



DEVELOPMENT IMPACT ASSESSMENT REPORT.

Campbells Stores

7-27 Circular Quay West-The Rocks-Sydney.

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1. SUMMARY:

This report has been commissioned by Reece Mackie of Altus Page Kirkland. The report is to assess the large mature *Ficus* tree located directly adjacent to the proposed development site. The tree has been assessed and allocated a tree retention value using the STARS rating system (IACA). Tree 1 has been allocated a high retention value (priority for retention) due to its prominence in the landscape and potential for retention in the long-term.

The tree is providing valuable amenity in the form of shade, aesthetics and environmental benefits. The tree has been allocated a tree protection zone of 12.8 metres and a structural root zone of 3.2 metres.

The proposed development has the potential to impose negative impacts upon the tree through disruption to the trees root system.

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2. INTRODUCTION/AIM

This report is to assess the potential construction impacts upon a mature *Ficus microcarpa* var. *hillii* (Hills Fig) which is located directly adjacent to the building known as bay eleven (11) and in front of the area which is to be known as bay twelve (12). The proposed works to construct a new building and renovate the interiors of the existing buildings have the potential to pose negative impacts upon the tree directly adjacent to the development site. Assessment of the tree was made using some elements of the *Visual Tree Assessment (VTA)*¹ procedure (see Section 3.1). The tree was assessed from ground level on Wednesday 12th August, 2015 and the determinations were reached through the assessment of the trees' health, vigour, and structural condition at the time of inspection.

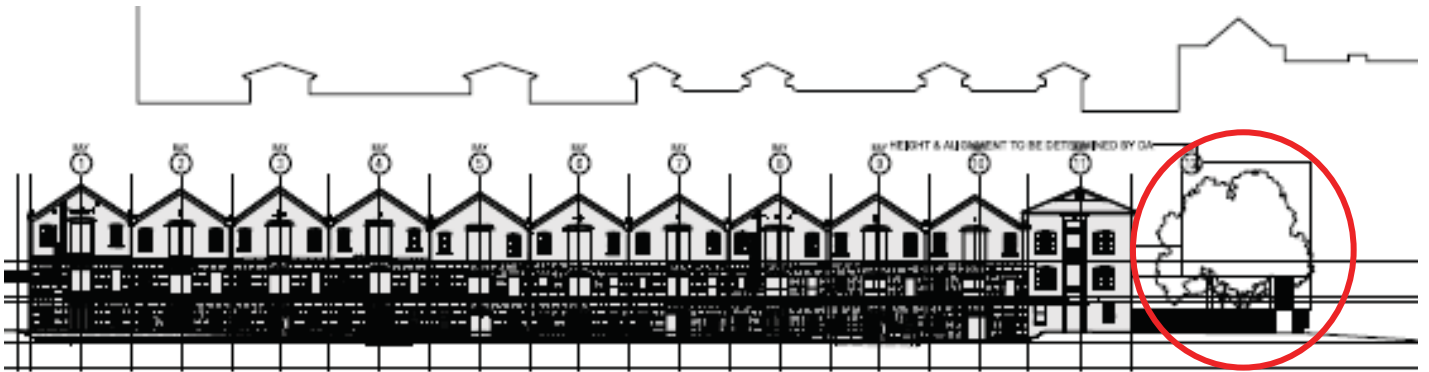


Figure 1: Preliminary DA drawing showing the existing buildings and the subject tree adjacent to bay eleven.

The tree has been allocated a landscape significance rating of high and estimated life expectancy (ELE) of long which were combined to arrive at a retention value of high (priority for retention); this was done by using the *Significance of a Tree, Assessment Rating System (STARS)*². For further explanation, see Section 3.2. Stem diameter was also recorded for the purpose of calculating a Tree Protection Zone (TPZ) of 12.8 metres and Structural Root Zone (SRZ) of 3.2 metres measured from the centre of the tree according to the *Australian Standard AS4970-2009*³.

- No internal diagnostic testing has been completed;
- No sub surface root testing has been completed;
- No soil testing has been completed;
- Stem diameter has been measured and height has been estimated.

Along with verbal advice and email correspondence the following drawings have been relied upon for this assessment:

EA-A-0002 (A) - EA-A-1001 (A) - EA-A-1002 (A) - EA-A-1003 (A) - EA-A-1004 (A) - EA-A-2000 (A)
EA-A-3011 (A) - EA-A-3012 (A).

Sydney Arbor Trees has been engaged to provide this Arboricultural report only. In doing so, Sydney Arbor Trees is hereby prohibited from providing services of any nature other than Arboricultural consultation.

¹ Mattheck & Breloer. 1994. *The Body Language of Trees*.

² IACA. 2010. *Significance of a Tree, Assessment Rating System (STARS)*. Institute of Australian Consulting Arborists.

³ Standards Australia. 2009. *AS4970-2009 The protection of trees on development sites*.

3. METHODOLOGY

3.1 Visual Tree Assessment

The VTA system is based on the theory of tree biology and physiology, as well as tree architecture and structure. This method is used by arborists to identify visible signs on trees that indicate good health, or potential problems. Symptoms of decay, growth patterns and defects are identified and assessed as to their potential to cause whole tree, part tree or branch failure. This system is based around methods discussed in 'The Body Language of Trees'. For the purpose of this report, parts of the VTA system will be used along with other industry standard literature and other relevant studies that provide an insight into potential hazards in trees. This assessment is a snapshot of what could be reasonably seen or determined from a basic visual inspection. The VTA system is generally used as a means to identify hazardous trees; however it is important to realize that for a tree to be hazardous there must be a target. In this case it should be noted that this is not a hazard assessment report so whilst tree defects will form part of the Tree Significance Assessment and therefore affect the retention values, the hazards are not the main focus of the assessment.

