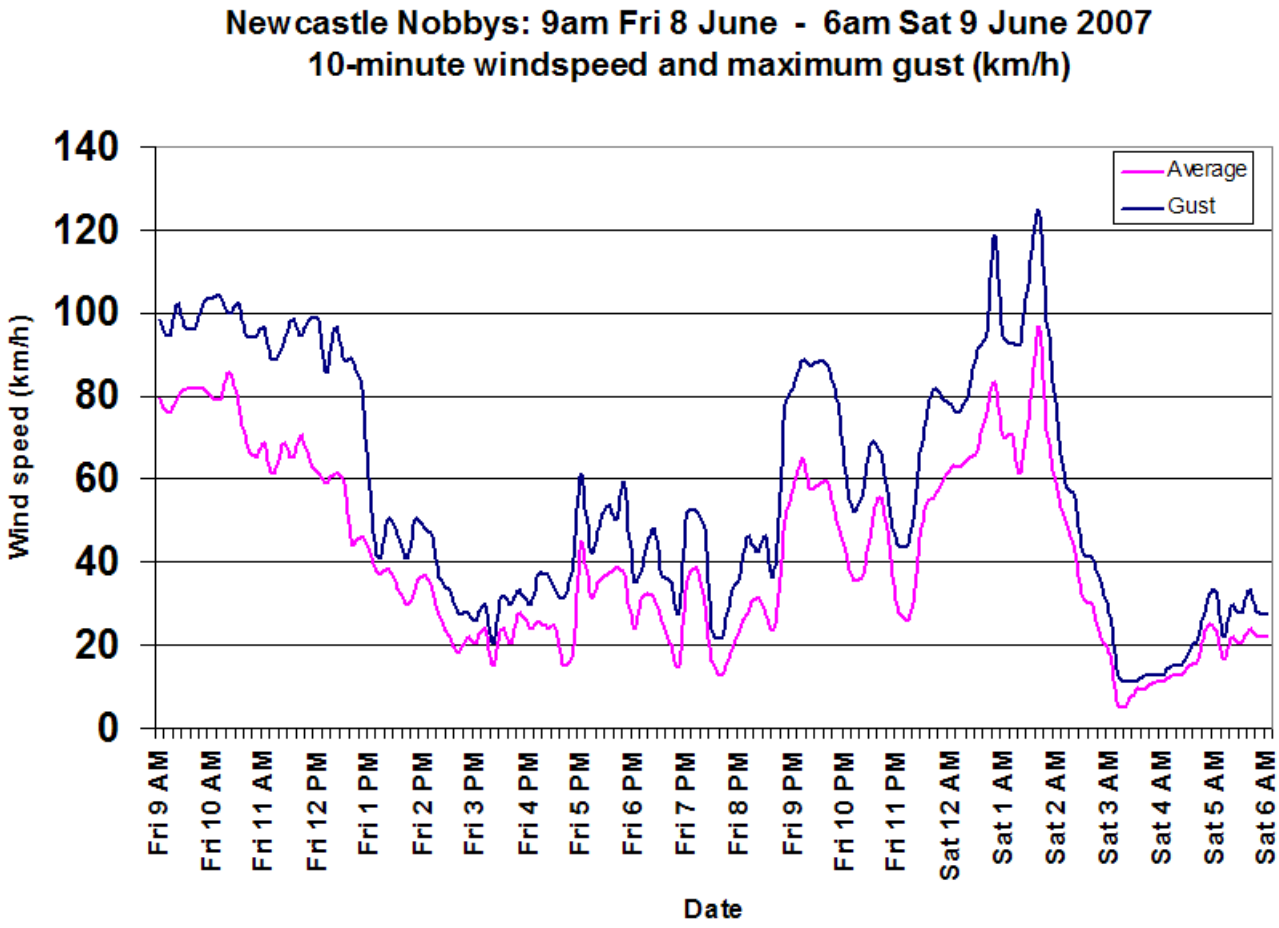
If this is put into context against Table 1 contained on page 11 (Appendix 1) of Simenson's report a person would be about 4 times more likely to die at work that be killed by one of these tree.

