



TREE MANAGEMENT CONSULTING ARBORICULTURISTS

ARBORICULTURAL IMPACT ASSESSMENT

for

London Lakes Pty Ltd
C/- Blue Pacific Constructions Pty Ltd
74 Cabarita Road
AVALON NSW 2107

SITE ADDRESS

STATION BEACH BOATHOUSE WHARF
1191 BARRENJOEY ROAD
PALM BEACH

FEBRUARY 2021

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SUMMARY

This Arboricultural Impact Assessment is an assessment of the existing tree assets in the Licenced Area (the site) adjoining the leased building and jetty to the west (known as The Boathouse), and an analysis of the impacts upon the trees that might occur as a result of the proposed rebuilding of the boathouse, new ancillary services building, seawall and other ancillary works, including drainage and landscaping, on the site.

Three significant Norfolk Island pine trees in the Licenced Area were assessed and accorded high retention values based on their current health and condition (i.e. their Useful Life Expectancy) and their significance in the landscape (Appendix B).

The tree species is well-known for its tolerance to changes within its growing environment, however, changes have been restricted as much as possible, keeping the long-term viability front and foremost when assessing and supporting certain activities around the trees.

During discussions with the architect, builder, hydraulic and geotechnical/structural engineers, planner, landscape designer and ecologist, tree retention was considered in the context of the cultural significance of the trees, permissible development of the site, and desirable outcomes from the public perspective. Subsequent design changes have been adopted to reduce impacts on the trees to supportable thresholds and utilising tree-sensitive works methodologies.

There are strict tree protection guidelines and protocols within this report that must be adhered to ensure disturbance to the trees is avoided or minimised.

The trees will not decline as a result of the proposal, however, it is intended to protect the assessed trees from direct impacts as much as possible, so they can tolerate and adapt to the site changes wrought by proposed development as quickly as possible.

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1 INTRODUCTION

- 1.1 This Arboricultural Impact Assessment (AIA), prepared by Urban Forestry Australia (UFA), was commissioned by London Lakes Pty Ltd, on behalf of the lessees of the subject site. "The site" is identified as Station Beach Boathouse Wharf, Lot 298 in D.P. 721522, at 1191 Barrenjoey Road, Palm Beach, and the adjoining Licenced Area to the east.
- 1.2 This AIA is to accompany a development application to Northern Beaches Council for the proposed rebuilding of the existing structure and alterations of existing floor plans, with addition of a services building and new accessible ramps and pathways in the Licenced Area east of the boathouse building.
- 1.3 The purpose of this report is to assess the *vigour* and *condition* of the surveyed trees, and identify the potential impacts the proposed development may have on those trees to be retained in proximity to the works.
- 1.4 This report gives recommendations for tree retention or removal, and provides guidelines for tree protection and maintenance.
- 1.5 Care has been taken to obtain all information from reliable sources. All data has been verified as far as possible; however, I can neither guarantee nor be responsible for the accuracy of information provided by others.
- 1.6 This AIA is not intended as an assessment of any impacts on trees by any proposed future development of the site, other than the current development application.
- 1.7 This report is not intended to be a comprehensive tree *risk* assessment; however, the report may make recommendations, where appropriate, for further assessment, treatment or testing of trees where potential structural problems have been identified, or where below ground investigation may be required.

2 METHODOLOGY

- 2.1** In preparation for this report, ground level, *visual tree assessments*¹ (VTA) of three (3) trees were undertaken by Catriona Mackenzie on 10 May 2016 and 28 January 2020. Inspection details of these trees are provided in Appendix C—*Schedule of Assessed Trees*.
- 2.2** This AIA takes account of prescribed trees pursuant to B4.22 of the Pittwater Development Control Plan (P21 DCP).
- 2.3** Tree heights and canopy spreads were visually estimated or measured using Nikon ForestryPro and Leica Distometer Laser measurers. Unless otherwise noted in Appendix C, all trunk diameters were measured at approximately 1.4 metres above ground level (“the DBH”). Field observations were written down, and photographs of the site and trees were taken using a Canon EOS1000D digital SLR camera and/or iPhone 8.
- 2.5** No *aerial inspections*, *root mapping* or woody tissue testing were undertaken as part of this tree assessment. Information contained in this tree report covers only the trees that were examined and reflects the condition of those trees at the time of inspection.
- 2.6** Plans and documents referenced for the preparation of this report include:
- Details and Levels Plan, Dwg No. 17534, dated 21/08/2019, prepared by CMS Surveyors.
 - Hydraulic and Drainage Plans H-100 & 101, Rev C, by Ascar Consulting, dated 20/03/2020.
 - Water Services Plans H-210 & H-202 Rev A, by Ascar Consulting, dated 24/01/2020.
 - Storm Erosion Protection Wall, EPW01 & W02, dated 03/03/2020 by McKee & Associates.
 - Plans DA01 – DA14, dated 30/01/2021, prepared by Canvas Architecture & Design.
 - Landscape, Ecology and Integration with Public Space by Ecological Consultants Australia, dated February 2021.
 - Landscape Plan, LP01-C, by Selena Hannan Landscape Design dated 4 February 2021.
 - Governor Philip Park Conservation Management Plan 2009 (CMP).
 - AS4970-2009 *Protection of trees on development sites*, Standards Australia.
- 2.7** The subject trees are shown on marked-up excerpts of the survey plan. These marked-up plans are attached as Appendix D—Tree Location Plan.

¹ Visual Tree Assessment (VTA) is a ground level inspection procedure of symptom analysis developed by Mattheck and Breloer (1994) that uses the growth response and form of trees to detect existing or potential issues with structural stability of a tree or any of its parts. VTA may identify features of concern that require advanced assessment techniques such as aerial and rootcrown inspections, decay testing, and specialised fungal, soil or chemical analysis.

3 OBSERVATIONS AND DISCUSSION

3.1 Assessed Trees

- 3.1.1 Three (3) trees were assessed for this AIA. Details of these are included in the Schedule of Assessed Trees – Appendix C.
- 3.1.2 The subject trees are all mature *Araucaria heterophylla* (Norfolk Island pine), located in the lease area immediately adjoining the east boundary of the site.
- 3.1.3 The species is endemic to Norfolk Island and was primarily introduced into Australia as an ornamental tree.
- 3.1.4 The species is highly salt spray tolerant and resistant to strong winds as it has a very robust Structural Root Zone (SRZ) that includes numerous anchoring ‘sinker’ roots that can extend 1 – 2m or more down into deep sand. The fibrous root system is generally found in the upper 200mm or so of sands and sandy loams.
- 3.1.5 The species is reasonably tolerant of woody root severance (although how much is too much is still up for debate). It is known to be very tolerant of compaction.
- 3.1.6 These subject Norfolk Island pines (NIP):
- are located within the Barrenjoey Heritage Conservation Area;
 - form part of the dominant cultural plantings in Governor Philip Park;
 - are not listed as a heritage item under Schedule 5 of the Pittwater Local Environment Plan (LEP), and
 - are not subject to threatened conservation status under Australian and/or State Government legislation (i.e. NSW *Biodiversity Conservation Act 2016* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*).
- 3.1.7 The physical dimensions of the subject trees have not altered in any material way and are very similar to those recorded in 2016. This also applies to the health and condition of the trees. All three appear to be vigorous with no apparent setbacks or decline in crown cover and branch structure.