3.1.1 Health and vigour assessment

The health and vigour of a tree is assessed by looking at the tree canopy and how it is performing. Certain indicators provide information on which to base the assessment. Abnormally small leaves, lack of lustre, chlorosis (yellowing), sparse crown, die-back etc. can be signs of ill-health or decline but may also be related to a temporary imbalance due to drought or pest infestations. Epicormic growth can be a sign of stress and low energy reserves but can also be related to increased light patterns through the removal or pruning of adjacent trees. For these reasons, each individual symptom or observation needs to be assessed with objectivity and consideration of all available information. Extension growth can be a good indicator of vigour but this can vary greatly between species and weather conditions.

3.1.2 Structural assessment

The structural assessment of trees is carried out using the basic framework of visual tree assessment along with other signs and symptoms of defect which can be assessed to gauge the likelihood of failure because every defect does not constitute a hazard. *"By definition co-dominant stems are a structural defect. The severity of the defect is increased by included bark, large crowns and strong wind."*⁴ If trees were removed purely on the basis that there were defects present without assessing the likelihood of failure or whether practical mitigation measures exist, the urban forest would cease to exist. For a tree to be hazardous there must be a target, a hazard poses no risk if there is no exposure to the hazard. A basic visual tree assessment is carried out from ground level, if defects are suspected further investigation may be required and recommended. *"[When using] the Visual Tree Assessment (VTA) procedure for assessing trees, as the suspicion increases that defects are present, the examination becomes more thorough and searching."*⁴

*"Some defects, especially some forms of decay, do not give rise to external signs and therefore tend to escape detection in a purely visual survey. If there is no reason for suspecting a hidden defect to occur within a particular part of the tree, there is no reasonable basis for carrying out a detailed internal assessment. Although in theory an unsuspected defect might be detectable by the use of specialized diagnostic devices, this would be impracticable in the absence of some external sign to indicate the place which should be probed. Also, internal examination without good reason is undesirable, as it usually causes injury to the tree and is unreasonably time consuming and costly."*⁵

3.2 Allocation of tree retention values

The tree is allocated a tree retention value based on the Significance of a Tree Assessment Rating System (STARS). In this system, trees are given a landscape significance rating based on their health, prominence, suitability and viability within the site, this is then cross-checked against an estimation of the trees expected remaining lifespan to achieve a retention value (see appendix 1).

⁴ Matheny & Clark, 1994

⁵ Lonsdale. 1999. *Principles of Tree Hazard Assessment and Management*.

3.3 Allocation of tree protection zones/structural root zones

According to the Australian Standard³, Tree Protection Zone (TPZ) radius is calculated using the following procedure. Diameter of the trunk is measured at approximately 1.4m above ground level; this measurement is referred to as *DBH* (Diameter at Breast Height).

$$R_{TPZ} = DBH \times 12$$

For multi-stemmed trees the formula used is

$$R_{TPZ} = \sqrt{[(DBH1)^2 + (DBH2)^2 + (DBH3)^2]}$$

The TPZ is measured radially from the centre of the stem and must be protected on all sides.

The Structural Root Zone (SRZ) radius is calculated by measuring the diameter of the stem close to ground level, just above the basal flare. This measurement is taken as *D* and then used in the following formula:

$$R_{SRZ} = (D \times 50)^{0.42} \times 0.64$$

This becomes the Structural Root Zone, measured radially from the centre of the stem.

It is important to realize that these calculations provide a notional figure only and tree dynamics, form and site conditions will greatly affect these zones, and it is the job of the arborist to interpret the information correctly.

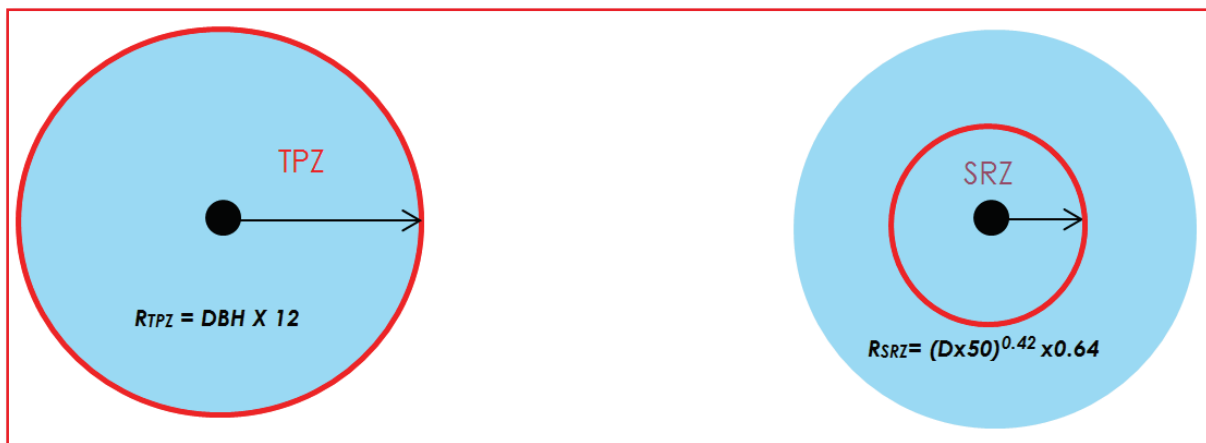


Figure 2 - The calculations for TPZ and SRZ respectively, in accordance with AS4970-2009³.