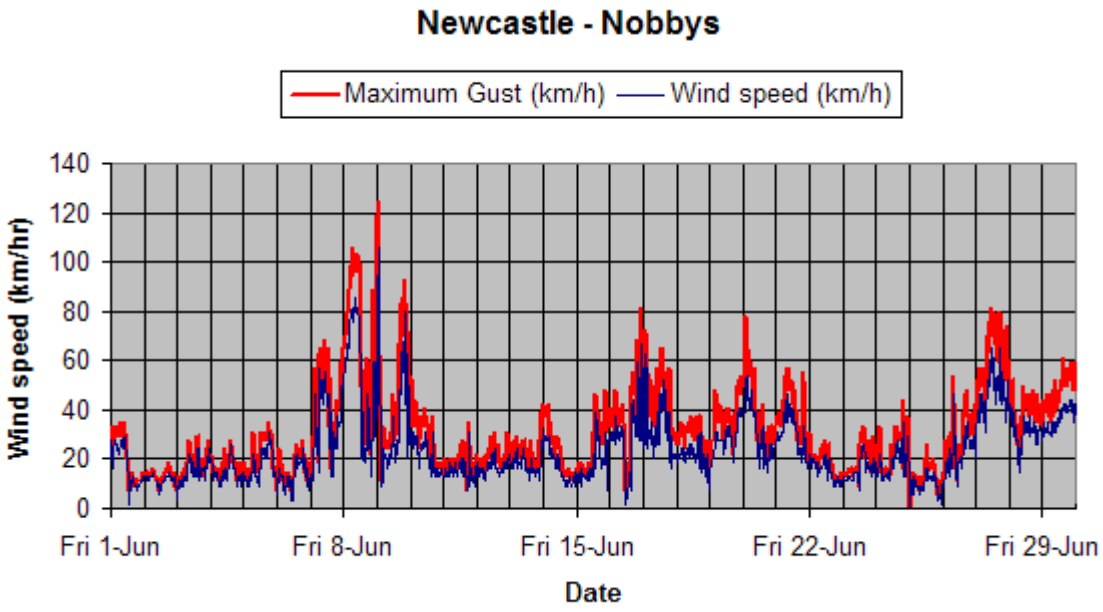
Would this work be expensive? No it is likely to cost less than 30% of the cost of tree removal alone and of course this would be rapidly offset by the ongoing value of these large trees to the urban forest.

Should you require any further information, do not hesitate to call our office for assistance.

Mark Hartley
Dip Hort (Arboriculture) with Distinction
LMNAAA, LMISA, LMIPS, MASCA
ISA Certified Arborist WC-0624 (since 1990)
NAAA Consulting Arborist # 6222-01

Appendix 1


Newcastle Nobbys: 9am Fri 8 June - 6am Sat 9 June 2007
10-minute windspeed and maximum gust (km/h)
Average
Gust
Wind speed (km/h)
140
120
100
80
60
40
20
0
Fri 9 AM
Fri 10 AM
Fri 11 AM
Fri 12 PM
Fri 1 PM
Fri 2 PM
Fri 3 PM
Fri 4 PM
Fri 5 PM
Fri 6 PM
Fri 7 PM
Fri 8 PM
Fri 9 PM
Fri 10 PM
Fri 11 PM
Sat 12 AM
Sat 1 AM
Sat 2 AM
Sat 3 AM
Sat 4 AM
Sat 5 AM
Sat 6 AM
Date


Newcastle - Nobbys
Maximum Gust (km/h)
Wind speed (km/h)
Wind speed (km/hr)
140
120
100
80
60
40
20
0
Fri 1-Jun
Fri 8-Jun
Fri 15-Jun
Fri 22-Jun
Fri 29-Jun
Date