- 3.1.8 Based on the relatively medium to long *Useful Life Expectancy* and high visual prominence and cultural landscape significance of each tree, each is accorded a High Retention Value².
- 3.1.9 Several items screwed into, wrapped around or attached in a number of ways to the trunks of the trees were observed. These were also noted during my inspection in 2016. Some items, such as rubber hoses appear to be restricting stem expansion, and other items hanging from limbs could be abrading and wounding the branches and may need to be relocated or removed. A water fountain which was observed to be continuously dripping water over the SRZ of Tree 3 was observed during my January 2020 site visit. I advised these items on and around the trees needed to be removed to prevent ongoing constriction of normal sap flow and trunk expansion of the trees, and excessive, volumes of water concentrated over the SRZ of Tree 3. These items have now been removed since my inspection in January 2020.
- 3.1.10 Existing exotic landscaping is being removed, generally by heavily cutting back of the larger plantings to enable careful removal and minimising disturbance of the existing soil profile. Repeated pruning of the regrowth will also assist in depleting energy reserves, eventually causing plant death.
- 3.1.11 The landscaping in the Licenced Area has been substantially altered from that approved with the CMP. A predominantly couch grass lawn has been replaced with paving, outdoor furniture and river stones, and the plantings are primarily exotic species. In any case, as the trees grew in height and spread, they increasingly intercepted direct light onto the ground beneath, and the couch lawn would have eventually succumbed and died out in patches.
- 3.1.12 Between 2009 and 2019 the landscaping has included substantial changes to the growing conditions of the trees, albeit without perceptible effects on their vigour or condition. These include addition of soil and stacking of river stones to more than 0.5m above the natural grade, existing concrete path between the trees, large areas of paving, outdoor seating/tables, ancillary service structures, walls and the like.

² Retention Value (RV) refers to the retention value of a tree based on its estimated *Useful Life Expectancy* (ULE) and the significance of the tree in the landscape (see Stars-Appendix B). Note: Where further investigation or testing of trees is required (e.g., where a lack of access to a tree prevents clear visual assessment, or the tree requires decay diagnostic testing), a RV cannot be accorded to that tree until the detailed assessment, investigation or testing has taken place. Refer to Appendix C for more detail.

3.1.13 Google street view images from 2009 to 2019 below effectively demonstrate the changes from the approved landscape at natural grade to a landscape that has built up its levels around the trees and the perimeter of the Licenced Area to create an enclosed space.

December 2009

Oct 2019



View to southwest from road



View to southwest from road



View to northwest from road

3.2 Proposed Removal of Prescribed Trees

3.2.1 No tree is proposed to be removed.

3.3 Potential Impacts on Trees Proposed for Retention

3.3.1 Under the Australian Standard 4970-2009 *Protection of trees on development sites* ("AS4970"), encroachments less than 10% of the *Tree Protection Zone* ("the TPZ") are considered to be minor. No specifications are provided in AS4970 for potential impacts of 10% or greater. A common misinterpretation of the standard is that no encroachment of 10% or greater is supportable. However, this 10% is the threshold figure where arboricultural investigations into TPZ encroachments beyond this need to be considered.

3.3.2 The trees have TPZ offsets between 9.0m –11.4m radius, measured from the centre of their trunks. Much of the TPZ's are currently covered by non- and semi-permeable pavements (i.e. concrete and bitumen, pavers on ground) and various structures such as tables and planter boxes. The area occupied by the combined TPZ's of the trees is vast, extending into the footprint of the existing building to the west and well out into the surrounding north, south and east which, if we were to avoid any disturbance of any kind within the TPZ, would effectively sterilise the area from any development taking place.

3.3.3 Most of the notional Structural Root Zone (SRZ) offsets of the trees have been covered with large river stones, which were in place during my site visit five years ago in 2016. A positive aspect of this is the stones assist in reducing soil moisture evaporation but importantly, prevent foot traffic directly over the upper structural root system. As these stones have likely been in place for more than four years there is no real reason to remove them and expose the soil beneath. However, these stones should generally only be a single layer and any excessive mounding of rocks should be addressed during future landscaping.

3.3.4 During the site inspection a lengthy meeting was held between the various consultants on this project including the planner, architect, builder, hydraulic and structural engineers, ecologist and arboriculturist. Of primary importance was the protection of the pines and ensuring that any new works would be kept to a minimum within the TPZ's of the trees.

- 3.3.5 New underground services were discussed, reviewed, amended where necessary, and routed to stay clear of the TPZ's as much as possible. I am satisfied the most practical and least impactful hydraulic design has been developed and will have little to no effect on the continued vigour and viability of the trees.
- 3.3.6 As the café floor level of the new building must be raised to RL2.800 this required the level between the entry and open public space area to the east to be BCA compliant for equitable access. From an arboricultural perspective, raising the ground level was not an option as this would require retaining walls and strip footings, and introduce large areas of fill within the TPZ's of the trees.
- 3.3.7 This presented a challenge in terms of the most suitable approach to minimise disturbance and preserve as much of the notional TPZ as possible, as well as creating a public pathway that links the roadway to the beach and focusses and frames the western water views available from the path. Apart from demolishing existing structures (e.g. shed, sandstone table, bollards, etc) existing concrete or bitumen surfaces are to remain, or be fractured in proposed extended landscape areas, and broken up to reduce the loss or desiccation of fine roots that may be concentrated beneath.
- 3.3.8 The outcome of discussions was to propose an elevated path and entry area that would drastically reduce the need for ground disturbance in the TPZ's. In addition, the trafficable surface of the path and entry areas would be an AS 4586-2013 compliant grated mesh which allows free movement of air and water between the path and ground beneath. A ramp at each end of the elevated path and one ramp west of Tree 3 are required to provide access from public space to the building entry and the beach south of the new building.
- 3.3.9 During discussions, a number of sketches were produced by the builder to demonstrate the proposed path construction. A final sketch that outlines the agreed upon most suitable path construction that considers ongoing tree health and viability is included in Section A-A in the Landscape Plan LP01-C.
- 3.3.10 There is an overall decrease in surface paved areas within the TPZ of the trees – see Site Calculations in the Landscape Plan LP01-C.

- 3.3.11 There will also be an increase in landscape area of approximately 42m² (via removal of existing paved areas and introducing very coarse, free draining soil) to protect underlying roots and as a base for planting of tubestock size native plantings within pockets created in the existing rock mulch around the trees.
- 3.3.12 Most of the works within the SRZ of trees is superficial and temporary in nature because it will be removing pavers and structures on nil or very shallow supports (i.e. existing gabion style tables on ground and pizza oven on shallow concrete slab), and replacing these with either landscaping or new pavers, but not structures requiring slabs or footings. In some places, existing outdoor seating areas will be retained, but the pavers will be removed, shallow depth of 80/20 sandy loam placed over the exposed ground and new pavers placed on top. This will assist new root growth as well as smooth the transition from the walkway to these seating areas.
- 3.3.13 Tree 3 will have a section of the existing gravel within its SRZ carefully removed beyond the west garden edge to create a new landscape area (diagonal hatching on Plan DA04). Isolated pad footing to support the ramp to the west will be just outside the notional SRZ radius.
- 3.3.14 The majority of works in the TPZ of the trees is also of a temporary and generally superficial nature. There will not be any deep excavations or below ground structures that would prevent root generation within the TPZ radii following works. However, the area occupied by the proposed ground anchors and seawall will result in a less than 10% permanent area within the TPZ.
- 3.3.15 A couple of isolated areas where concrete will be placed to support path ramp and very shallow excavations (essentially just 'seating' into ground) will occur via placement of the elevated path edge from the road to the beach.
- 3.3.16 Tree 1 will have a small permanent encroachment involving the construction of a new ancillary building to the south and within the outer edge of the tree's TPZ radius.