4. THE SITE

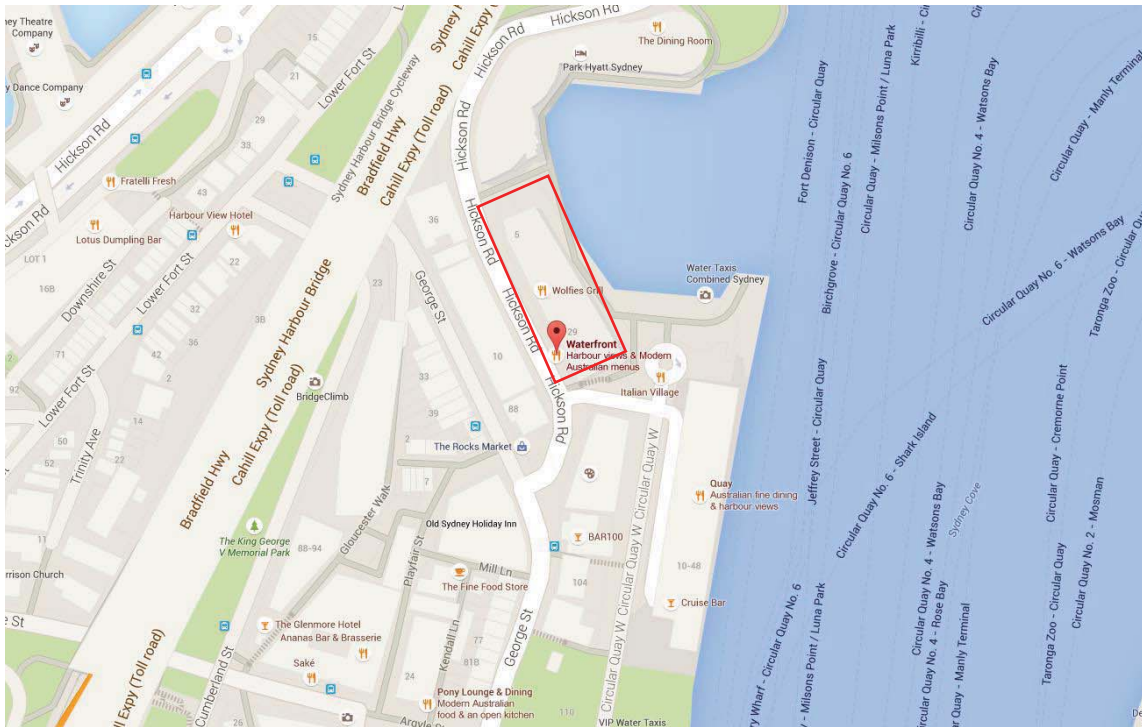


Figure 3: The subject site and the surrounding area. Image from Google maps⁶

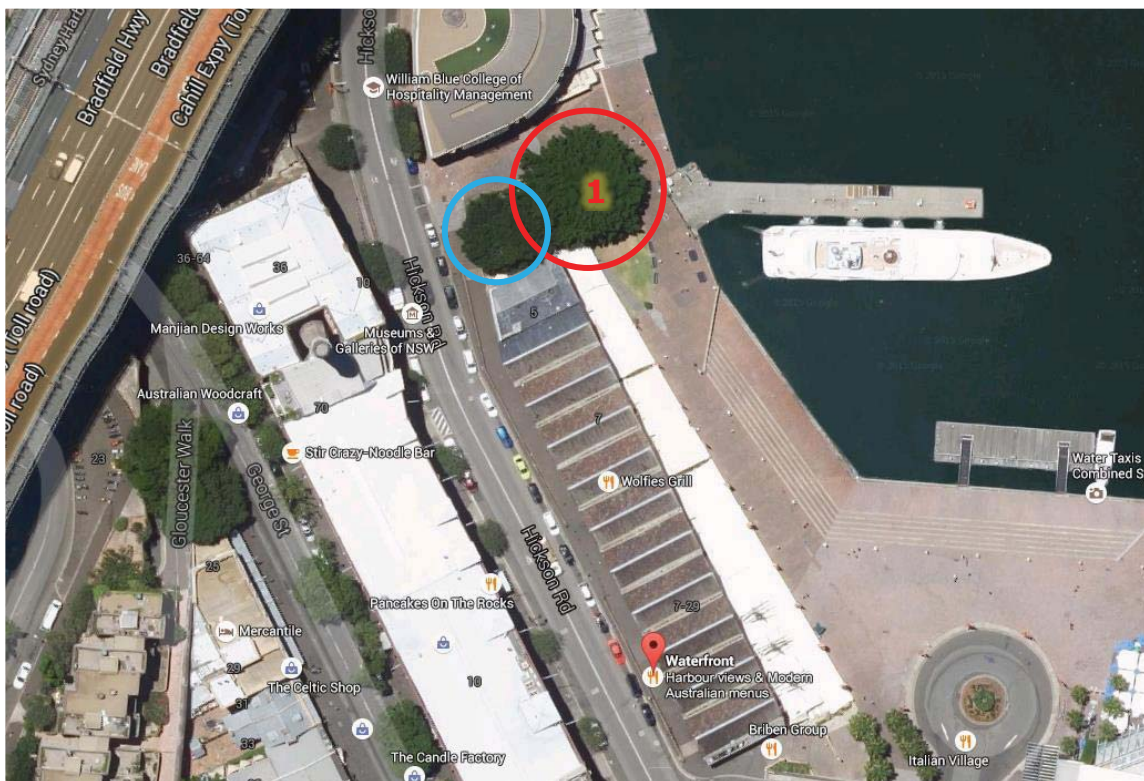
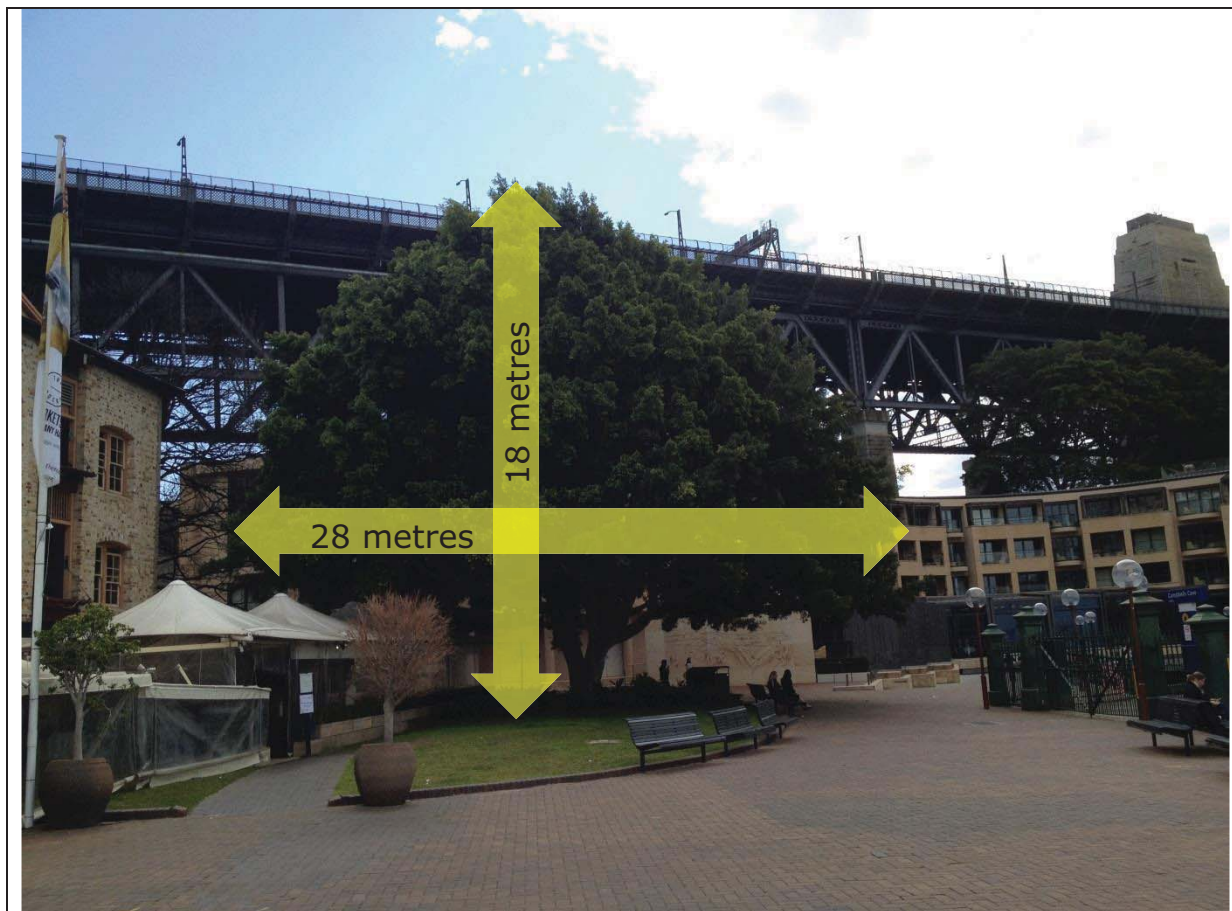


Figure 4: The subject site and the tree locations circled. The tree circled in Blue is a *Celtis sinensis* which is not included in the scope of this report as it is to be removed prior to construction.

⁶ Google maps- The location of 7-27 Circular Quay West-The Rocks-Google maps 2015

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5. TREE SCHEDULE



species	Height (m)	Dbh (mm)	TPZ (m)	Health & Vigour	Structure	Significance	ELE
<i>Ficus microcarpa</i> var. hillii	18	630 660 560	12.8	Fair- Trees canopy is noticeably lacking in vigour on Eastern side	Fair	High	Long
Canopy spread	North/South	East/West	Dgl (mm)	SRZ (m)	Pest + Disease	Age Class	Comments
	24metres	28 metres	910	3.2m	Citrus Black fly and associated sooty mould.	Mature	4.5m from centre of tree to Sandstone wall. 6.6m from Sandstone wall to existing building alignment. Sandstone wall and pavers appear to be undisturbed.

*Dbh= Diameter at breast height (approximately 1.4m above ground level).