3.4 Analysis of Proposed Works within the Tree Protection Zones

3.4.1 Tree 1

Structural Root Zone:

- Removal of existing pavers, pavement and structures north and northwest of the tree (diagonal hatched areas on Plan DA04), low level of clean 80% sand 20% loam (80/20 sandy loam) fill, use of existing river stones to protect the SRZ, and landscaping with tubestock (e.g. forestry tubes) size plantings.
- Shallow depth of clean 80/20 sandy loam fill after removal. Replace with new pavers with approximately 50mm gaps to assist with oxygen and water movement to tree roots and to provide space for 'gap-filler' plantings – see notes on Landscape Plan LP01-C.
- No excavation is proposed inside the tree's SRZ.

Tree Protection Zone:

- Removal of existing pavers and concrete path.
- Concrete ramp from east side of new path entry, and elevated walkway across northern TPZ, utilising concrete plinths and/or I-beams placed perpendicular to the path edge at approximately 2000mm spacings to allow passage of soil resources and fine tree roots between both sides of the landscaped areas.
- Edge between new path and outdoor seating areas consisting of 300mm x 300mm split/cut sandstone seated on ground (with very minor ground adjustment to 'seat' securely), and clean 80/20 sandy loam to suit. This arrangement means there is very little obstruction to root generation between the north and south sides of the open public space.
- Extension of landscape area to south (Plan DA04) which requires the breaking up and removal of some of the existing bitumen.
- Remaining areas of bitumen that require upgrading only: (e.g. proposed loading bay and demolished structures, gardens and edges) will be repaired/restored with new 50mm bitumen layer placed on the existing or damaged path areas.
- New building south of the tree, set further south than existing buildings. The estimated TPZ encroachment of this building (including an allowance for some 'disturbance area' north of the footprint) will be approximately 9m², or about 3.7% of the tree's TPZ 242m² area.
- The new building will be on isolated piers with limited excavation (i.e. pier and beam type construction) which is considered to present the least amount of disturbance within the notional TPZ radius.

Pruning impacts:

- None proposed.



Figure 1 – Tree 1

Shows the existing pavers and structures within the SRZ of Tree 1. These will be removed and replaced with landscaping only. Refer to the ecologist's landscape report and the Landscape Plan LP01-C for planting details.

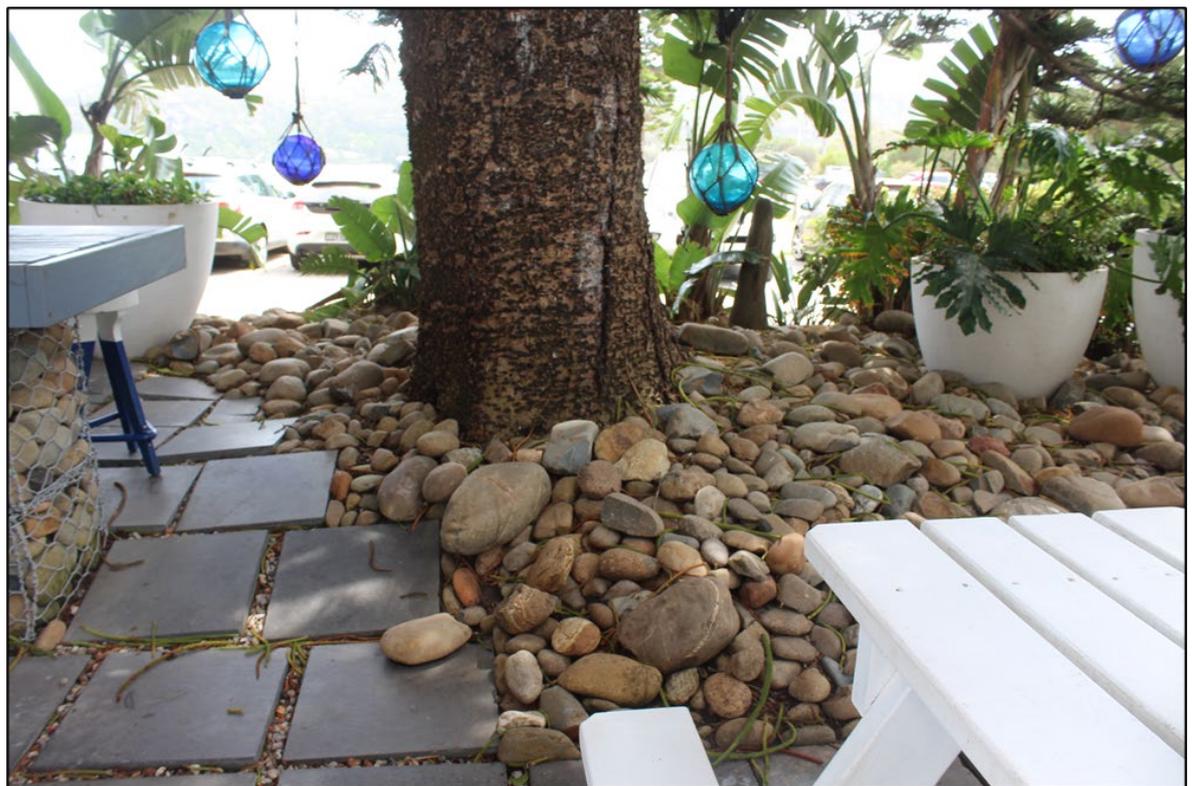


Figure 2 – Tree 2

Shows the existing pavers and structures within the SRZ of Tree 2. These will be removed and replaced with landscaping, with a small section of paved area within the SRZ area to the south retained for use. The pavers will be removed, new 80/20 fill to a depth no greater than 100mm depth and then new pavers seated on sand with 20mm gaps to maintain soil moisture and gaseous exchange to soil beneath. Refer to the ecologist's landscape report and Landscape Plan LP01-C for planting details.

Tree 2

3.4.2 Structural Root Zone:

- Removal of existing pavers, pavement and structures to the immediate west of the tree (diagonal hatched area on Plan DA04), low level of clean 80% sand 20% loam fill (80/20 sandy loam), use of existing river stones to protect the SRZ, and landscaping with small container size plantings.
- Remove existing pavers. Shallow depth of clean 80/20 sandy loam fill after removal of pavers. Replace with new pavers with approximately 50mm gaps to assist with oxygen and water movement.
- No excavation is proposed inside the tree's SRZ.

Tree Protection Zone:

- Removal of small section of concrete path to southwest.
- Concrete ramp from east side of new path entry and elevated walkway across southern portion of the TPZ, utilising sandstone logs placed perpendicular to the path edge and approximately 2m+ spacings to allow passage of soil resources and fine tree roots between both sides of the landscaped areas.
- Edge between new path and outdoor seating areas consisting of cut stone seated on ground (with very minor ground adjustment to 'seat' securely – see Landscape Plan LP01-C), and clean 80/20 sandy loam to suit. This arrangement means there is very little obstruction to root generation between the north and south sides of the open public space.
- Extension of landscape area to southwest (Plan DA04).

Pruning:

- None proposed.

Tree 3

3.4.3 Structural Root Zone:

- Hand removal and/or cultivation of existing gravel within proposed landscape area extension.
- Extension of landscape area to west of tree, edged with sandstone blocks (LP01-C). Use of 80/20 sandy loam as planting media to 'ramp-up' and meet existing soil level beneath existing stones. Existing stones and tubestock/small container planting used to stabilise soil.

Tree Protection Zone:

- Removal of existing pavers to east and concrete path to southeast.
- Concrete ramp from east side of new path entry and elevated walkway across most of the TPZ utilising concrete plinths and/or I-beams placed perpendicular to the path edge and approximately 2000mm spacings to allow passage of soil resources and fine tree roots between both sides of the landscaped areas – See Section A-A in the landscape plan LP01-C.
- Suspended, permeable ramp to west.
- A seawall is required to protect the interface of the land and water beneath the new building. Construction of this wall will require excavations below MHWM and in Crown Land leased area. Two land anchors (above MHWM) and the northern seawall return will be within the TPZ of Tree 3 (Erosion Wall Concept EPW01). These land anchor excavations will be perpendicular to the TPZ, not running across it. The closest excavation will be approximately 4.5m from the centre of the tree (this includes an area of disturbance around the excavation which is about 5m from the tree) and would be approximately 1.5m outside its SRZ (Figure 3).
- The proposed wharf building support wall will be approximately 8m from the centre of Tree 3. The excavations for support wall, drainage services, seawall land anchors and return wall (allowing a maximum excavated width of 1.5m) account for approximately 43m². The total encroachment due to excavation represents around 13% of the trees 327m² TPZ area and will be less than 10% after works are completed.
- Edge between new path and outdoor seating areas consisting of cut stone seated on ground (with very minor ground adjustment to 'seat' securely), and clean 80/20 sandy loam to suit. This arrangement means there is very little obstruction to root generation between the north and south sides of the open public space.
- Extension of landscape area to south (Plan DA04) which requires the breaking up and removal of existing concrete and provision for planting – see Section A-A of the Landscape plan LP01-C.
- Retention of existing concrete and bitumen to the southwest, below the proposed permeable, grated deck to the boathouse. Retention of these existing surfaces will protect the underlying sand and soil from erosive forces and fine tree roots potentially located in this area.

Pruning:

- None proposed.

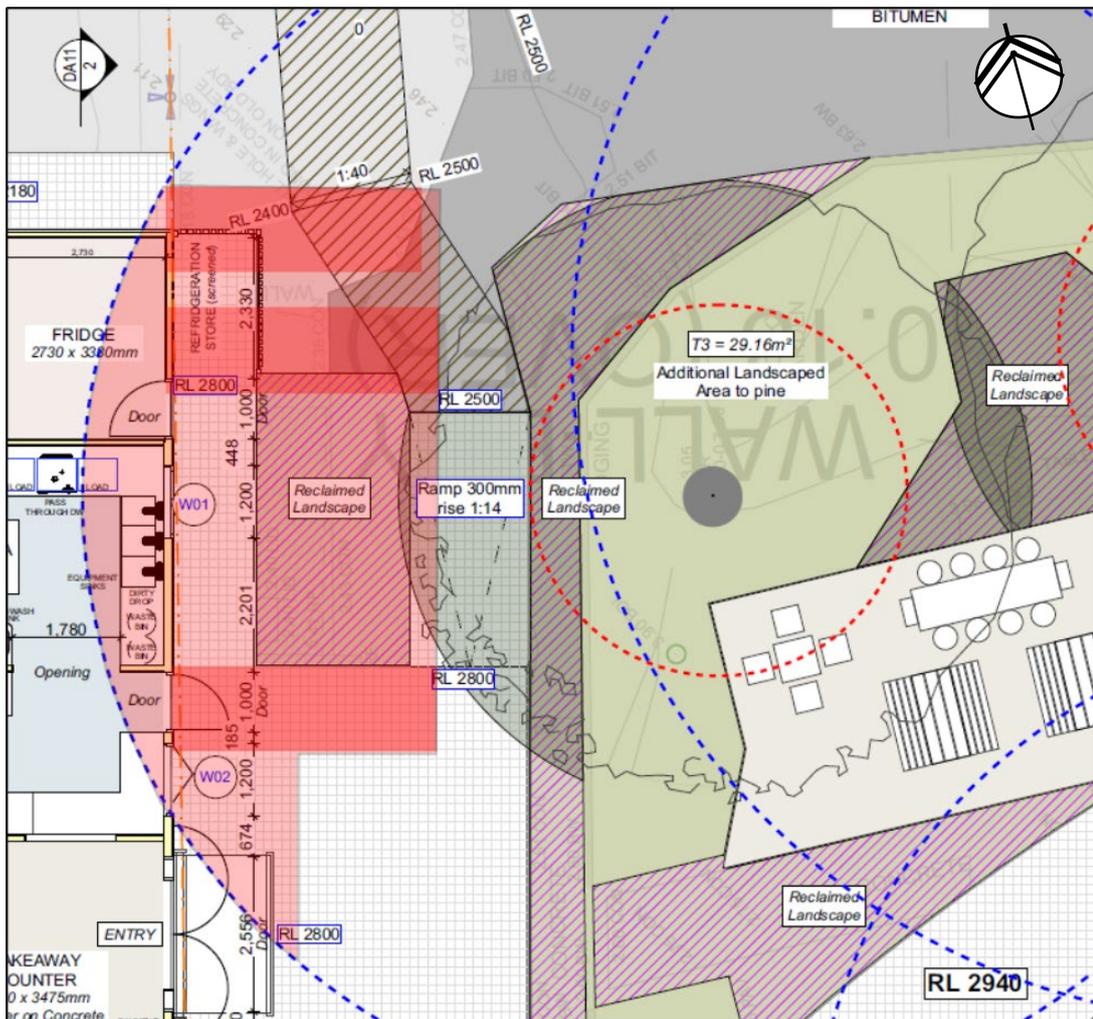


Figure 3 – Tree 3

The shaded red areas show the extent of excavation, including generous ‘disturbance’ area around the proposed ground anchors, drainage service pipes, and the like, within the TPZ of Tree 3. Following excavation and installation of services and the other structures, fine roots can generate and grow into those areas not occupied by the below ground structures. Note proposed extension of landscape area (shaded pink) to west of the tree. Marked up excerpt of DA04, by C. Mackenzie. Not to scale.

3.5 Landscaping Works within the Tree Protection Zones

- 3.5.1 Proposed plantings within the Licenced Area are locally indigenous species. Species that have weak or non-competitive roots, such as ground covers, are proposed within the SRZ, which is supportable provided they are a maximum 100mm tubestock size (e.g. forestry tubes) at planting. This will avoid necessary soil displacement and potential for conflict with structural roots.
- 3.5.2 Plantings proposed around the perimeter of the Licenced Area (bounded by existing timber logs/sleeper) are also supportable, however proposed tree and shrub plantings (e.g. *Acacia*, *Banksia*, *Leptospermum*) should be limited to a maximum 300mm container size to avoid unnecessary soil disturbance within the TPZ.

3.6 Concerns Raised by Council Landscape/Tree Officer

3.6.1 Following a Development Application Prelodgement Meeting (PLM) held at Council on 9 July 2020, the subsequent meeting notes included concerns regarding the excavation and construction of the paths and ramps on the Norfolk Pine Trees, including a statement that “...*The existing Norfolk Island Pines are to remain and the ground surface treatments shall be proposed to enhance the long term health of the trees.*”

A number of Council requirements were included in the PLM and I have included those relevant to the arboricultural aspect of the proposal, below.