**Dgl= Diameter at ground level (directly above basal flare).

6. TREE RETENTION VALUE (STARS SYSTEM).

Tree #	Species	Significance	ELE	Retention Value
1	<i>Ficus microcarpa</i> var. hillii	High	Long	Priority for retention

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7. POTENTIAL IMPACTS

The area directly around the tree comprises of lawn, garden beds and areas of hardstand and paving. There is a low Sandstone wall to the West of the tree, bisecting the tree protection zone in a North/South direction at a distance of 4.5 metres from the centre of the tree. The area beyond this low Sandstone wall is covered with Sandstone flagging which extends to meet the existing building line approximately 11 metres from the centre of the tree. Brick paving surrounds the tree on the Northern and Eastern aspects approximately 5 metres from the centre of the tree. Works are proposed to upgrade the promenade but this area is not covered by this report and will not be discussed as it is to be completed by others.

Minor pruning will be required on the Western side of the canopy to provide suitable construction access. The exact pruning dose will need to be quantified and approved by City of Sydney Council (the consent authority).



Figure 5: The extent of works covered by this report, highlighted in Green.

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7.1 Soil compaction

The landscaped areas and lawn are obviously at risk of soil compaction from pedestrian and vehicle movement around the tree. Construction machinery, tools and equipment, materials etc. must be restricted and excluded from these areas.

Activities generally excluded from the TPZ include but are not limited to—

- (a) machine excavation including trenching;
- (b) excavation for silt fencing;
- (c) cultivation;
- (d) storage;
- (e) preparation of chemicals, including preparation of cement products;
- (f) parking of vehicles and plant;
- (g) refuelling;
- (h) dumping of waste;
- (i) wash down and cleaning of equipment;
- (j) placement of fill;
- (k) lighting of fires;
- (l) soil level changes;
- (m) temporary or permanent installation of utilities and signs, and
- (n) physical damage to the tree.⁷

⁷ AS4970-2009- The protection of trees on development sites
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7.2 Removal of existing Sandstone wall

The Sandstone wall which bisects the tree protection zone is desired for removal as part of the new design. The removal of this wall will have the potential to pose significant impacts upon the long-term health and vigour of the subject tree and is therefore not recommended. The wall bisects the TPZ approximately 4.5m from the centre of the tree; this is outside the SRZ but constitutes an encroachment to the TPZ of approximately 28%. This level of encroachment is unacceptable unless strict controls are implemented. Any work to remove this wall must be done under the direct supervision of an AQF Level 5 Arborist and only following non-destructive excavation with an air spade or vacuum excavation to ensure that the wall can be removed safely without significant damage to adjacent tree roots.

The Sandstone flagging beyond the existing wall appears undamaged as does the wall. This would suggest that either tree roots have gone beneath the wall at sufficient depth to be posing no impacts upon the structure, or tree roots have hit the wall and been deflected sideways. This would mean that a large amount of root mass may be found against the face of the wall making its removal impractical. If this assumption is proven to be correct through non-destructive excavation, it may be necessary to remove the above ground courses of Sandstone blocks carefully by hand and leave the below ground sections of wall and foundation in situ. This may have the additional benefit of retaining a root barrier to restrict damage to the proposed permeable paving beyond the existing wall.