3.6.2 *Reclaimed landscape areas will not be beneficial to the existing Norfolk Island Pines if existing roots are damaged/removed for the proposed works, as any removal of existing roots will see a decline in the health of the existing Norfolk Island Pines.*

The design of the ramps, decking and landscape areas has specifically focussed on minimising the potential for any tree root loss or disturbance. This is achieved by removing existing structures and pavements (with some exceptions, as explained at 5.1.3 for existing bitumen areas), avoiding excavation in the landscape areas, and providing shallow areas of a suitable sandy soil mix to accommodate plantings and allow tree roots to access and occupy those areas.

There is no proposal to remove or damage woody roots in the SRZ of the trees and, as excavations are avoided, the loss of fine, non-woody roots will be negligible. Notably, I have specifically recommended that any existing bitumen located in the reclaimed landscape areas is to be fractured only to avoid excessive removal of any fine roots that might be adhered to the underside of the bitumen. Supervision during this time will confirm if fine roots are adhering to the bitumen and whether all or parts of bitumen areas can be removed.

It is likely there will be some loss of fine, non-woody roots, but I do not agree that “...*any removal of existing roots will see a decline in the health...*” of these trees.

The fine, non-woody root system of a tree is dynamic and many of these roots are ephemeral in nature; some of these fine roots die and new ones generate over and over in the course of a single growing season. The removal of pavers and replacement with a sandy loam will encourage new roots into those reclaimed landscape areas.

- 3.6.2 *The tree protection zones of the three existing Norfolk Island Pines are expansive and the accumulation of surface works (ramps, new paths, paved sitting areas) shall be calculated to provide a before and after area.*

These before and after calculations are provided in the Landscape Plan LP01-C. Essentially, there will be an increase of 61m² landscape area from the existing 189m² garden area under the trees, to the proposed 250m².

- 3.6.3 *All surface treatments within the tree protection zones shall be porous.*

I interpret the above to mean that the proposed landscape area under the trees is to provide for porous surface treatments, and not to the actual Tree Protection Zone radii as these extend well into the public road and paths that are currently surfaced – See Appendix E for confirmation of this. There is no proposal to alter the existing public road and certainly no proposal to turn it into a ‘porous’ surface.

Generally, the landscaped area is to be surfaced with a sandy loam mix for planting and tree root occupation. It is reasonable to expect some form of non-porous treatment in limited application is required to provide stable pedestrian access to outdoor seating areas in the form of 450mm x450mm concrete pavers. These will be isolated by 50mm gaps for groundcover growth and allow for passage of water and oxygen to the soil beneath.

In addition, there will be concrete plinths and sandstone logs seated at/or slightly below existing ground to provide support for the grated decking. These plinths and logs will not form contiguous edging or supporting structures, therefore allowing for the progression of tree roots and groundcovers beneath the raised grated decking.

4 CONCLUSIONS

- Three (3) Norfolk Island Pines (NIP) of High Retention Value are located in a licenced leased area adjoining the site's east boundary.
- The trees are all in good health, although Trees 2 and 3 have potential structural issues that warrant closer investigation.
- The trees are part of culturally significant NIP plantings located in the Barrenjoey Heritage Conservation Area and Governor Philip Park.
- The trees deserve a high priority consideration when works are undertaken in the Licenced Area.

- Apart from the excavations required for drainage services and the land anchors for the new sea wall, which are not expected to have any impact on the ongoing vigour and life expectancy of Tree 3, the proposed changes occurring over the general TPZ of the trees are generally focused at or near the existing surface and mostly comprised of pervious surface treatments. These works are acceptable given the relatively minor nature of the works and, given the robustness of the species and the good health of the subject NIPs, the continued viability of these trees is not considered to be under threat because of the proposed development.
- However, it is important that an experienced and qualified arboriculturist is engaged immediately following development consent, with acceptance from the developer and builder that a high level of supervisory and advisory input is maintained during all stages of the development, including the demolition of existing pavers and structures, and excavations and construction occurring within the Licenced Area.
- Provided the recommendations of this report are adopted, adverse impacts on tree vigour and structural condition of trees to be retained will be managed appropriately.

5 RECOMMENDATIONS

5.1 TREE PROTECTION

Minimising Impacts on Trees 1–3

5.1.1 The following recommendations are provided to ensure these trees are afforded appropriate consideration during demolition, excavation and construction activities.

- An arboriculturist with a minimum Australian Qualification Framework (AQF) Level 5 (Diploma) is to be engaged as the project arboriculturist and supervise demolition and construction within a 6m radius of Trees 1 - 3.
- The project arboriculturist must advise on all aspects of on-going tree protection prior to and during construction.
- Tree Protection fencing is to be located in accordance with the Tree Protection Plan Appendix E.
- All works within the SRZ of trees must be carried out using hand-held tools only and under supervision of the project arboriculturist.
- Careful removal of existing plantings, particularly those larger, established ones. Uncontrolled digging and cutting to remove plants such as the Giant Bird of Paradise can disturb roots. Cut down as close to base as possible and leave to die back and then remove.
- Woody perennials to be removed should be cut back as close to the main base as possible and where practical, allowed to die before removal.
- Some very shallow rooting plants (e.g. Agaves, etc) may be pulled gently out (put aside rocks and pull out, then replace rocks).
- Do not use herbicides to control unwanted plants within the TPZ of the NIP.
- Prevent any solutions, solvents, glues, abiotic particulates and other contaminants from entering the soil, i.e. mixing of mortars, cutting of stone, etc., should be undertaken with a protective cover (tarpaulin, or similar) placed under the equipment to capture debris for later disposal.
- Any potential conflicts with tree protection and approved works must be discussed with the project arboriculturist *before commencement* to ensure the most appropriate methods for the works are adopted and minimise impacts on the tree.
- Any pruning requirements must be discussed with the project arboriculturist *prior to commencing those works*, to ensure pruning is kept to the minimum required to facilitate site development.
- Planting within the SRZ must be limited to plants of a maximum 100mm tubestock size only. Suitable planting locations shall be investigated by carefully probing the soil to avoid disturbance to structural (woody) roots.
- Plantings outside the SRZ, and/or around the perimeter of the Licenced Area shall be limited to a maximum 300mm (14 litre) container size.
- The trees should be subject to aerial inspection, focusing on the stem anomalies noted for Trees 2 (co-dominant stems) and Tree 3 (upper stem kink).
- Refer to the following sections for additional recommendations that require adoption during development.

General Tree Protection Recommendations

5.1.2 The Tree Protection is to be in accordance with the following:

- Tree Protection Devices (TPD) may include mulching, tree guards and other devices other than fencing.
- The TPD must be in place prior to any site works commencing, including clearing, demolition or grading. Refer to the Tree Protection Plan – Appendix E, for locations of fencing.
- The most appropriate fencing for tree protection is 1.8m chainlink with 50mm metal pole supports or 1.8m high fencing panels on sturdy 'feet.
- It is recommended that the arboriculturist provide written certification that the TPD is/are installed and will satisfy tree protection requirements.
- Signage should explain exclusion from the area defined by TPD and carry a contact name for access or advice.
- The TPD cannot be removed, altered, or relocated without the project arborists' prior assessment and approval. It is noted that following construction of the seawall and building that new path works and landscaping will commence within the fenced Tree Protection Zone of the trees.
- Trakmat® or similar ground protection device is to be utilised under direction of the project arboriculturist following removal of the existing path between the trees. The ground protection is to remain in place and only be removed gradually as the path construction progresses. No machinery is to be used within the Tree Protection Zone unless expressly approved by the project arboriculturist.

Breaking up and/or removal of BITUMEN surfaces in Tree Protection Zone

5.1.3 In many cases, fine fibrous roots congregate directly beneath bitumen surfaces as the bitumen functions also as a mulch and reduces evaporation of soil moisture. Some root may adhere to the rough underside of the bitumen surface. For this reason, where bitumen areas are proposed to be repurposed as landscape areas, I recommend using hand tools to gently fracture the bitumen surface to create numerous cracks and crevices where soil and water can infiltrate and landscape plantings can develop roots into the lower layer, and the trees can also access newly exposed sections. This work needs to be supervised by an AQF5 arboriculturist.

- Some large pieces of bitumen may be removed where large masses of roots are not adhered to the underside. This will become apparent during the work to break up the bitumen.
- Do not undertake the removal of pavement during hot, dry or windy weather.
- Begin at the area closest to the tree and work backwards away from the tree, taking care not to de-bark or damage any woody roots encountered.
- Work small sections only, approximately 1m² at a time. Remove any debris that does not have roots adhered to it, and load onto trucks, or stockpile in approved areas, until the material is removed off-site.
- Immediately water areas of exposed ground thoroughly, then place mulch or hessian over the exposed areas until planting media and plantings are undertaken.
- New soil media placed over the new exposed surfaces shall not be greater than 150mm depth and be an 80/20 sandy loam.

Breaking up and/or removal of CONCRETE surfaces in Tree Protection Zone

5.1.4 The existing concrete path along the middle of the Licenced Area is to be removed and a new, wider curved and elevated path installed. This will create an opportunity for roots to generate back into the area below the elevated path. Shallow sandstone edging will allow for new paved areas to meet the path edge without preventing roots to generate beneath.

- The existing concrete path is to be broken up using hand tools and removed to a truck or bin located outside the fenced TPZ.
- All areas within the TPZ where concrete is to be removed must be watered prior to commencement and immediately following to ensure soil water levels remain relatively constant and root desiccation is minimised.
- Any machine used for works within the TPZ shall be less than 2 tonne GVM. Trakmat® or similar ground protection device shall be utilised in areas where natural ground is exposed through removal of pavements or structures.
- No machinery is to be used within the Tree Protection Zone unless expressly approved by the project arboriculturist.

5.2 POST CONSTRUCTION TREE CARE

5.2.1 Tree preservation requires a long-term commitment to monitoring and rectifying problems associated with trees. In this case:

- Irrigation—the project arboriculturist should determine whether irrigation should be carried out during extended periods of drought.
- Pest Management—monitoring is required as trees under stress are more prone to insect attack.
- Risk Management—monitoring and management of the trees and routine re-assessment by a qualified arboriculturist is required for adequate long-term safety of residents.

Report prepared by Catriona Mackenzie

February 2021




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Tree Risk Assessment Qualified 2014, 2019 (TRAQ)

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APPENDIX A

TERMS AND DEFINITIONS



TERMS AND DEFINITIONS

The following relates to terms or abbreviations that may have been used in this report and provides the reader with a detailed explanation of those terms.

Aerial inspection Where the subject tree is climbed by a professional tree worker or arborist specifically to inspect and assess the upper stem and crown of the tree for signs or symptoms of defects, disease, etc.

Co-dominant refers to stems or branches equal in size and relative importance.

Condition refers to the tree's form and growth habit, as modified by its environment (aspect, suppression by other trees, soils) and the state of the scaffold (i.e. trunk and major branches), including structural defects such as cavities, crooked trunks or weak trunk/branch junctions. These are not directly connected with health and it is possible for a tree to be healthy but in poor condition.

Crown All the parts of a tree arising above the trunk where it terminates by its division forming branches, e.g. the branches, leaves, flowers and fruit: or the total amount of foliage supported by branches.

Crown raise pruning Pruning technique where lower limbs are removed, thereby lifting the overall crown above the ground.

Defect Any structural weakness or deformity.

Diameter at Breast Height (DBH) refers to the tree trunk diameter at breast height, i.e. measured at 1.4 m above ground level.

Health (syn. vigour) refers to the tree's vigour as exhibited by the crown density, leaf colour, presence of epicormic shoots, ability to withstand disease invasion, and the degree of dieback.

Mature refers to a full sized tree with some capacity for further growth.

Root Mapping The exploratory process of recording the location of roots usually in reference to a datum point where depth, root diameter, root orientation and distance from trunk to existing or proposed structures are measured. It may be slightly invasive (disturbs or displaces soil to locate but not damage roots, e.g. hand excavation, or use of air or water knife), or non-invasive (does not disturb soil, e.g. ground penetrating radar).

Structural Root Zone (SRZ) Refers to the radial distance in metres, measured from the centre of the tree stem, which defines the critical area required to maintain stability of the tree. Only thorough investigation into the location of structural roots within this area can identify whether any minor incursions into this protection zone are feasible. Note: The SRZ is calculated on the diameter measured immediately above the root/stem buttress (DAB).

Sweep A curve in the trunk, generally near the ground. This usually occurs when a tree is partially wind thrown when young, but then stabilises itself and straightens due to reaction wood. Stem sweep can also be a naturally developed feature of some tree species. e.g. *Araucaria columnaris* (Cook Pine), that has no relationship to a defect or partial windthrow.

Tree Protection Zone (TPZ). Refers to the radial distance in metres, measured from the centre of the tree stem which defines the *tree protection zone* for a tree to be retained. This is generally the minimum distance from the center of the tree trunk where protective fencing or barriers are to be installed to create an exclusion zone. The **TPZ** surrounding a tree aids the tree's ability to cope with disturbances associated with construction works. Tree protection involves minimising root damage that is caused by activities such as construction. Tree protection also reduces the chance of a tree's decline in health or death and the possibly damage to structural stability of the tree from root damage.

To limit damage to the tree, protection within a specified distance of the tree's trunk must be maintained throughout the proposed development works. No excavation, stockpiling of building materials or the use of machinery is permitted within the TPZ. Note: In many circumstances the tree root zone does not occupy a symmetrically radial area from the trunk, but may be an irregular area due to the presence of obstructions to root spread or inhospitable growing conditions.

Tree Risk Assessment is the systematic process to identify, analyze, and evaluate tree risk. A tree risk rating of Low, Moderate, High or Extreme is derived by categorising or quantifying both the *likelihood* (probability) of tree or tree part(s) failure and impact on a target(s) and the severity of consequences of the impact on the target(s).

USEFUL LIFE EXPECTANCY (ULE) In a planning context, the time a tree can expect to be usefully retained is the most important long-term consideration. ULE i.e. a system designed to classify trees into a number of categories so that information regarding tree retention can be concisely communicated in a non-technical manner. ULE categories are easily verifiable by experienced personnel without great disparity. A tree's ULE category is the life expectancy of the tree modified first by its age, health, condition, safety and location (to give the life expectancy); then by economics (i.e. cost of maintenance - retaining trees at an excessive management cost is not normally acceptable); and finally, effects on better trees, and sustained amenity (i.e. establishing a range of age classes in a local population). ULE assessments are not static but may be modified as dictated by changes in tree health and environment. Trees with a short ULE may at present be making a contribution to the landscape, but their value to the local amenity will decrease rapidly towards the end of this period, prior to them being removed for safety or aesthetic reasons. For details of ULE categories see Appendix B, modified from Barrell 2001.