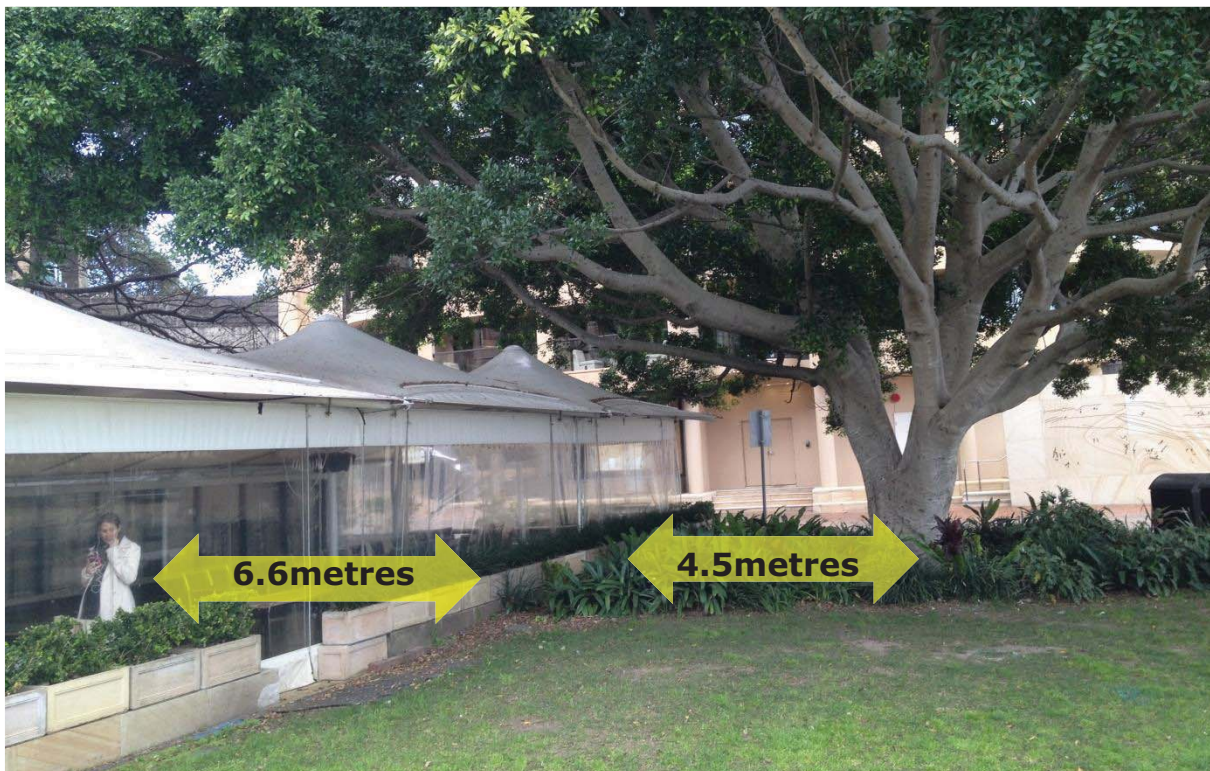


Figure 5: This shows the subject tree and the lawn and garden bed surrounding it. The centre of the tree is 4.5metres from the low Sandstone wall which appears to be undisturbed and in good condition. The distance from the Sandstone wall to the existing building line is 6.6metres. This means that the distance from the centre of the tree to the existing building line is 11.1metres.

7.3 Removal of Sandstone flagging and installation of permeable paving

The removal of the existing floor covering and replacement with permeable paving appears unlikely to pose significant impacts upon the tree as the condition of the existing flagging would suggest that there are few significant tree roots directly below the pavers. This will need to be confirmed through the careful removal of existing flagstones and assessment of the root matter found beneath. The main concern from the installation of permeable paving would be mechanical damage to the roots directly beneath the stones and all of the Sandstone flagging between the tree and the building is within the TPZ so this should be done under supervision of a suitably qualified Arborist.



Figure 6: The existing ground covering is Sandstone paving. This paving appears to be in good condition suggesting that it is possible that minimal significant tree roots will be found directly beneath this surface.

7.4 Installation of drainage within the TPZ

The proposal includes the installation of a significant drainage system between the existing low Sandstone wall and the proposed building line, (see figure 7 below).

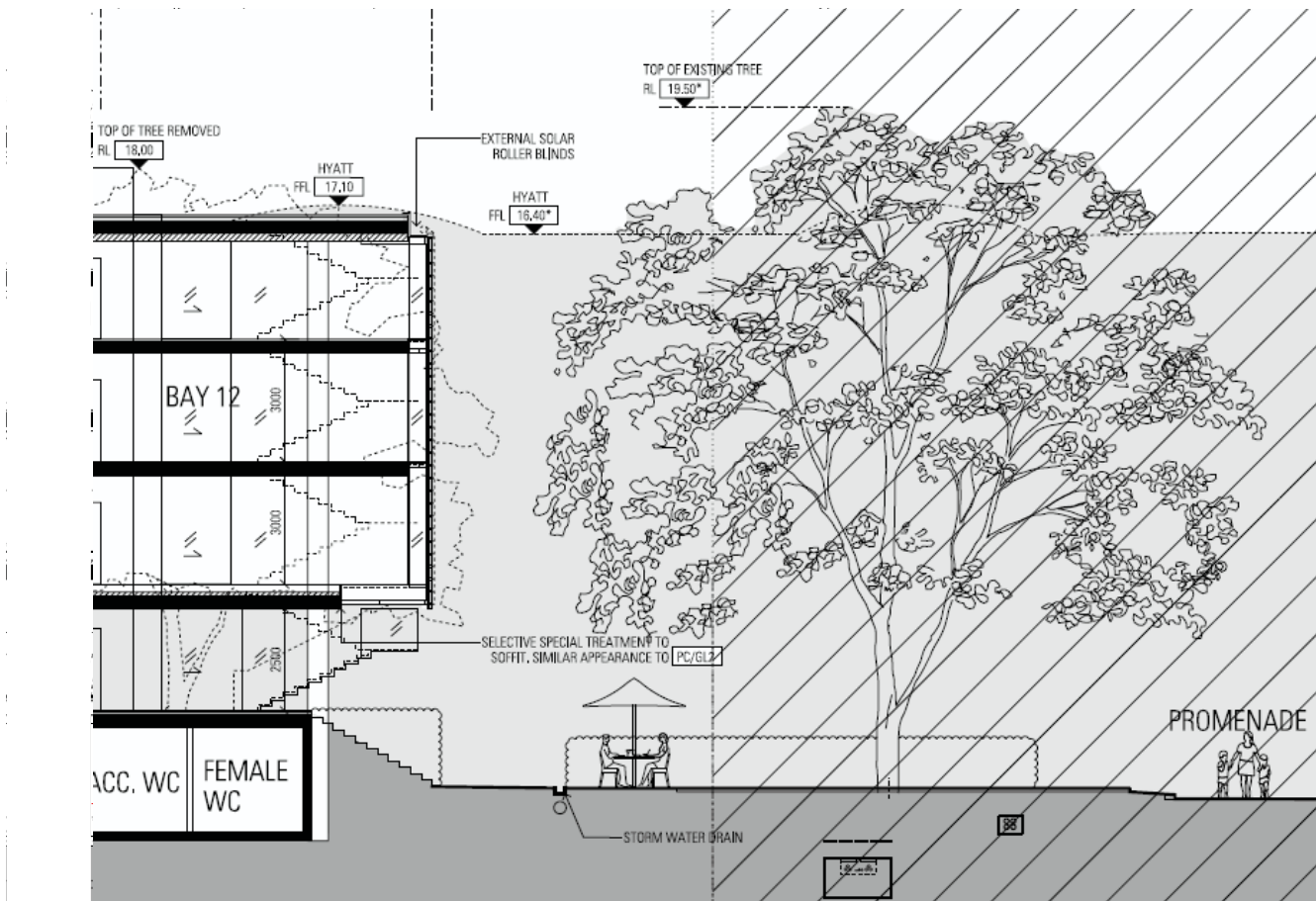


Figure 7: The proposed drainage can be seen here and appears to be approximately 7.5metres from the centre of the tree.