Vigour (syn. health) refers to the tree's health as exhibited by the crown density, leaf colour, presence of epicormic shoots, ability to withstand disease invasion, and the degree of dieback.

Woody roots usually used in reference to the first order roots i.e. structural (anchor) roots and woody lateral roots within the Structural Root Zone. Damage, disturbance to, or severing of these roots can compromise the stability of the tree.

APPENDIX B

TREE RETENTION VALUE ASSESSMENT



APPENDIX B – TREE RETENTION VALUE ASSESSMENT (TRVA)

Part 1 of 3—Useful Life Expectancy (ULE)

In a planning context, the time a tree can expect to be usefully retained is the most important long-term consideration. ULE i.e. a system designed to classify trees into a number of categories so that information regarding tree retention can be concisely communicated in a non-technical manner. ULE categories are easily verifiable by experienced personnel without great disparity. A tree's ULE category is the life expectancy of the tree modified first by its age, health, condition, safety and location (to give the life expectancy); then by economics (i.e. cost of maintenance - retaining trees at an excessive management cost is not normally acceptable); and finally, effects on better trees, and sustained amenity (i.e. establishing a range of age classes in a local population). ULE assessments are not static but may be modified as dictated by changes in tree health and environment. Trees with a short ULE may at present be making a contribution to the landscape, but their value to the local amenity will decrease rapidly towards the end of this period, prior to them being removed for safety or aesthetic reasons.

ULE categories (modified from Barrell 2001) The five categories and their sub-groups are as follows:

1. **Long ULE** - tree appeared retainable at the time of assessment for over 40 years with an acceptable degree of risk, assuming reasonable maintenance:
 - A. structurally sound trees located in positions that can accommodate future growth
 - B. trees which could be made suitable for long term retention by remedial care
 - C. trees of special significance which would warrant extraordinary efforts to secure their long term retention
2. **Medium ULE** - tree appeared to be retainable at the time of assessment for 15 to 40 years with an acceptable degree of risk, assuming reasonable maintenance:
 - A. trees which may only live from 15 to 40 years
 - B. trees which may live for more than 40 years but would be removed for safety or nuisance reasons
 - C. trees which may live for more than 15 years but would be removed to prevent interference with more suitable individuals or to provide space for new planting
 - D. trees which could be made suitable for retention in the medium term by remedial care
3. **Short ULE** - tree appeared to be retainable at the time of assessment for 5 to 15 years with an acceptable degree of risk, assuming reasonable maintenance:
 - A. trees which may only live from 5 to 15 years
 - B. trees which may live for more than 15 years but would be removed for safety or nuisance reasons
 - C. trees which may live for more than 15 years but would be removed to prevent interference with more suitable individuals or to provide space for new planting
 - D. trees which require substantial remediation and are only suitable for retention in the short term
4. **Removal** - trees which should be removed within the next 5 years.
 - A. dead, dying, suppressed or declining trees because of disease or inhospitable conditions.
 - B. dangerous trees through instability or recent loss of adjacent trees
 - C. dangerous trees because of structural defects including cavities, decay, included bark, wounds or poor form.
 - D. damaged trees that are clearly not safe to retain.
 - E. trees which may live for more than 5 years but would be removed to prevent interference with more suitable individuals or to provide space for new planting.
 - F. trees which are damaging or may cause damage to existing structures within the next 5 years.
 - G. trees that will become dangerous after removal of other trees for the reasons given in (a) to (f).
 - H. trees in categories (a) to (g) that have a high wildlife habitat value and, with appropriate treatment, could be retained subject to regular review.
5. **Small, young or regularly pruned** - Trees that can be reliably moved or replaced.
 - A. small trees less than 5m in height.
 - B. young trees less than 15 years old but over 5m in height.
 - C. formal hedges and trees intended for regular pruning to artificially control growth

Part 2 of 3—IACA Significance of a Tree, Assessment Rating System (STARS)©

The landscape significance of a tree is an essential criterion to establish the importance that a particular tree may have on a site. However, rating the significance of a tree becomes subjective and difficult to ascertain in a consistent and repetitive fashion due to assessor bias. It is therefore necessary to have a rating system utilising structured qualitative criteria to assist in determining the retention value for a tree. To assist this process all definitions for terms used in the *Tree Significance - Assessment Criteria* and *Tree Retention Value - Priority Matrix*, are taken from the IACA Dictionary for Managing Trees in Urban Environments 2009.

The system uses a scale of *High*, *Medium* and *Low* significance in the landscape. Once the landscape significance of an individual tree has been defined, the retention value can be determined.



Tree Significance - Assessment Criteria

1. HIGH SIGNIFICANCE IN LANDSCAPE
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 Councils 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 <i>in situ</i> - tree is appropriate to the site conditions
2. MEDIUM SIGNIFICANCE IN LANDSCAPE
The tree is in fair-good condition and good or low vigour
The tree has a form typical or atypical for the species
The tree is a planted locally indigenous or a common species with its taxa commonly planted in the 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 and/or below ground influences, reducing its ability to reach dimensions typical for the taxa <i>in situ</i> .
3. LOW SIGNIFICANCE IN LANDSCAPE
The tree is in fair-poor condition and good or low vigour
The tree has a form atypical for the species
The tree is not visible or is partly visible from surrounding properties as 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 <i>in situ</i> - tree is inappropriate to the site conditions
The tree is listed as exempt under the provisions of the local Council Tree Preservation Order or similar protection mechanisms
The tree has a wound or defect that has potential to become structurally unsound.
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
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 full or part in the immediate to short term

The tree is to have a minimum of three (3) criteria in a category to be classified in that group.

The assessment criteria are for individual trees only, however, can be applied to a monocultural stand in its entirety e.g. hedge. In the development of this document IACA acknowledges the contribution and original concept of the Tree Significance & Retention Value Matrix, developed by Footprint Green Pty Ltd and Andrew Morton in June 2001.

Part 3 of 3—Tree Retention Value Priority Matrix

		SIGNIFICANCE										
		1. High			2. Medium			3. Low				
		Significance in landscape			Significance in landscape			Significance in landscape		Environmental pest / Noxious weed species		Hazardous / Irreversible decline
ESTIMATED LIFE EXPECTANCY	1. Long >40 years	[Vertical lines pattern]						[Horizontal lines pattern]		[Grid pattern]		[Grey shaded area]
	2. Medium 15–40 years	[Vertical lines pattern]			[Horizontal lines pattern]			[Grid pattern]		[Grid pattern]		
	3. Short <1–15 years	[Grid pattern]			[Grid pattern]			[Grid pattern]		[Grid pattern]		
	Dead	[Grid pattern]			[Grey shaded area]			[Grid pattern]		[Grid pattern]		
LEGEND FOR MATRIX ASSESSMENT												
[Vertical lines pattern]		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 AS4970 <i>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.										
[Horizontal lines pattern]		Consider for Retention (Medium) -These trees may be retained and protected. These 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.										
[Grid pattern]		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.										
[Grey shaded area]		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.										

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APPENDIX C
SCHEDULE OF ASSESSED TREES



Schedule of Assessed Trees – The Boathouse, Palm Beach. January, 2020.

Tree No.	Genus & species Common Name	Ht (m)	Sp (m)	DBH (mm)	Age	V	C	Comments and Recommendations	ULE	TSR	RV	SRZ (m)	TPZ (m)	TPZ (area)
1	<i>Araucaria heterophylla</i> Norfolk Island Pine	17	10	750	M	G	G	Introduced native species. Typical mature form. Upper stem bifurcation. No obvious defects noted. Various items of minimal impact and disturbance over SRZ, including lobster pots, large river stones, timber pieces, etc. Open, segmental paving in root zone showing signs of upheaval. Power lines through crown. Services/utilities in SRZ, and electrical lines and switches attached to trunk.	2A	H	H	3.1	9.0	255
2	<i>Araucaria heterophylla</i> Norfolk Island Pine	24	11	950	M	G	F-G	Introduced native species. Co-dominant stems upper third. Very slight stem sweep to NW. Rubber hose around trunk starting to constrict expansion. Services screwed into trunk. Wiring for lights potentially impacting on expansion of parts. Possible abrasion wounding.	2A	H	H	3.4	11.4	408.5
3	<i>Araucaria heterophylla</i> Norfolk Island Pine	19	16	850	M	G	F	Introduced native species. Old impact damage. Crown raised to N/NW. Elkhorn attached to lower trunk. Notable stem bulges, resin exudates to lower stem on N/NW side. Services attached screwed into lower trunk. Hoses, wires, lights, etc., all potentially impacting on tree. Upper stem kink to N (about 8m from apex)—can't visually access point of kink origin (likely past storm damage to apical stem). Water fountain in SRZ.	2D	H	H	3.3	10.2	327

KEY

	Trees to be retained.		Dead or non-prescribed tree or palm on site that may be removed or retained without Development Consent or Tree Management Permit.		Trees proposed to be removed.
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	Low Retention Value-These trees are not considered important for retention.		Medium Retention Value-These trees may be retained and protected.		High Retention Value -These trees are considered important for retention and should be retained and protected.
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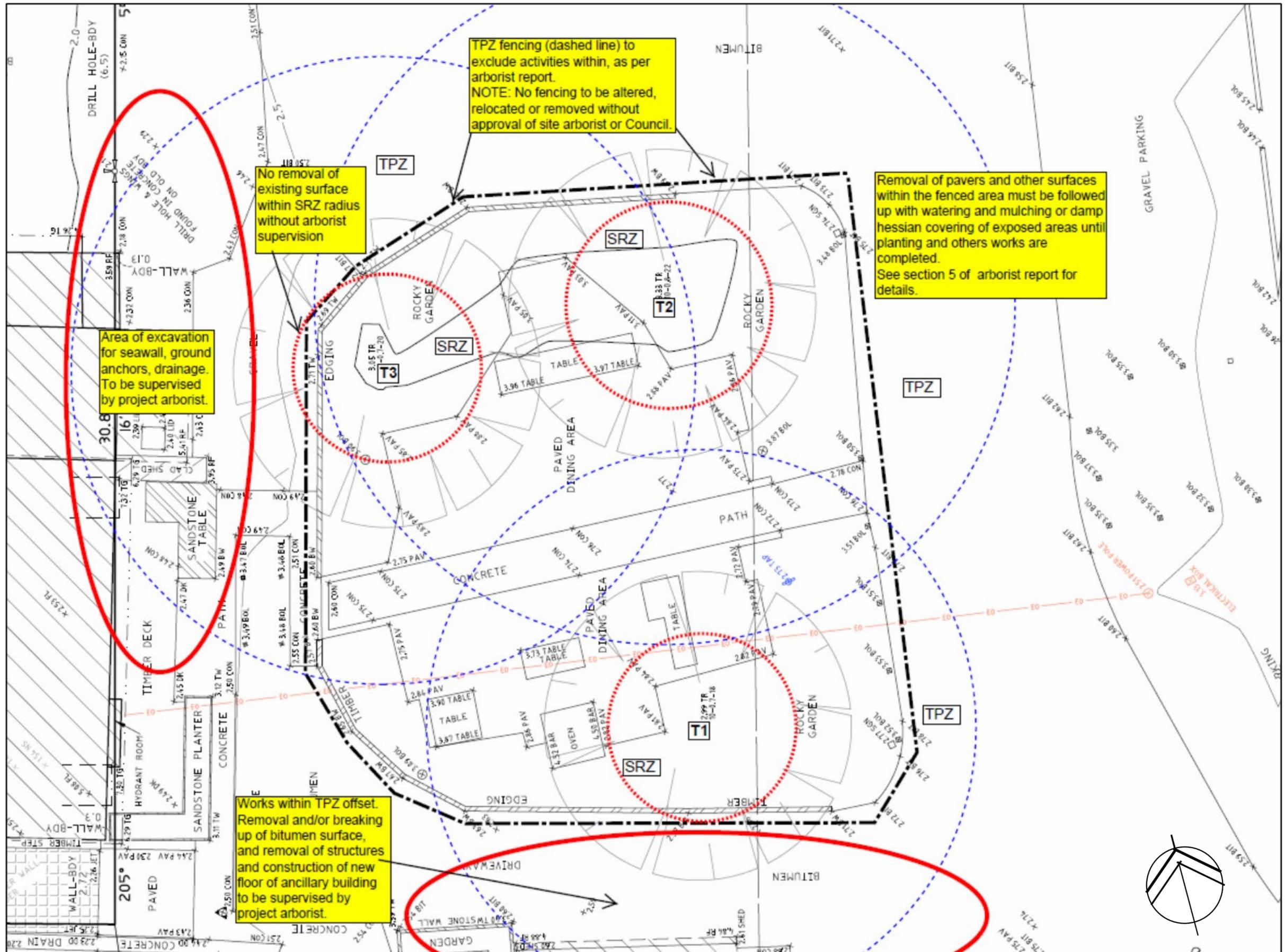
H	approximate height of a tree in metres, from base of stem to top of tree crown.	ULE	the estimated <i>Useful Life Expectancy</i> of a tree. Refer to Appendices A and B for details.
Sp	approximate and average spread in metres of branches/canopy (the 'crown') of a tree.	TSR	The <i>Tree Significance Rating</i> considers the importance of the tree as a result of its prominence in the landscape and its amenity value from the point of public benefit. Refer to Appendix B – Significance of a Tree Assessment Rating for more detail.
DBH	approximate diameter in mm of tree stem at breast height i.e. 1.4 metres above ground (unless otherwise noted).	RV	The retention value of a tree based on the tree's ULE and Tree Significance. Refer to Appendix B.
Age	refer to Appendix A -Terms and Definitions for more detail.	SRZ	Structural Root Zone (SRZ) refers to the critical area required to maintain stability of the tree. Refer to Appendix A
V	refers to the tree's vigour (health) Refer to Appendix A -Terms and Definitions for more detail.	TPZ	Tree Protection Zone (TPZ) refers to the <i>tree protection zones</i> for trees to be retained. Refer to Appendix A.
C	refers to the tree's structural condition. Refer to Appendix A for more detail.	ILR	Impact Level rating. Refer to Appendix A.

APPENDIX D
TREE LOCATION PLAN



APPENDIX E
TREE PROTECTION PLAN





REPRODUCTION PLAN
 To be read in conjunction with recommendations - section 5 of this report.
 This drawing not to scale.
 Based on call of OVS Survey.
 Vared up by C. Valenze.