The encroachment for this drainage trench has been calculated at approximately 15% of the TPZ which is classified as a major encroachment.

If the proposed encroachment is greater than 10% of the TPZ or inside the SRZ, the project arborist must demonstrate that the tree(s) would remain viable. The area lost to this encroachment should be compensated for elsewhere and contiguous with the TPZ. This may require root investigation by non-destructive methods and consideration of relevant factors.⁸

Whilst I am unable to assess the impacts of the additional works to be completed by others on the Northern and Eastern sides of the tree, the fact that there will be further disturbance around the tree will mean that there is no practical area set aside from construction that can act as compensation for the encroachments which are proposed.

Other concerns are raised regarding possible footings of the awnings/umbrellas.

⁸ AS4970-2009- The Protection of Trees on Development Sites

8. DISCUSSION

The tree protection zone (TPZ) which has been calculated for the mature *Ficus microcarpa* var. *hillii* (Hills Fig) is 12.8 metres measured radially from the centre of the main stem in all directions. The structural root zone (SRZ) has been calculated at 3.2 metres from the centre of the main stem. The existing building line is 11.1 metres from the centre of the tree; this is an encroachment of 2.85% of the tree protection zone which is allowable under AS4970-2009 so long as this area is allowed for elsewhere and contiguous with the TPZ.

The low Sandstone wall is 4.5 metres from the centre of the main stem, this is outside of the SRZ but equates to an encroachment of 28% of the TPZ. This level of encroachment is unacceptable so the Sandstone wall should be retained if possible. If it is not possible to retain the wall, non-destructive excavation must be employed to assess the location of tree roots directly adjacent to the wall. If significant roots are abutting the wall, the wall and its foundations must remain in situ and only the top course (s) of Sandstone blocks may be removed.

The proposed drainage trench is approximately 7.5-8metres from the proposed building line; this is an encroachment of 13-15% of the TPZ. Due to the fact that other works are proposed by others on the Northern and Eastern sides of the tree, the area which would ordinarily be used to compensate for the encroachment will not be suitable. This will mean that the drainage may need to be redesigned to be located closer to the building line to reduce encroachment. If the drain were to be located closer to the exterior wall of the proposed structure it may reduce the encroachment back to a more acceptable level.

It should be noted that this species of tree tend to handle root disturbance relatively well and generally develop large and invasive root systems. This will mean that even at the extent of the tree protection zone and beyond, large roots may be present and will require protection. The tree protection zone is a hypothetical figure to be used as a guide only, any significant root greater than 30mm in diameter discovered inside or outside of this area should be retained, protected and inspected by a suitably qualified Arborist.

Ground protection measures should be employed on all landscaped areas and lawns to reduce the likelihood of soil compaction from foot traffic and construction activity. This should be done by installing 75-100mm depth of good quality mulch preferably sourced from the same species of tree. An automated irrigation system is to be installed to provide a reliable water source for the tree throughout the project. This system should be installed and activated as soon as the TPZ has been delineated and prior to any construction activity. Tree protection fencing must be erected to restrict access to all softscaped areas and must bear suitable signage on all sides stating: Tree Protection Zone- Do Not Enter. If access is required by machinery, rumble boards or track mats must be utilized to protect the ground surface and trunk and branch protection must be installed to protect the tree from mechanical injury.

There will need to be some minor pruning on the Western side of the canopy to enable sufficient construction access. It appears that this would be fairly minor as per the representation in figure 8 below. The minor pruning should be conducted under council approval by a suitably qualified Arborist who holds AQF Level 3 in Arboriculture. This level of pruning should have no long-term impact upon tree health, however the tree currently displays a reduction of vigour and an infestation of Citrus Blackfly which is predominantly affecting the Eastern side of the canopy, this should be addressed prior to construction.



Figure 8: A representation of the approximate pruning dose required to enable construction.

The tree is of high retention value and should be maintained and protected as per AS4970-2009 The Protection of Trees on Development Sites.

9. CONCLUSIONS/ RECOMMENDATIONS

The following conclusions/recommendations have been reached regarding the tree directly adjacent to 7-27 Circular Quay West.

- 1. The works will have the potential to pose negative impacts upon the large mature Ficus microcarpa var. hillii (Tree 1).*
- 2. Concerns are raised in particular regarding the proposed removal of the existing low Sandstone wall and the installation of a drainage system within the tree protection zone.*
- 3. Due to proposed works by others which have not been fully assessed, the area which would have been used to compensate for encroachment is no longer suitable.*
- 4. The works to remove the Sandstone wall and install the drainage must be done without the use of heavy machinery using non-destructive excavation methods such as air spade or vacuum excavation, under direct supervision of an AQF Level 5 Arborist.*
- 5. Ground protection will be used on all softscaped areas with the addition of rumble boards or track mats if access for machinery is required. Trunk and branch protection must be installed if machinery is to enter the tree protection zone.*
- 6. The tree protection zone must be delineated with chain mesh temporary fencing 1.8m high. Tree protection zone signage must be clearly visible from all angles stating: Tree protection zone- Do Not Enter.*
- 7. A plant health care specialist should be engaged to address the reduced vigour on the Eastern side of the tree and the Citrus Blackfly infestation.*
- 8. The tree should be retained and protected in accordance with AS4970-2009.*

10. REFERENCES

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Google Maps, *The location of 7-27 Circular Quay West, The Rocks, Sydney*.
Google Maps-Accessed 31/8/15

APPENDIX 1: Significance of a Tree Assessment Rating System

The STARS² system was developed by IACA, and is useful for determining the retention values of trees, by assessing the trees' significance within the landscape, and expected lifespan. Landscape significance is determined by criteria from the table below. (Note: a tree must have a minimum of 3 criteria in a category to be classified in that group.) The assessment criteria are for individual specimens, but can also be applied to tree stands of like species i.e. hedges. A tree that is an environmental pest or noxious weed, or that is hazardous or in irreversible decline, is automatically placed in the Low Significance category.

Category	Criteria
1. High Significance	- The tree is in good condition and good vigour
	- The tree has a form typical for the species
	- The tree is a remnant or is a planted locally indigenous specimen and/or is rare or uncommon in the local area or of botanical interest or of substantial age
	- The tree is listed as a Heritage Item, Threatened Species or part of an Endangered Ecological Community or listed on Council's Significant Tree Register.
	- The tree is visually prominent and visible from a considerable distance when viewed from most directions within the landscape due to its size and scale and makes a positive contribution to the local amenity
	- The tree supports social and cultural sentiments or spiritual associations, reflected by the broader population or community group or has commemorative values
	- The tree's growth is unrestricted by above and below ground influences, supporting its ability to reach dimensions typical for the taxa in situ – tree is appropriate to the site conditions
2. Medium Significance	- The tree is in fair-good condition and good or low vigour
	- The tree has form typical or atypical of the species
	- The tree is a planted locally indigenous or a common species with its taxa commonly planted in the local area
	- The tree is visible from surrounding properties, although not visually prominent as partially obstructed by other vegetation or buildings when viewed from the street
	- The tree provides a fair contribution to the visual character and amenity of the local area
	- The tree's growth is moderately restricted by above or below ground influences, reducing its ability to reach dimensions typical for the taxa in situ
3. Low Significance	- The tree is in fair-poor condition and good or low vigour
	- The tree has form atypical of the species
	- The tree is not visible or is partly visible from surrounding properties as is obstructed by other vegetation or buildings
	- The tree provides a minor contribution or has a negative impact on the visual character and amenity of the local area
	- The tree is a young specimen which may or may not have reached dimension to be protected by local Tree Preservation Orders or similar protection mechanisms and can easily be replaced with a suitable specimen
	- The tree's growth is severely restricted by above or below ground influences, unlikely to reach dimensions typical for the taxa in situ – tree is inappropriate to the site conditions
	- The tree is listed as exempt under the provisions of the local Council's Tree Preservation Order or similar protection mechanisms
	- The tree has a wound or defect that has potential to become structurally unsound
3. Environmental Pest/ Noxious Weed Species	- The tree is an Environmental Pest Species due to its invasiveness or poisonous/ allergenic properties
	- The tree is a declared noxious weed by legislation
3. Hazardous/ Irreversible Decline	- The tree is structurally unsound and/or unstable and is considered potentially dangerous
	- The tree is dead, or is in irreversible decline, or has the potential to fail or collapse in the immediate or short term

Once the tree is placed into a Significance category, an assessment is also made of its Estimated Life Expectancy (ELE). This is an estimate of the sustainability of the tree in the landscape. This calculation is based on an estimate of the average lifespan of the species, less its estimated current age. The life expectancy of the tree is then further modified where necessary in consideration of its natural range of occurrence, climatic preferences, rainfall, microclimate, soil types, current health and vigour, condition and suitability to the site.

When both Significance and ELE have been determined, the matrix is used to determine Retention Value. Retention Values are 'Priority for Retention', 'Consider for Retention', 'Consider for Removal' and 'Priority for Removal'.

Tree Retention Values priority matrix (IACA, 2010)².

		Significance				
		1. High	2. Medium	3. Low		
		Significance in Landscape	Significance in Landscape	Significance in Landscape	Environmental Pest/ Noxious Weed Species	Hazardous/ Irreversible Decline
ELE	1. Long >40 years					
	2. Medium 15-40 years					
	3. Short <1-15 years					
	Dead					

Legend for Matrix Assessment (IACA, 2011).

	<p>Priority for Retention (High) – These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed by the Australian Standard <i>AS4970-2009 Protection of trees on development sites</i>. Tree sensitive construction measures must be implemented e.g. pier and beam etc. if works are to proceed within the Tree Protection Zone.</p>
	<p>Consider for Retention (Medium) – These trees may be retained and protected. These trees are considered less critical; however their retention should remain priority with removal considered only if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.</p>
	<p>Consider for Removal (Low) – These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.</p>
	<p>Priority for Removal – These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.</p>